To Securitize or Not?
An Agency Cost Perspective*

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Abstract

This paper provides a novel theory of securitization based on intermediaries minimizing the moral hazard that insiders can misuse assets held on-balance sheet. The model predicts how intermediaries finance different assets. Under deposit funding, the moral hazard is greatest for low-risk assets that yield sizable returns in bad states of nature; under securitization, it is greatest for high-risk assets that require high guarantees and large reserves. Intermediaries thus securitize low-risk assets. In an extension, I identify a novel channel through which government bailouts exacerbate the moral hazard and reduce total investment irrespective of the funding mode. This adverse effect is stronger under deposit funding, implying that intermediaries finance more risky assets off-balance sheet.

JEL Classification: G01, G11, G21, G23

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1 Introduction

Securitization allows financial intermediaries to move assets off their balance sheets to special purpose vehicles (SPVs) and sell them to outside investors in the form of asset-backed securities (ABS).\(^1\) An example is commercial banks off-loading mortgage assets by selling mortgage-backed securities (MBS) to mutual funds. Securitization provides about 25% of outstanding U.S. consumer credit and 60% – 80% of mortgage credit.\(^2\) The collapse of the ABS markets played a key role in triggering the financial crisis in 2007.\(^3\)

According to the conventional risk-transfer view, financial intermediaries securitize to transfer risks from their balance sheets to outside investors. However, contrary to this view, the shadow banking system is a major provider of safe assets to outside investors. Acharya et al. (2013) document that financial intermediaries frequently retain the risks of securitized assets by providing guarantees to their SPVs to secure outside investors’ returns.\(^4\) The severity of the crisis lay precisely in the fact that losses on bad assets were not all passed on to outside investors.\(^5\) Acharya et al. (2013) interpret “securitization without risk transfer” as evidence that banks securitize to get around capital requirements. However, this regulatory-arbitrage view only applies to securitization by banks that are indeed subject to capital requirements.

This paper provides a novel theory of securitization based on intermediaries minimizing moral hazard that does not suffer the shortcomings of the existing two views. The paper focuses on the moral hazard that insiders who have the discretion over the use of assets on-balance sheet, e.g. managers in financial institutions, have incentives to divert assets. This moral hazard can be generally interpreted as insiders’ incentives to engage in ex-post activities that benefit themselves but can hurt outside investors. For example, insiders of a bank have the incentive to ex-post misuse the cash flows of the assets held on-balance sheet, or to ex-post take on higher risks. Insiders benefit from such activities, but outside investors are the ones bearing losses in bad states.

The paper shows that securitization can reduce this moral hazard by increasing the remoteness of assets from managers in financial institutions. This idea is formulated in a banking model in which intermediaries choose between deposit funding and securitization in an environment with moral hazard. Even when intermediaries provide guarantees and the resulting risk-sharing structures are equivalent under securitization and deposit funding, insiders’ incentives to divert assets,\(^1\)

\(^1\)SPVs are robot firms that have no employees, make no substantive decisions, and have no physical location. Their sole purpose is to issue ABS and sell them in capital markets for their sponsor intermediaries (Gorton and Souleles, 2007). For a discussion of the detailed institutional structures of the shadow banking system, see Pozsar et al. (2010).


\(^3\)The Financial Crisis Inquiry Report, Part IV.

\(^4\)Implicit guarantees are commonplace in credit card securitization (Higgins and Mason, 2004; Gorton and Souleles, 2007). Explicit guarantees are extensively used in the asset-backed commercial paper (ABCP) market. Acharya et al. (2013) document that only 2.5% of ABCP outstanding as of July 2007 entered default from July 2007 to December 2008, and hence term the phenomenon “securitization without risk transfer.”

i.e. the magnitudes of the moral hazard, are different under the two funding modes. The moral-hazard-reducing motive implies that securitization can encourage investment in low-risk assets.

In an extension, the paper unveils a novel channel through which government bailouts exacerbate the moral hazard and reduce total investment irrespective of the funding mode. This adverse effect is stronger for high-risk assets under deposit funding, implying that intermediaries finance a larger portion of high-risk assets off-balance sheet. Government bailouts thus have the effect of promoting risk-taking in securitization.

The model economy has two key types of agents: a bank holding company (BHC) that consists of a bank entity and an SPV, and a continuum of outside investors. Two features are important. First, the BHC is risk neutral, and outside investors are infinitely risk-averse. This assumption makes it desirable for the BHC to use guarantees in securitization to secure outside investors’ returns. To stand ready for guarantee payments, the BHC needs to hold safe reserves on the bank entity’s balance sheet. Second, à la Holmström and Tirole (1998), there is a moral hazard that insiders of the BHC can divert a portion of the assets held on the bank entity’s balance sheet and let the BHC default. One possible interpretation of the seizable portion is the assets’ information intensity. Assets with high information-intensity, e.g. small business loans, are harder for outside investors to value, and thus easier for insiders to divert.

Insiders’ incentives to divert assets are greatest in bad states of nature. Under deposit funding, the BHC holds assets on the bank entity’s balance sheet, and its incentive to divert is greatest for low-risk assets that yield sizable returns in bad states. By contrast, under securitization, the BHC holds reserves on the bank entity’s balance sheet, and the moral hazard is most severe for high-risk assets that imply large draw-downs on reserves in bad states. To reduce the agency cost associated with the moral hazard, the BHC securitizes low-risk assets and holds high-risk assets on-balance sheet. This agency cost mechanism reduces risk taking in securitization.

In a dynamic setting, the BHC can use its franchise value to commit not to default and overcome the moral hazard, as in the Folk Theorem of repeated games. High-return assets generate high franchise values for the bank entity, making it easier to commit not to default. To overcome moral hazard, the BHC is more likely to finance high-return assets on-balance sheet and only securitize low-return assets. This franchise value mechanism promotes deposit funding for high-return assets.

The moral hazard of insiders diverting assets naturally gives rise to the moral hazard of weak ex-post monitoring. Due to the first moral hazard, the BHC’s equilibrium payoffs are determined by what can be diverted off-equilibrium. Under securitization, the SPV’s payoff is thus determined by the amount of reserves set aside ex-ante, which is independent of the ex-post performance of securitized assets. Therefore, securitization weakens the incentive to monitor SPV assets ex-post.

In an extension to the dynamic model, the paper identifies a novel channel through which government bailouts affect securitization. When the BHC defaults, there is a chance that it will be bailed out. After a bailout, the BHC continues to operate, but it can no longer overcome moral hazard via commitment and hence lives with a post-bailout profit lower than the one before
default. The probabilistic nature of bailouts induces a misalignment of incentives: the risk-neutral BHC values bailouts, but infinitely risk-averse outside investors do not value them at all. The misalignment exacerbates the moral hazard, and thus reduces total investment irrespective of the funding mode.\footnote{If the misalignment was not present, government bailouts would not exacerbate the moral hazard. When government bailouts realize with probability one, financial intermediaries and outside investors will collectively increase risk taking and shift the risks to the public sector.}

This misalignment is especially large for high-risk assets if they are financed on-balance sheet. Outside investors do not value bailouts as always, but the bank entity values them very much. For high-risk assets, the post-bailout profit under deposit funding is not that low, as the moral hazard in this case is very small. To reduce misalignment, the BHC securitizes them. When the probability of getting a bailout is sufficiently high, the effect of government bailouts dominates the agency cost mechanism, and the BHC finances a larger portion of risky assets via securitization.

The main contribution of the paper is to provide an alternative theory, other than risk transfer and regulatory arbitrage, to understand securitization. It is frequently mentioned in the literature and policy discussions that several types of moral hazards are prevalent in securitization, but this is the first paper that studies how the moral hazard of ex-post risk taking affects securitization decisions ex-ante, and how this moral hazard can induce the moral hazard of ex-post weak monitoring. This agency cost perspective should be considered by regulators to ensure sound policy making regarding securitization and financial stability.

Moreover, the paper provides a new understanding of how government bailouts affect securitization. Contrary to the conventional view that government bailouts induce risk-taking by financial institutions that have access to the public safety net, this paper shows that government bailouts can also induce risk-taking in off-balance sheet financing through creating a misalignment that worsens moral hazard.

The model can explain several important empirical regularities about the shadow banking system. The reduced incentive to monitor securitized assets explains the empirical finding that ex-ante similar assets have a higher default risk when securitized (Keys et al., 2010; Elul, 2015). The use of guarantees and the prioritization of securitization induce an increase in reserve holdings that may dominate the reduction of risky assets on-balance sheet. This is consistent with the regularity that banks sponsoring off-balance-sheet conduits tend to have high bank leverage in comparison to non-sponsor banks (Altunbas et al., 2009; Kalemli-Ozcan et al., 2012; Kühler, 2015). The misalignment of the perceived value of bailouts increases with the likelihood of a bailout, thereby explaining the extensive participation and risk-taking of large banks in shadow banking (Kalemli-Ozcan et al., 2012; Acharya and Schnabl, 2010; Acharya et al., 2013). The resulting increase in the securitization of risky assets is consistent with the empirical finding that large banks securitize risky assets but keep safe assets on their balance sheets (Mian and Sufi, 2009; Demyanyk and Van Hemert, 2011).

The paper also discusses the implications of different forms of guarantees. Explicit guarantees
are contracted insurance to outside investors, while implicit guarantees are only verbal promises. With explicit guarantees, agency costs under securitization increase in both the risk level and information intensity of the underlying asset. Therefore, intermediaries securitize assets with either low information intensity or low risk. Implicit guarantees are non-contractual promises sustained by bank reputation. Hence, intermediaries only securitize information-intensive assets for which bank reputation is highly valued. The incentive to monitor is weakest under securitization with implicit guarantees, as they allow banks to renege on their monitoring promises without being declared bankrupt.

An extension to the static model studies the optimality of tranching versus securitization with guarantees. Tranching eliminates agency costs but worsens adverse selection, while securitization with guarantees does the opposite. When a certain category of assets is sufficiently heterogeneous in ex-ante quality, and when the ex-ante highest quality assets are perceived to be sufficiently safe, securitization with guarantees dominates tranching.

Related literature  This paper contributes to the literature by offering an economic rationale for securitization that can explain securitization without risk transfer and securitization by non-bank financial institutions.

The conventional view on securitization assumes that outside investors have a higher or equal risk-bearing capacity, and thus financial intermediaries securitize to transfer risks to outside investors. Along this view, the literature of security design emphasizes the superiority of debt-like structures in terms of overcoming adverse selection and creating a liquid market (Gorton and Pennachi, 1990; DeMarzo and Duffie, 1999; DeMarzo, 2005; and Dang, Gorton, and Holmström, 2009). This liquid market allows banks to sell off loans to transfer risks to outside investors. Building on this view, Shin (2009) and Adrian and Shin (2009) emphasize that banks securitize to tap new funding sources. The resulting increase in the leverage of the financial sector as a whole drives down lending standards and makes the financial system more fragile.

However, Acharya et al. (2013) show that financial intermediaries frequently retain the risks of securitized assets by providing guarantees to security investors, and hence coin the term “securitization without risk transfer.” Securitization without risk transfer is in clear contrast with the conventional risk-transfer view, and is interpreted by Acharya et al. (2013) as evidence supporting the regulatory-arbitrage view on securitization. Calomiris and Mason (2004) study credit card securitization and also find that regulatory arbitrage is an important consequence of securitization. This view is often combined with the idea of “too big to fail” and the resulting abuse of the public safety net. Acharya and Richardson (2009) suggest that banks provide guarantees and retain excessive risks because they are counting on a government bailout if things go bad.

Gornicka (2015) formalizes the regulatory-arbitrage view on securitization in a theoretical model. Her model predicts that banks have higher incentives to monitor securitized assets, as the arbitrage motive implies that profits strongly depend on off-balance sheet items. This predic-
tion is inconsistent with the empirical finding that ex-ante similar assets have a higher default risk if securitized (Keys et al., 2010; Elul, 2015). This inconsistency suggests that regulatory arbitrage is not the sole explanation for securitization. Moreover, non-bank financial institutions that are not subject to capital regulations constitute a significant portion of securitization markets (Ashcraft and Schuermann, 2008).

Contrary to the risk-transfer view, Gennaioli, Shleifer, and Vishny (2012, 2013) assume that banks have a higher risk capacity and a higher diversification capacity than outside investors. In their setting, banks securitize to facilitate pooling and diversification in order to synthesize risk-free securities demanded by risk-averse investors. Although the risk-sharing structure is consistent with securitization without risk transfer, banks do not achieve this outcome by retaining risks but by diversifying away risks. Their model abstracts from guarantees and does not explicitly model the distinction between on- and off-balance sheet financing.

This paper provides a novel theory of securitization based on minimizing agency costs that does not suffer the shortcomings of the existing views. As in Gennaioli, Shleifer, and Vishny (2012, 2013), banks have a higher risk capacity than outside investors, but they bear risks by providing guarantees instead of diversification. The agency cost perspective of this paper emphasizes the difference in the magnitudes of moral hazard under the two funding modes. The desire to reduce or overcome agency costs rationalizes securitization and carries important implications for how intermediaries finance different assets and monitor them ex-post.

In the literature on implicit guarantees, Gorton and Souleles (2007) show that banks provide implicit guarantees to overcome adverse selection, and these guarantees are sustained by bank reputation. Building on this reputation model, Ordonez (2014) argues that the reputational benefit of honoring implicit guarantees is lower under adverse economic circumstances. By contrast, Segura (2013) emphasizes the signaling role of honoring guarantees and shows that a pooling equilibrium, in which both good and bad banks signal, is more likely to arise in bad states. These studies abstract from the implications of honoring guarantees ex-post for the ex-ante securitization decisions.

My analysis of tranching versus securitization with guarantees is in line with Farhi and Tirole (2015) who argue that bundles are more liquid, as they encourage information-equalizing investment. This model generates a similar effect through the channel of agency costs and explores the optimality of tranching versus securitization with guarantees.

The paper is also related to studies of the benefits of financial innovation. Rajan (2005) argues that financial innovation has made the world better off by expanding opportunities but cautions that innovation without an adequate regulatory framework can make the financial system riskier. Yorulmazer (2013) develops a model of credit default swaps (CDS) and shows that banks only buy cheap CDS for regulatory arbitrage. Korinek (2012) uses a household-banker framework to study how banks can extract rents by creating new markets. My paper suggests a mixed effect of financial innovation. In the benchmark model, securitization improves welfare by increasing
investment and reducing output volatility. However, when ex-post monitoring is non-verifiable, securitization causes weak monitoring. When there is a high chance of government bailouts in the event of default, securitization will be geared toward riskier assets, increasing output volatility.

The rest of the paper is structured as follows: Section 2 presents the benchmark static model. Section 3 embeds the static model in a dynamic framework to study explicit and implicit guarantees. Section 4 studies how the possibility of government bailouts affects risk taking in securitization. Section 5 extends the model to study moral hazard in monitoring. Section 6 explores the optimality of tranching versus securitization with guarantees. Section 7 concludes.

2 Benchmark static model

2.1 Model setup

Environment The economy lasts for two periods, \( t = 0, 1 \), and consists of a banking sector with a single good. There are three types of agents – a risk-neutral bank holding company (BHC), a risk-neutral equity investor, and a continuum of competitive and infinitely risk-averse outside investors. The BHC consists of a bank entity and a special purpose vehicle (SPV) if it decides to sell assets. At \( t = 0 \), outside investors are endowed with wealth \( w \) for consumption and investment. At the same time, the equity investor receives an endowment \( A \) and gives it to the BHC as equity. At \( t = 1 \), the state of the economy is realized. With probability \( q \), the high state is realized, and with probability \( 1 - q \), the low state is realized. All agents receive no endowments in the second period.

There are two types of assets in this economy – a safe asset available to both outside investors and the BHC, and a risky asset available only to the BHC. The safe asset yields a fixed rate of return \( r_S = 1 \), while the rate of return of the risky asset, \( x \), is stochastic. In the high state, the risky asset yields a rate of return \( H > 1 \); while in the low state, it yields a rate of return \( L < 1 \). All returns are consumed in the second period.

Outside investors Deep-pocketed outside investors receive a large amount of a perishable endowment \( w \) in period 0 for investment and consumption. As in Gennaioli, Shleifer, and Vishny (2013), investors are infinitely risk-averse in the sense that, ex-ante, they value stochastic consumption in the second period at the worst-case scenario. In the first period, they invest by buying safe assets or financing the BHC either by providing deposits or buying asset-backed securities (ABS). Outside investors’ aggregate endowment is assumed to be large enough to meet all funding needs of the BHC.

The bank holding company
Real decisions The risk-neutral BHC receives capital $A$ from the equity investor in period 0, and divides the capital between its bank entity and SPV. The BHC maximizes its expected profit by making real and financial decisions. Let $X$ be the total units of investment in the risky asset, among which $X_B$ units are kept on-balance sheet and $X_S$ units are securitized up-front when the asset is originated. All profits generated by the BHC are consumed by the equity investor in the second period. To assure that the BHC has incentives to invest in the risky asset, I assume that the expected return of the risky asset is greater than the safe return:

**Assumption 1.** The expected return of the risky asset is greater than 1, i.e. $qH + (1 - q)L > 1$.

Financial decisions The BHC raises external funding from outside investors through deposit funding and/or securitization. The BHC finances $X_B$ units of the risky asset on-balance sheet with deposits $D$ and the bank entity’s capital $A_B$. Under securitization, the BHC sets up an SPV and moves $X_S$ units of the risky asset to the SPV. There is no cost of setting up an SPV, and its only role is to sell claims on the risky asset originated by the bank entity. The SPV issues $X_S$ units of ABS. Each ABS is backed by one unit of the risky asset and is sold at a market price $p$. The sales revenue $pX_S$ and the SPV’s capital $A_S$ are used to invest in the risky asset $X_S$ and the safe asset, in the amount of $RX_S$, as reserves to honor guarantees.

Guarantees The BHC can provide guarantees to outside investors. A guarantee is a promise that the BHC pays $\rho \in \mathbb{R}^+$ per unit of ABS to outside investors in the low state, e.g. an investor holding an ABS with a guarantee policy $\rho$ gets $L + \rho$ in the low state and $H$ in the high state. To make guarantees valuable to infinitely risk-averse investors, the BHC promises to stand ready for potential payouts in all states. This implies that the BHC must hold a certain amount of the safe asset as reserves. Reserves are kept on the bank entity’s balance sheet.

Moral hazard The moral hazard problem is modeled à la Holmström and Tirole (1998): the BHC can divert a portion of the assets held on the bank entity’s balance sheet in the second period and default. This moral hazard can be generally interpreted as the incentive of insiders of the BHC to engage in ex-post activities that benefit themselves but hurt outside investors. For example, insiders of a bank have the incentive to ex-post misuse the cash flows of the assets held on-balance sheet, or to ex-post take on excessive risks. Insiders benefit from such activities, but outside investors are the ones bearing losses in bad states.

A possible interpretation of the portion that the BHC can divert is the transparency of the bank entity’s balance sheet. More transparent financial statements make it harder for insiders to misrepresent the level of risk taking or to misuse the cash flows of the assets. Another interpretation of this portion is the degree of soft information of an asset that only the BHC possesses. Soft information is defined as information that cannot be reduced to a series of hard numbers (Petersen, 2004). An example of an information-intensive asset is a relationship-based small-business loan.
Information intensive assets are hard to be valued by outside investors, and thus easy to be diverted by insiders. For instance, if a bank defaults with a small business loan on its balance sheet, it is more likely that the bank can appropriate a large portion of the actual value of the asset, while outside investors bear sizable losses.

Let \( \alpha_B \) denote the divertable portion of the risky asset, and \( \alpha_S \) the divertable portion of the safe reserves. I make the following assumption:

**Assumption 2.** Under deposit funding, the BHC can seize \( \alpha_B \in (0,1) \) of the risky asset held on-balance sheet. Under securitization, the BHC cannot seize the risky asset in the SPV, but can seize \( \alpha_S \in (0,1) \) of the safe reserves held on-balance sheet.

Knowing this, outside investors and the BHC devise a contract with incentive payments to make the BHC indifferent between defaulting and remaining solvent. As in Holmström and Tirole (1998), an efficient contract requires outside investors to grant a portion of the returns to the BHC.

Under deposit funding, the efficient contract features a payoff of \( \alpha_B L \) to the BHC in the low state per unit of investment. This incentive payment makes the BHC indifferent between defaulting or not in the low state. Since outside investors are infinitely risk-averse, they get state-noncontingent payoff \( (L - \alpha_B L) \) per unit of investment. As a result, the BHC gets the residual return \( H - L + \alpha_B L \) in the high state. This high-state payoff ensures that the BHC will not default in the high state, as \( H - L + \alpha_B L > \alpha_B H \). Under securitization, investors mandate the BHC to hold reserves in the amount of \( R \geq \rho/(1 - \alpha_S) \) per unit of investment. In the efficient contract under securitization, the BHC gets \( \alpha_S R \) in the low state, and \( R \) in the high state. Efficient contracts ensure that no default happens in equilibrium.

### 2.2 BHC’s optimization problem

The BHC’s problem is the following:

\[
\begin{align*}
\max_{A_B, A_S, X_B, X_S, r_D, \rho, p, R} & \quad \mathbb{E} \Pi^D + \mathbb{E} \Pi^S + A - A_B - A_S, \\
\text{subject to} & \quad r_D \geq 1, \quad (1) \\
& \quad \min\{L + \rho, H\}/p \geq 1, \quad (2) \\
& \quad A_S + pX_S \geq X_S + RX_S, \quad (3) \\
& \quad R \geq \rho/(1 - \alpha_S), \quad (4) \\
& \quad A \geq A_B + A_S. \quad (5)
\end{align*}
\]

The terms \( \mathbb{E} \Pi^D \) and \( \mathbb{E} \Pi^S \) represent the expected returns from the bank entity and the SPV respectively. Under the efficient contracts, they are given by:
\[ E\Pi^D = [q(H - L + \alpha_B L) + (1 - q)\alpha_B L]X_B - A_B, \]

and

\[ E\Pi^S = [qR + (1 - q)\alpha_S R]X_S - A_S. \]

(1) is the participation constraint for deposit investors, which says that the return on deposits, \( r_D = (1 - \alpha_B)LX_B/(X_B - A_B) \) must be at least as high as the return on the safe asset, which is 1. (2) is the participation constraint for ABS investors, which says that the rate of return on ABS, \( \min\{L + \rho, H\}/p \), must be no less than 1. (3) is the cash flow constraint of the BHC under securitization, where the total financing to the SPV, \( A_S + pX_S \) (bank’s equity plus ABS sales), is allocated between the risky project and safe reserves. (4) is the reserve constraint imposed by outside investors, requiring the BHC to hold a sufficient amount of reserves in order to stand ready for guarantee payments. (5) says that the BHC can use no more capital than what it is endowed from the equity investor.

2.3 Equilibrium

The equilibrium is defined as an efficient contract between outside investors and the BHC that specifies an allocation \( (A_B, A_S, X_B, X_S, \rho, R) \) and a price system \( (p, r_D) \) where (i) \( (X_B, X_S, \rho) \) maximizes the profit of the BHC, given \( (r_D, p) \); (ii) the no short-sale constraint is not violated, such that \( X_B, X_S \geq 0 \); (iii) the price of the ABS \( p \) and the deposit rate \( r_D \) satisfy the individual participation constraints as in (1) and (2); and (iv) the cash flow and the reserve constraints of the SPV hold as in (3) and (4), while the capital constraint holds as in (5).

From the BHC’s problem, total investment \( X \) is bounded by the total capital \( A \) and the leverage per unit of capital allowed by investors’ participation constraints. Consequently, for a given asset, the BHC chooses the one funding mode that delivers the highest profit. In other words, there will be no partial securitization in this model – if a risky asset suits securitization, its entirety would be moved to the SPV. Therefore, without loss of generality, I proceed by splitting the problem into two, one under each funding mode. A novel result regarding the choice between deposit funding and securitization is derived at the end of the section: the BHC chooses the optimal funding mode by minimizing agency costs.

2.4 Deposit funding

Under deposit funding, the BHC levers all its capital \( A \) for on-balance sheet investment. The BHC’s problem is reduced to

\[ \max_{X_B, r_D} E\Pi^D = [q(H - L + \alpha_B L) + (1 - q)\alpha_B L]X_B - A, \]
subject to \[ r_D \geq 1, \] (6)

where \( r_D = (1 - \alpha_B) L X_B / (X_B - A) \).

Since outside investors are competitive, participation constraint (6) must bind. As a result, the level of investment under deposit funding is given by

\[ X_B = \frac{A}{1 - L + \alpha_B L}. \] (7)

The expected profit under deposit funding can be written as

\[ \mathbb{E} \Pi^D = A - L + \alpha_B L \mathbb{E}(x) - 1, \] (8)

where the agency cost under deposit funding is captured by \( \alpha_B L \).

Without incentive payments, the bank gets nothing in the low state and \( H - L \) in the high state. Hence, the bank has the highest incentive to default in the low state. For each unit of the risky asset, the return in the low state is \( L \), and hence the incentive payment making the bank indifferent between defaulting and not, i.e. the agency rent, is \( \alpha_B L \). Because of the moral hazard, the bank can only pledge \( (1 - \alpha_B) L \) to outside investors per unit of investment. Consequently, the bank needs \( (1 - L + \alpha_B L) \) units of capital per unit of investment, resulting in the level of investment given by (7).

In other words, outside investors require the bank to hold more capital to protect themselves from the moral hazard, and since the bank only has a fixed amount of capital, a higher moral hazard implies a lower leverage and investment. In the absence of moral hazard (\( \alpha_B = 0 \)), the agency cost is zero, and the pledgeable return is \( L \). Therefore, the first-best level of investment is given by \( X^{FB} = \frac{A}{1-L} \), where “FB” stands for “first-best.”

2.5 Securitization with explicit guarantees

Under securitization, the BHC finances the risky asset by selling ABS through an off-balance sheet SPV. Sale proceeds of ABS are used to finance the risky asset and the safe asset held as reserves. The BHC chooses the levels of investment and guarantees. A higher level of guarantees increases the price of ABS but exposes the BHC to risks associated with the asset, thus reducing leverage. Since the BHC is risk neutral and outside investors are risk-averse, the optimal risk sharing structure is the BHC bearing all the risks through providing full guarantees. In this section, I show that there is a minimum level of guarantee that is necessary for an active ABS market to exist. In equilibrium, the BHC optimally synthesizes risk-free securities out of risky assets.

Under securitization, the BHC leverages its capital \( A \) for off-balance sheet investment to maximize expected profits as follows:
\[
\max_{X_S, \rho, p, R} \mathbb{E}\Pi^S = [qR + (1 - q)\alpha_S R] X_S - A,
\]

subject to

\[\begin{align*}
\min\{L + \rho, H\} / p & \geq 1, \\
A + pX_S & \geq X_S + RX_S, \\
R & \geq \rho / (1 - \alpha_S).
\end{align*}\]  

Because outside investors are competitive, participation constraint (9) must bind, and hence the price of ABS will be given by \(p = \min\{L + \rho, H\}\). Investors’ infinite risk-aversion narrows the range of \(\rho\) to \([0, H - L]\). When \(\rho = H - L\), we say that the BHC is providing full guarantees to its ABS investors. Since \(\mathbb{E}(x) > 1\), (10) and (11) must bind, and the level of SPV investment is given by \(X_S = \frac{A}{1 - L + \alpha_S (\frac{H - L}{1 - \alpha_S})} \). Using this, one can re-write \(\mathbb{E}\Pi^S\) as \(\mathbb{E}\Pi^S(X_S) = [(L + \rho) - ((1 - q)\rho + 1)] X_S\).

For a market to exist, the price of ABS, \(L + \rho\), must exceed the issuance cost, \((1 - q)\rho + 1\), and hence the guarantees must reach a minimum level.

**Lemma 1. (Threshold level of guarantee)** There is a unique threshold level of guarantee given by

\[\hat{\rho} = \frac{1 - L}{q} .\]

When \(\rho \geq \hat{\rho}\), an active ABS market exists, and the BHC earns a positive unit profit \(\pi = L + q\rho - 1\), which is increasing in \(\rho\).

One can check that \(\mathbb{E}\Pi^S\) is increasing in \(\rho\), and hence in equilibrium the BHC provides full guarantees, i.e. \(\rho = H - L\). Therefore, the BHC’s expected profit under securitization is given by

\[\mathbb{E}\Pi^S = \frac{A}{1 - L} \left[ \frac{H - L}{\alpha_S} \right] \left( \mathbb{E}(x) - 1 \right),\]

where the agency cost under securitization is captured by \(\alpha_S \frac{H - L}{1 - \alpha_S}\). Correspondingly, the price of the ABS is \(p = H\), and the guaranteed ABS yields a rate of return equal to 1.

In the low state, guarantee payments are due, and the BHC has the highest incentive to default and seize \(\alpha_S\) of the total amount of reserves \(\frac{H - L}{1 - \alpha_S}\). Therefore, the incentive payment making the BHC indifferent between defaulting and not, i.e. the agency rent, is \(\alpha_S \frac{H - L}{1 - \alpha_S}\). Again, moral hazard reduces leverage and investment, and in the absence of that, the BHC achieves the first-best level of investment \(X^{FB} = \frac{A}{1 - L}\) under securitization. In the absence of agency problems, we are back in the Modigliani – Miller world.
2.6 Optimal funding mode and agency cost

Having separately derived the expected profits under deposit funding and securitization, the BHC chooses the funding mode that delivers the highest profit. For a given asset, this choice boils down to maximizing leverage, or, equivalently, minimizing agency costs, across funding modes. From equation (8) and (12), securitization is strictly preferred if the agency cost under securitization is smaller than that under deposit funding.

Proposition 1. The BHC strictly prefers securitization if $\alpha_S \frac{H - L}{1 - \alpha_S} < \alpha_B L$.

This result implies three observations.

Agency cost and information intensity The agency cost is the product of the agency rate, the level of information intensity, and the agency base, the unit value of the asset held on-balance sheet. Under deposit funding, the agency rate is $\alpha_B$ and the agency base is simply $L$. Hence, the agency cost under deposit funding is linear in $\alpha_B$. Under securitization, the agency rate is $\alpha_S$ and the agency base is $\frac{H - L}{1 - \alpha_S}$. Hence, the agency cost under securitization is quadratic in $\alpha_S$. For assets with high information intensity, both the agency rate and agency base are high under securitization.

A reduction in the information intensity of the safe reserves increases the profitability of securitizing riskier assets. When $\alpha_S \ll \alpha_B$, securitization may be the most profitable funding mode, even for an asset with a high level of risk, i.e. high $H - L$, which implies a large agency base. For instance, this could be the case when reserves are standardized safe assets, e.g. U.S. Treasury securities.

Return structure and the agency cost mechanism To see how agency costs vary with the mean and the standard deviation of the binomial return distribution, I conduct two experiments. First, I increase the level of risk (standard deviation of the return) in a mean-preserving fashion. Second, I fix the level of risk but increase the mean return. To do this, I re-write $H = \mu + \sigma \sqrt{\frac{1 - q}{q}}$ and $L = \mu - \sigma \sqrt{\frac{q}{1 - q}}$, where $\mu = \mathbb{E}(x)$ and $\sigma = \text{std}(x)$. Using this formulation, the agency costs under the two funding modes are given by:

$$\text{Deposit funding agency cost} = \alpha_B \left( \mu - \sigma \sqrt{\frac{q}{1 - q}} \right),$$

$$\text{Securitization agency cost} = \frac{\alpha_S}{1 - \alpha_S} \left( \frac{\sigma}{\sqrt{q(1 - q)}} \right).$$

The deposit funding agency cost is increasing in $\mu$ and decreasing in $\sigma$. Under deposit funding, for a given risk level, a higher mean return implies a higher return in the low state, leading to a higher agency cost. For a given mean return, a higher risk implies a lower return in the low
state, implying a lower agency cost. On the contrary, the agency cost under securitization is not affected by the mean return, and is increasing in the risk level. Higher risks imply larger reserves in securitization, and hence higher agency costs. For a given information intensity, an asset’s return structure determines its optimal funding mode: an asset with low risk and high mean return is most likely to be securitized. When there are multiple assets, the BHC ranks assets according to both expected return and agency cost. This is discussed in Section 2.8.

I term this the *agency cost mechanism*, through which safer assets are securitized and riskier ones are held on-balance sheet. High-risk assets generate low agency costs under deposit funding, but high agency costs under securitization.

**Output and welfare** For a given asset, when only deposit funding is allowed, the level of investment is given by $A_{1 - L + \alpha B L}$; after the introduction of securitization, the level of investment is given by $\max \left\{ \frac{A}{1 - L + \alpha B L}, \frac{A}{1 - L + \alpha S \mu - \sigma} \right\}$. Therefore, securitization weakly increases total investment and the expected aggregate output. If investment in the risky asset is socially optimal, securitization also increases welfare.

### 2.7 Threshold information intensity

In the previous section, I discussed the case of $\alpha_S \ll \alpha_B$, in which risk taking in securitization is driven by a low information intensity of reserves. To emphasize the role of agency costs, I henceforth assume that the divertable portion of the risky asset and the reserves are identical, i.e. $\alpha_B = \alpha_S = \alpha$. This assumption also suits better the interpretation of the divertable portion as the transparency of financial statements. Since the deposit funding agency cost is linear in $\alpha$ and the securitization agency cost is quadratic in $\alpha$, there is a unique threshold information intensity, below which securitization strictly dominates.

**Corollary 1.** Assuming $\alpha_B = \alpha_S = \alpha$, there is a unique threshold information intensity $\alpha_0 = 2 - H/L$. For $\alpha \in [0, \alpha_0)$, securitization with guarantees strictly dominates deposit funding. For $\alpha \in (\alpha_0, 1]$, deposit funding strictly dominates. When $\alpha = \alpha_0$, the BHC is indifferent between deposit funding and securitization. The threshold $\alpha_0$ is increasing in $L$ and decreasing in $H$.

To see how the risk level affects this threshold information intensity, I re-write $\alpha_0$ in terms of the mean $\mu$ and the standard deviation $\sigma$ of the binomial return distribution.

**Corollary 2.** The threshold $\alpha_0$ can be written as $\alpha_0 = 2 - \frac{\mu + \sigma \sqrt{\frac{\mu - \sigma}{1 - q}}}{\mu - \sigma \sqrt{\frac{1 - q}{1 - q}}}$, which is increasing in $\mu$ and decreasing in $\sigma$.

From Corollary 2, riskier assets have a lower threshold level of information intensity and are less likely to be securitized. Again, this is the *agency cost mechanism* – the agency cost in risk taking is high under securitization but low under deposit funding.
What to securitize  The predictions of the static model are in line with the observation that mortgage loans are much more likely to be securitized than small business loans. In the context of the model, the high-state return of a loan asset is the full payment with interest, while the low-state return is what banks get when borrowers default. In general, small business loans carry higher interest rates and are riskier than mortgage loans. With residential property as collateral, banks get the market value of the house if a mortgage borrower defaults. Although small business loans also have physical capital as collateral, the value of business capital depreciates considerably if the business fails. From the lens of this model, the high return volatility of small business loans elevates the securitization agency cost, making securitization undesirable.

Prior to the recent crisis, the ABS market was particularly concentrated in mortgage assets (Gorton and Metrick, 2010). One explanation is the optimism regarding collateral values of real estate. In a booming housing market, banks believed that they could quickly sell these assets at minimal loss in the event of default. Optimism and low mortgage interest rates translate into a high $L$ and low $H$, making securitization particularly profitable.

Another example of securitization with guarantees is credit card securitization. Individual credit card loans carry high interest rates and can be highly risky, but the associated risks are idiosyncratic and hence diversifiable.

2.8 Agency costs and asset ranking

In an environment with multiple limited-supplied assets, the introduction of securitization alters the BHC’s ranking of assets. From (8) and (12), the BHC computes scores of assets under deposit funding and securitization according to the following formulas:

$$\Upsilon_B = \frac{\mu - 1}{1 - (1 - \alpha)\mu + (1 - \alpha)\sqrt{\frac{q}{1-q}}\sigma},$$

$$\Upsilon_S = \frac{\mu - 1}{1 - \mu + \left[\frac{1}{(1-\alpha)}\sqrt{\frac{q}{1-q}} + \frac{\alpha}{1-\alpha}\sqrt{\frac{1-q}{q}}\right]\sigma}.$$

If securitization is not an option, the BHC ranks assets according to $\Upsilon_B$. When both funding modes are available, assets are ranked according to $max \{\Upsilon_B, \Upsilon_S\}$. I conduct four experiments to illustrate how securitization affects the rank of assets. In the first three experiments, I vary only one of three parameters of the risky asset ($\alpha$, $\mu$, and $\sigma$) and keep the other two unchanged. In the fourth experiment, I vary two parameters at the same time. Recall that $\mu$ and $\sigma$ are the mean and the standard deviation of the binomial stochastic return $x$.

Panel A of Figure 1 plots the scores of assets with the same $\alpha$ and $\mu$ but different $\sigma$. Both scores are declining in the level of risk, with the securitization score higher at low risk levels. Similarly, panel B plots the scores of assets with the same $\alpha$ and $\sigma$ but different $\mu$. The effect of mean return
on the optimal funding mode is very weak. In almost all parameterizations, the two scores do not cross for a wide range of $\mu$. However, the advantage of a certain funding mode increases with $\mu$. In the plotted parametrization, securitization dominates deposit funding because of the low $\sigma$, and the advantage of securitization over deposit funding is increasing in $\mu$. For a higher $\sigma$, deposit funding would dominate, and its advantage would also increase in $\mu$. Panel C plots the scores of assets with the same $\mu$ and $\sigma$ but different $\alpha$. Securitization dominates for assets with lower information intensity. In these three experiments, with both funding modes available, the ranking score is the upper contour of the two curves. Although for some assets the optimal funding mode is changed, the rank is preserved.

When assets differ in more than one dimension, the rank can be altered by the introduction of securitization. Figure 2 plots iso-profit curves under deposit funding and securitization for assets with a given $\alpha$ but different $\mu$ and $\sigma$. As the profit under securitization is more sensitive to the risk level, the iso-profit curve under securitization is flatter than that under deposit funding, and they cross at point A. To the north-east of A, deposit funding dominates, and to the south-west of A, securitization dominates. Imagine there are two assets, given by point A and B – an arbitrary point between the two indifference curves to the left of A. With only deposit funding available, A achieves higher profits. The bank would first invest in A using deposits and then move to B. With both funding modes available, the preference is reversed. In the region of B, securitization is the preferred funding mode, and according to the iso-profit curve under securitization, B is superior to A. Therefore, the BHC would prioritize securitizing B and then securitize A. The introduction of securitization elevates the rank of assets with low risk and low mean return.

3 A dynamic model

In the static model, the BHC cannot commit not to default, and hence only the agency cost mechanism is at play. In a dynamic framework, the BHC may use its franchise value to commit not to default, giving rise to a franchise value mechanism, through which high expected return assets
are more likely to be held on-balance sheet, as opposed to being securitized in the static model. The ability to overcome moral hazard depends on both the franchise value and the magnitude of moral hazard. Hence, the *agency cost mechanism* is still at play in the dynamic model.

### 3.1 Securitization with explicit guarantees

#### 3.1.1 Model setup

Everything is the same as in the static benchmark, except that now the economy lasts for infinite periods, $t = 0, 1, \ldots, \infty$. The three types of agents – a risk-neutral BHC, a risk-neutral equity investor, and infinitely risk-averse outside investors – are infinitely-lived with a common time preference $\beta \in (0, 1)$. The BHC invests in the risky asset at the beginning of each period, and returns are realized and consumed at the end of each period.

**Bankruptcy** In a dynamic setting, it is important to specify the consequence of default. Default happens either when the bank entity fails to pay depositors in full, or when the SPV fails to honor guarantees to ABS investors. After a default, the BHC declares bankruptcy and loses its ability to raise external funding forever, i.e. its franchise value. In this section, I assume that there are no government bailouts after default.

#### 3.1.2 BHC’s optimization problem

Similar to Acharya (2003), all profits generated by the BHC in a period are consumed by the equity investor at the end of each period. As the equity investor cannot commit to any dynamic investment strategy, the BHC’s problem can be expressed as a stationary dynamic program as follows:

$$V_t = \max_{A_B, A_S, X_B, X_S, \rho, p, R} \mathbb{E} \Pi^D + \mathbb{E} \Pi^S + \mathbb{I}_{\text{no default}} \beta V_{t+1},$$
subject to \[ \tilde{L} X_B \geq X_B - A_B, \] (13)
\[ \min \{ L + \rho, H \}/p \geq 1, \]
\[ A_S + pX_S \geq X_S + RX_S, \]
\[ R \geq \tilde{\rho}, \] (14)
\[ A \geq A_B + A_S. \]

The expected per-period return \( \mathbb{E} \Pi^D \) and \( \mathbb{E} \Pi^S \) are given by

\[ \mathbb{E} \Pi^D = \left[ q(H - \tilde{L}) + (1 - q)(L - \tilde{L}) \right] X_B - A_B, \]
\[ \mathbb{E} \Pi^S = \left[ qR + (1 - q)(R - \tilde{\rho}) \right] X_S - A_S, \]

where \( \tilde{L} \) is the pledgeable return per unit of the risky asset under deposit funding. \( \beta V_{t+1} \) is the discounted continuation value of the bank. \( I \{ \text{nodefault} \} \) is an index function that equals to 1 when the BHC does not default, and 0 otherwise.

In the dynamic setting, rather than relying on incentive payments, the BHC can use its franchise value to commit not to default. All the constraints are the same as in the static model, except that in (13), the pledgeable return \( \tilde{L} \) depends on whether the bank entity can commit not to default, as discussed further below. Similarly, in (14), the minimum required reserves per ABS \( \tilde{\rho} \) depends on whether the SPV can commit not to default.

**Deposit funding** Without incentive payments, the BHC potentially has incentives to default in both states. In the absence of franchise value considerations, the bank always has an incentive to default in the low state. However, if the following condition holds:

\[ H - L \leq \alpha H, \] (15)

the bank also has an incentive to default in the high state. Since \( \alpha L < \alpha H \), the sufficient ex-post ICC to ensure that the bank does not default when \( H - L \leq \alpha H \) is

\[ \alpha H X^{FB} \leq \beta V^{FB}, \] (ICCH)

where \( X^{FB} = \frac{A}{1-L} \) is the first-best level of investment of a credible bank, and \( V^{FB} = \frac{1}{1-\beta} \cdot X^{FB} \left[ \mathbb{E}(x) - 1 \right] \) is the first-best franchise value. Conversely, if (15) does not hold, the bank would only default in the low state absent franchise value considerations, and the sufficient ex-post ICC is

\[ \alpha L X^{FB} \leq \beta V^{FB}. \] (ICCL)

ICCH and ICCL ensure that the bank entity’s commitment is credible. In other words, even
if the bank has an incentive to default absent franchise value considerations, it will not do so, as losing franchise value is too much compared to the one-time gain. Having specified the relevant ICCs, the pledgeable return \( \tilde{L} \) is given by

\[
\tilde{L} = \begin{cases} 
L & \text{if } H - L \leq \alpha H \text{ and ICCH holds, or if } H - L > \alpha H \text{ and ICCL holds,} \\
(1 - \alpha)L & \text{otherwise.}
\end{cases}
\]

If the relevant ICC holds, rational investors know that the bank will not default ex-post, and they will finance \( X_B = X^{FB} \) ex-ante. Otherwise, they only finance \( X_B = X^B_d = \frac{A}{1 - L + \alpha L} < X^{FB} \). Note that ICCH and ICCL can be simplified to

\[
\alpha H \leq \frac{\beta}{1 - \beta} \cdot \left[ \mathbb{E}(x) - 1 \right], \quad (16)
\]

\[
\alpha L \leq \frac{\beta}{1 - \beta} \cdot \left[ \mathbb{E}(x) - 1 \right]. \quad (17)
\]

**Securitization** Under securitization, the BHC only has an incentive to seize reserves and default in the low state, in the absence of franchise value considerations. Therefore, the required reserves per ABS, \( \tilde{\rho} \), are given by

\[
\tilde{\rho} = \begin{cases} 
\rho & \text{if } \alpha \rho X^{FB} \leq \beta V^{FB}, \quad \text{(ICCS)} \\
\rho/(1 - \alpha) & \text{if } \alpha \rho X^{FB} > \beta V^{FB},
\end{cases}
\]

where ICCS ensures that the SPV’s commitment is credible. In other words, if ICCS holds, the cost of default (losing franchise value) is too high compared to the one-time gain from seizing reserves.

If ICCS is satisfied, ABS investors will finance \( X_S = X^{FB} \). Otherwise, they only finance \( X_S = X^S_d = \frac{A}{1 - L + \alpha(H - L)} < X^{FB} \). ICCS can be simplified to

\[
\alpha(H - L) \leq \frac{\beta}{1 - \beta} \cdot \left[ \mathbb{E}(x) - 1 \right]. \quad (18)
\]

As in the static model, I proceed, without loss of generality, by splitting the BHC’s problem into two, one under each funding mode.

### 3.1.3 Threshold \( \alpha \) under deposit funding

Condition (15), (16), and (17) generate three thresholds, \( \alpha^{PH}_1 \), \( \alpha^H_1 \), and \( \alpha^L_1 \), respectively. The superscript “DH” stands for “default in high state”, and “H” and “L” stand for “high state” and “low state” respectively. The three thresholds together generate a unique threshold information
intensity, below which the bank entity can achieve $X^{FB}$.

**Lemma 2. (Threshold information intensity under deposit funding)** Assuming $\alpha_B = \alpha_S = \alpha$, under deposit funding, there is a unique threshold level of information intensity

$$\alpha_1 = \min \left\{ \max \{ \alpha_{1D}^H, \alpha_{1}^H \}, \alpha_{1}^L \right\},$$

where

$$\alpha_{1D}^H = 1 - \frac{L}{H},$$

$$\alpha_{1}^H = \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{H},$$

$$\alpha_{1}^L = \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{L}.$$

For $\alpha \in [0, \alpha_1]$, depositors agree to finance $X = X^{FB} = \frac{A}{1-L}$. Otherwise, depositors only finance $X = X_d^B = \frac{A}{1-L+\alpha L}$. $\alpha_{1D}^H$ is increasing in $H$ and decreasing in $L$. $\alpha_{1}^H$ is increasing in $L$ and decreasing in $H$. $\alpha_{1}^L$ is increasing in $H$ and decreasing in $L$.

When $\alpha \leq \alpha_1$, the one-time gain of default is too small compared to the forfeited franchise value. Therefore, default is less tempting, and the bank entity’s commitment is credible.

I conduct the same experiments as in the static model: (1) increasing risk in a mean-preserving fashion, and (2) fixing the risk level and increasing the mean return. To do this, I re-write the above thresholds in terms of the mean and standard deviation of the binomial return as:

$$\alpha_{1D}^H = 1 - \frac{\mu - \sigma \sqrt{\frac{q}{1-q}}}{\mu + \sigma \sqrt{\frac{1-q}{q}}},$$

$$\alpha_{1}^H = \frac{\beta}{1 - \beta} \cdot \frac{\mu - 1}{\mu + \sigma \sqrt{\frac{1-q}{q}}},$$

$$\alpha_{1}^L = \frac{\beta}{1 - \beta} \cdot \frac{\mu - 1}{\mu - \sigma \sqrt{\frac{q}{1-q}}}.$$

For a given $\mu$, $\alpha_{1D}^H$ is increasing in $\sigma$: high-risk assets enlarge the non-default payoff in the high state, $H - L$, making default in the high state less tempting. For a given $\sigma$, $\alpha_{1D}^H$ is decreasing in $\mu$, since a higher $\mu$ means a higher high-state return, making default in the high state more tempting. Threshold $\alpha_{1}^L$ is increasing in $\sigma$, since high-risk assets yield less in the low state and diminish the one-time gain of default. On the contrary, $\alpha_{1}^H$ is decreasing in $\sigma$, as high-risk assets yield more in the high state, making default in the high state more tempting. Both $\alpha_{1}^H$ and $\alpha_{1}^L$ are
increasing in $\mu$, as higher franchise values strengthen incentives to repay and maintain reputation – the franchise value mechanism.

Figure 3 depicts the threshold information intensity under deposit funding for different levels of risk and a fixed mean return. The shaded region under the thick solid line is where the bank entity can achieve the first-best level of investment through credible commitment. The size of the shaded region is generally increasing in the level of risk, especially for moderate- to high- risk assets. This is because of the agency cost mechanism – under deposit funding, high-risk assets yield less in the low state, reducing the benefit of default and making it easier for the bank entity to commit.

3.1.4 Threshold $\alpha$ under securitization with explicit guarantees

Condition (18) creates a threshold information intensity $\alpha_2$, below which the SPV can achieve $X^{FB}$.

Lemma 3. (Threshold information intensity under securitization) Assuming $\alpha_B = \alpha_S = \alpha$, under securitization, there is a unique threshold level of information intensity

$$\alpha_2 = \frac{\beta}{1-\beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{H-L}.$$ 

For $\alpha \in (0, \alpha_2]$, ABS investors agree to finance $X = X^{FB} = \frac{A}{1-L}$. Otherwise, ABS investors only finance $X = X^S_d = \frac{A}{1-L+\alpha \frac{H-L}{1-\alpha}}$. The threshold $\alpha_2$ is increasing in both $H$ and $L$.

When $\alpha$ is smaller than $\alpha_2$, the one-time gain of default is too small relative to the cost of default. When securitizing assets with $\alpha \in (0, \alpha_2]$, the bank has no incentive to default ex-post,
and ex-ante investors will finance $X^{FB}$. For assets with $\alpha \in (\alpha_2, 1]$, the SPV cannot credibly commit not to default, and hence the level of investment is given by $X^S_d$. Re-writing $\alpha_2$ as

$$\alpha_2 = \frac{\beta}{1 - \beta} \cdot \frac{\mu - 1}{\left(\sqrt\frac{q}{1-q} + \sqrt\frac{1-q}{q}\right)\sigma},$$

it is obvious that $\alpha_2$ is increasing in $\mu$ and decreasing in $\sigma$. A higher mean return gives the SPV more incentives to repay and maintain reputation, while a higher risk implies a larger reserve that worsens the incentive to repay. This is again the agency cost mechanism.

Figure 4 depicts the threshold information intensity under securitization for a fixed mean return and different risk levels. The shaded region is where the SPV can achieve the first-best level of investment through credible commitment.

3.1.5 Range of securitization with explicit guarantees

Lemma 2 and Lemma 3 describe the set of assets for which the first-best level of investment can be achieved under deposit funding and securitization. Once $\alpha$ is sufficiently high that the BHC cannot commit, we are back in the static model, as far as comparing deposit funding versus securitization. Combining Corollary 1 and Lemma 2 and 3, a full description of optimal funding modes is derived.

Proposition 2. (Optimal funding modes) Assume both deposit funding and securitization with explicit guarantees are allowed, and $\alpha_B = \alpha_S = \alpha$. For assets with $\alpha \in [0, \min\{\alpha_1, \alpha_2\})$, the BHC is indifferent between deposit funding and securitization, with the level of investment given by $X = X^{FB} = \frac{A}{1-L}$. If $\alpha_1 \geq \alpha_2$, the BHC strictly prefers deposit funding for assets with $\alpha \in [\alpha_2, \alpha_1]$,
with $X = X^{FB}$. If $\alpha_2 \geq \alpha_1$, the BHC strictly prefers to securitize assets with $\alpha \in [\alpha_1, \alpha_2]$, with $X = X^{FB}$. When $\alpha_0 = 2 - \frac{H}{L} \geq \max\{\alpha_1, \alpha_2\}$, the BHC strictly prefers to securitize assets with $\alpha \in (\max\{\alpha_1, \alpha_2\}, \alpha_0]$, with $X = X^S_d = \frac{A}{1-L+\alpha_0 L}$. For assets with $\alpha \in (\max\{\alpha_1, \alpha_2, \alpha_0\}, 1]$, the BHC strictly prefers on-balance sheet financing, with $X = X^R_d = \frac{A}{1-L+\alpha L}$.

The left panel of Figure 5 is a map of optimal funding modes for assets with the same $\mu$ and different $\sigma$. The optimal funding mode in each region is labeled and shaded. The width of the region where securitization is strictly preferred is generally decreasing in the level of risk (except the very left end with small $\sigma$). Assets with both high information-intensity and high risk are less likely to be securitized, as they are too obscure to be accepted by outside investors, and the associated reserves create agency costs that are too large under securitization. This reflects the agency cost mechanism in the dynamic setting. Among the safest assets, banks strictly prefer to securitize assets with high information intensity. As the agency base under securitization is very small given the low risk, the bank can afford to securitize information-intensive assets.

The right panel of Figure 5 depicts optimal funding modes for a fixed $\sigma$ and varying $\mu$. For a wide range of $\alpha$ (0% to almost 50%), securitization strictly dominates for low-return assets, while the bank is indifferent between funding modes for high mean return assets. This is the effect of the franchise value mechanism. High return assets have high franchise values, and hence the associated cost of default is large. In other words, high franchise values make default less tempting, and thus make the bank entity’s commitment more credible. For high-return assets, the increased ability to achieve the first-best level of investment under deposit funding reduces the region where securitization is strictly preferred.
3.2 Securitization with implicit guarantees

In some markets, regulation forbids the use of explicit guarantees, and financial intermediaries resort to implicit guarantees. The difference between an explicit and an implicit guarantee lies in the legal consequence of reneging on the guarantee promise ex-post. Explicit guarantees are contractual, and failing to honor them constitutes a default that forfeits the bank’s franchise value. Meanwhile, implicit guarantees are non-contractual, and the bank is not legally obligated to repay anything. I assume that if a bank “defaults” on its implicit guarantees, it loses credibility in the ABS market and subsequently continues as a discredited bank that can use only deposit funding subject to moral hazard.

3.2.1 Range of securitization with implicit guarantees

In the previous section, since the bank can only seize a portion of the assets held on-balance sheet in the event of default, I assumed \( \alpha_B = \alpha_S = \alpha < 1 \). Under implicit guarantees, the bank can potentially seize all of the reserves and still not be held liable in court. Therefore, I assume \( \alpha_B < \alpha_S = 1 \) in this section. Recall that in the static model, as \( \alpha_S \to 1 \), the agency cost of securitization goes to infinity, making securitization unsustainable. In the dynamic framework, implicit guarantees can be supported by the BHC’s reputation. Once reputation is lost, the BHC becomes a discredited bank entity in all future periods and is identical to the deposit funding case of the static model.

With implicit guarantees, the ex-post incentive compatibility constraint under securitization is given by

\[
(H - L)X^{FB} \leq \beta \left( V^{FB} - V_d^B \right),
\]

where \( V_d^B = \frac{1}{1-\beta} \cdot \frac{A}{1-L+\alpha L} \mathbb{E}(x) - 1 \) is the franchise value of a discredited bank entity with \( X_d^B = \frac{A}{1-L+\alpha L} \). The cost of not honoring guarantees, \( \beta \left( V^{FB} - V_d^B \right) \), is the discounted reduction in the franchise value caused by losing credibility. A discredited bank entity suffers agency costs, and hence the cost of not honoring guarantees is large when agency costs are high absent reputation. As a result, the BHC is less tempted to renege on guarantees if the asset is subject to high agency cost under deposit funding without reputation. This condition gives rise to a minimum on-balance sheet information intensity for securitization.

Proposition 3. (Region of securitization with implicit guarantees) When both deposit funding and securitization with implicit guarantees are allowed, the BHC strictly prefers deposit funding for assets with \( \alpha_B \in [0, \min\{\alpha_1, \alpha_{IM}\}] \), with investment given by \( X = X^{FB} = \frac{A}{1-L} \). If \( \alpha_{IM} < \alpha_1 \), the BHC is indifferent between deposit funding and securitization for assets with \( \alpha_B \in (\alpha_{IM}, \alpha_1) \), with \( X = X^{FB} \). If \( \alpha_{IM} \geq \alpha_1 \), the BHC strictly prefers deposit funding for assets with \( \alpha_B \in (\alpha_1, \alpha_{IM}) \), with \( X = X_d^B = \frac{A}{1-L+\alpha L} \). For assets with \( \alpha_B \geq \max\{\alpha_1, \alpha_{IM}\} \), the BHC

\(^7\)The existence of implicit guarantees is well documented in credit-card securitization (Higgins and Mason, 2004; Gorton and Souleles, 2007).
strictly prefers securitization, with $X = X^{FB}$. The threshold $\alpha_{IM}$ is given by $\alpha_{IM} = \varphi_S/L$, where

$$\varphi_S = \frac{H - L}{\beta} \cdot \frac{\mathbb{E}(x) - 1 - L}{1 - L} = \frac{R(1 - L)}{\beta V^{FB} - R},$$

(19)

and $\partial \alpha_{IM} / \partial H \geq 0$ and $\partial \alpha_{IM} / \partial L \leq 0$.

The commitment device in securitization with implicit guarantees is the BHC’s reputation, the value of which depends in part on whether agency costs are high without reputation. Therefore, the BHC only securitizes highly information-intensive assets with implicit guarantees. The denominator in (19), $\beta V^{FB} - R$, is the net benefit from honoring implicit guarantees if failing to do so constitutes a legal default. Note that if $\beta V^{FB} \leq R$, the SPV would default even when facing the strongest penalty. This threshold is decreasing in $\beta V^{FB} - R$, as a higher net benefit from repayment constitutes a stronger commitment device, and is increasing in $R$, as more reserves provide stronger incentives to “default.”

The left panel of Figure 6 plots optimal funding modes with $\mu = 1.03$ and varying $\sigma$. The securitization region lies where information intensity under deposit funding is relatively high and the risk level is relatively low. As assets get riskier, the securitization region vanishes due to the increase of reserve holdings associated with high-risk assets, making default more tempting – the agency cost mechanism. The right panel of Figure 6 plots optimal funding modes with $\sigma = 0.15$ and a range of $\mu$. The securitization region lies where the mean return is relatively high, as high mean returns increase the net benefit of honoring implicit guarantees – the franchise value mechanism.
3.3 Explicit vs. implicit guarantees

In this section, I superimpose the plots from the previous two sections to evaluate the optimal funding mode when deposit funding and securitization with both kinds of guarantees are available.

The left panel of Figure 7 shows the optimal funding modes under securitization with implicit and explicit guarantees for a fixed $\mu$. The right panel of Figure 7 does the same thing, but for a fixed $\sigma$. The region for securitization with implicit guarantees is a subset of that with explicit guarantees. Since implicit guarantees provide the BHC a form of insurance, in the sense that the bank can continue to operate following a “default,” the bank has greater incentive to renege on its promise. Therefore, under implicit guarantees, rational investors are only willing to finance the first-best level of investment for a more selected set of assets. This result can be generalized as long as outside investors are more risk-averse than the BHC. The plot suggests that moderate-risk assets with high information intensities should only be securitized with explicit guarantees – a potentially testable implication for empirical work.

3.4 Changes in asset ranking and the bank’s portfolio

Introducing securitization changes the size and composition of the bank entity’s portfolio. To see this, imagine that all the assets have the same information intensity, $\alpha = 0.3$, the same mean return, $\mu = 1.03$, but different levels of risk. Each asset is in limited supply, and all the assets can be thought of as lying on the horizontal blue line at $\alpha = 0.3$ in Figure 8.

Before the introduction of securitization, the BHC invests according to the left panel of Figure 8. Absent moral hazard, safer assets with higher pledgeable returns achieve higher capital efficiency, and hence are prioritized by the bank entity. Equivalently, in terms of Figure 8, the bank entity
invests from the left.

With moral hazard, the bank may prioritize riskier assets to overcome moral hazard. Since $\alpha_1$ is upward sloping, there is a range of $\alpha$ (including $\alpha = 0.3$ in the figure), for which safer assets inflict agency costs, but riskier ones do not. For $\alpha = 0.3$, the bank computes a cutoff $\hat{\sigma}(\alpha)$ such that the asset with $\hat{\sigma}(\alpha)$ generates the same profit as the asset with $\sigma_0 = 0.06$ (the lowest risk level). For assets with $\sigma > \hat{\sigma}(\alpha)$, even the first-best profit, $A_{1-\sigma}(\mu - 1)$, is lower than the profit from the safest asset, $A_{1-\sigma_0}(\mu - 1)$.

Therefore, under deposit funding, the bank entity starts investing from the asset with $\sigma = 0.132$ (the first one in the shaded region in the left panel), and moving right along the horizontal blue line (as indicated by the arrow on the right), until it uses up all of its capital or reaches $\hat{\sigma}(0.3) = 0.197$. If the bank entity still has capital left after reaching $\hat{\sigma}(0.3)$, it goes to the asset with $\sigma_0$ and moves right again (as indicated by the arrow on the left).

After the introduction of securitization, the BHC invests according to the right panel of Figure 8. In this map, with the help of securitization, safer assets can also achieve the first-best level of investment. Therefore, the BHC starts by investing in very safe assets, prioritizing them for securitization and de-prioritizing high-risk assets for deposit funding (as indicated by the long arrow).

If the distribution of assets across $\sigma$ has higher weights for lower values of $\sigma$, the associated reserve holdings on-balance sheet may dominate the reduction of high-risk assets on-balance sheet, resulting in a higher total leverage of the bank entity (empirical fact II).
### Table 1: Output changes from securitization

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>Mean of output before secu.</th>
<th>Mean of output after secu.</th>
<th>Change (%)</th>
<th>Vol. of output before secu.</th>
<th>Vol. of output after secu.</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>9.65</td>
<td>9.65</td>
<td>0</td>
<td>0.207</td>
<td>0.207</td>
<td>0</td>
</tr>
<tr>
<td>0.2</td>
<td>9.65</td>
<td>9.65</td>
<td>0</td>
<td>0.207</td>
<td>0.207</td>
<td>0</td>
</tr>
<tr>
<td>0.3</td>
<td>4.29</td>
<td>9.65</td>
<td>125%</td>
<td>0.271</td>
<td>0.207</td>
<td>-23.8%</td>
</tr>
<tr>
<td>0.4</td>
<td>3.08</td>
<td>9.65</td>
<td>213%</td>
<td>0.315</td>
<td>0.207</td>
<td>-34.3%</td>
</tr>
<tr>
<td>0.5</td>
<td>2.22</td>
<td>9.65</td>
<td>335%</td>
<td>0.351</td>
<td>0.207</td>
<td>-41.2%</td>
</tr>
</tbody>
</table>

### 3.5 Output analysis

This section analyzes output consequences of introducing securitization to banks that otherwise rely only on deposit funding. This is carried out numerically using the results in the previous two sections.

I discretize $\sigma \in [0.06, 0.25]$ into 96 points, and assume that there is 1 unit of asset available at each level of risk. All assets have a mean return of 1.03. The probability of the high state is 0.8, and the discount factor is 0.9. The endowed capital is $A = 1$. The information intensity $\alpha$ is varied across experiments.

Table 1 shows the mean and standard deviation of aggregate period-two output before and after the introduction of securitization in the dynamic model. At all levels of $\alpha$, securitization weakly increases mean output and reduces volatility. When both funding modes are available, the BHC prioritizes securitizing low-risk assets and de-prioritizes deposit-funding high-risk assets. As a result, the number of risky assets falls. The mean and volatility of output after the introduction of securitization is constant across $\alpha$, since, under the given parameterization, the BHC always uses up its capital before going out of the region where the first-best level of investment is achievable.

### 4 A dynamic model with government bailouts

In the benchmark dynamic model, the penalty to the BHC for reneging on its promises is losing external funding forever. In reality, banks have access to the public safety net – government bailouts may allow banks to continue operation after default. In this section, I incorporate this realistic assumption into the dynamic framework.

I define a bailout as help from the government to repay outside investors in full, along with a permission to continue operation after default rather than going out of business. I assume that default of either the bank entity or the SPV trigger a potential bailout with probability $\phi \in (0, 1)$.

After a bailout, the BHC continues to operate, but only as a discredited bank entity or SPV, as in the static model, in all future periods. The cost of default is losing reputation and having to suffer agency costs thereafter. The probabilistic nature of the bailout is crucial, as it induces the misalignment of outside investors’ and the BHC’s perception of the cost of default. The
misalignment exacerbates the moral hazard and hence makes the BHC worse off irrespective of the funding mode. Moreover, for high-risk assets, the misalignment is bigger under deposit funding: infinitely risk-averse outside investors value probabilistic bailouts at 0, while the bank entity values it highly as the bank entity can continue operating with low agency costs. This misalignment reduces total investment irrespective of the funding mode and works in the opposite direction of the agency cost mechanism, promoting risk taking in securitization.

Note that allowing for government bailouts only affects the equilibria under deposit funding and securitization with explicit guarantees – these are the cases where seizing assets constitutes a default. With implicit guarantees, the bank is never legally obligated to repay.

4.1 Threshold information intensity under deposit funding

With probability $\phi$, the bank entity will be bailed out following a default and continue as a discredited bank. Therefore, the incentive compatibility constraints (ICCs) under deposit funding are now written as

$$\alpha H X^{FB} \leq \beta \left[ V^{FB} - \phi V_d^B \right], \quad \text{(ICCH)}$$

$$\alpha L X^{FB} \leq \beta \left[ V^{FB} - \phi V_d^B \right], \quad \text{(ICCL)}$$

respectively for assets satisfying the condition $H - L < \alpha H$ and not. $V_d^B = \frac{1}{1-\beta} \cdot \frac{A}{1-L+\alpha L} \left[ \mathbb{E}(x) - 1 \right]$ is the franchise value of a discredited bank with $X_d^B = \frac{A}{1-L+\alpha L}$. The cost of default is the expected reduction of franchise value caused by the resurrection of agency costs as a discredited bank, $V^{FB} - \phi V_d^B$. When agency costs are low, the franchise value of a discredited bank entity, $V_d^B$, is high, making default more tempting and commitments less credible. Recall that, without reputation, high-risk assets create low agency costs under deposit funding, and hence they make the bank entity worse off ex-ante by weakening its ability to commit.

As in the benchmark, conditions $H - L < \alpha H$, ICCH, and ICCL together create a maximum information intensity given by the following lemma.

**Lemma 4. (Threshold information intensity under deposit funding)** Under deposit funding, there is a unique threshold level of information intensity

$$\alpha_1^B = \min \left\{ \max \{ \alpha_{DH}^1, \alpha_H^1 \}, \alpha_L^1 \right\},$$
where

\[
\alpha_{1}^{DH} = 1 - \frac{L}{H},
\]

\[
\alpha_{1}^{H} = \phi \left[ \frac{\beta}{1 - \beta} \left( \mathbb{E}(x) - 1 \right) \frac{L}{H} - 1 + L \right] \frac{1}{L} + (1 - \phi) \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{H},
\]

\[
\alpha_{1}^{L} = \phi \left[ \frac{\beta}{1 - \beta} \left( \mathbb{E}(x) - 1 \right) - 1 + L \right] \frac{1}{L} + (1 - \phi) \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{L}.
\]

For \( \alpha \in [0, \alpha_{1}^{B}] \), investors agree to finance \( X = X^{FB} = \frac{A}{1 - L} \). Otherwise, investors only finance \( X = X_{d}^{B} = \frac{A}{1 - L + \alpha L} \).

In the above equations, the terms multiplying \( \phi \) represent the threshold information intensity if the bailout probability approaches 1, and the terms multiplying \( 1 - \phi \) represent the threshold information intensity in the benchmark with a zero probability of bailouts.

### 4.2 Threshold information intensity under securitization

After being bailed out following a default, the SPV has two options: continuing as a discredited SPV or as a discredited bank entity. Therefore, the ICC is given by:

\[
\alpha(H - L)X^{FB} \leq \beta \left( V^{FB} - \phi \max \{ V_{d}^{S}, V_{d}^{B} \} \right) \quad \text{(ICCS)}.
\]

Again, the cost of default is the expected cost of losing reputation, \( V^{FB} - \phi \max \{ V_{d}^{S}, V_{d}^{B} \} \). When agency costs are high, the franchise value of a discredited BHC, \( \max \{ V_{d}^{S}, V_{d}^{B} \} \), is low, making default less tempting and commitments more credible. Recall that, in the absence of reputation, high-risk assets create high agency costs under securitization, and hence they make the BHC better off by strengthening its commitment under securitization.

This condition generates a threshold information intensity under securitization:

**Lemma 5. (Threshold information intensity under securitization)** Under securitization, there is a unique threshold level of information intensity

\[
\alpha_{2}^{B} = \phi \min \{ \alpha_{2}^{S}, \alpha_{2}^{D} \} + (1 - \phi) \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{H - L},
\]

where

\[
\alpha_{2}^{S} = \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] - (1 - L) \frac{H - 1}{H},
\]

\[
\alpha_{2}^{D} = \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{L}{H - L} - (1 - L) \frac{L}{L}.
\]
For $\alpha \in [0, \alpha^B_2]$, investors agree to finance $X = X^FB = \frac{A}{1-L}$ in the SPV. Otherwise, investors only finance $X^S_d = \frac{A}{1-L+\alpha \frac{H}{1-\alpha}}$ in the SPV.

### 4.3 Range of securitization

As in the benchmark, I combine Corollary 1 with Lemma 4 and 5 to get the full range of securitization.

**Proposition 4. (Region of securitization with government bailouts)** Assume that both deposit funding and securitization with explicit guarantees are allowed; and that the BHC is bailed out by the government after a default with probability $\phi \in (0,1)$; and that $\alpha_B = \alpha_S = \alpha$. The BHC is indifferent between deposit funding and securitization for assets with $\alpha \in [0, \alpha^B_1)$, with $X = X^FB = \frac{A}{1-L}$. If $\alpha^B_2 \geq \alpha^B_1$, the BHC strictly prefers securitizing assets with $\alpha \in [\alpha^B_1, \alpha^B_2]$, with $X^FB = \frac{A}{1-L}$. If $\alpha_0 \geq \alpha^B_2$, the BHC strictly prefers securitizing assets with $\alpha \in (\alpha^B_2, \alpha_0]$, with $X^S_d = \frac{A}{1-L+\alpha \frac{H}{1-\alpha}}$. For assets with $\alpha \in (\max\{\alpha^B_2, \alpha_0\}, 1]$, the BHC strictly prefers on-balance sheet financing with $X^B = \frac{A}{1-L+\alpha L}$.

Figure 9 plots the optimal funding modes when the probability of government bailouts is set to $\phi = 0.99$. In drastic contrast with the benchmark map, a large portion of moderate- to high-risk assets are now financed off-balance sheet. Real world examples of assets in the white region of the left panel might be high-risk small business loans that are rarely securitized. Assets in the securitization region might represent sub-prime mortgages and other moderate- to high-risk assets, and assets in the indifference region might represent prime mortgages and other safer assets.

In the benchmark dynamic model with no bailouts, the deposit funding threshold $\alpha_1$ is increasing in $\sigma$; while with a high probability of a government bailout, the deposit funding threshold $\alpha^B_1$ is decreasing in $\sigma$. The effect of a government bailout is twofold. First, bailout expectations reduce the cost of default – instead of losing its entire franchise value, the BHC only faces a reduction of its franchise value commensurate with the magnitude of the agency costs in the absence of reputation. This adverse effect uniformly limits the set of assets for which a bank entity or an SPV can commit to repay, therefore reducing total investment irrespective of the funding mode. Second, in either funding mode, the BHC is less tempted to default when facing a large drop in its franchise value after a default – the *franchise value mechanism*. Recall that the reduction of franchise value is commensurate with the resurrected agency costs after default. From the *agency cost mechanism*, without reputation, high-risk assets inflict high agency costs under securitization but low agency costs under deposit funding. Therefore, when securitizing moderate- to high-risk assets, the SPV values its reputation more than the bank entity does, making it easier to commit under securitization. The *franchise value mechanism* here increases the chance that banks will fund moderate- to high-risk assets through securitization rather than deposit funding.
In determining risk taking in securitization, the *franchise value mechanism* works in the opposite direction of the *agency cost mechanism*, and the force of the former is increasing in the likelihood of bailouts, consistent with empirical fact III. Corollary 3 derives the threshold level of the bailout probability above which risk taking occurs in the shadow banking system.

**Corollary 3. (Threshold bailout probability)** The partial derivative of $\alpha^L_1$ with respect to $\sigma$ depends on the bailout probability as follows:

$$\frac{\partial \alpha^L_1}{\partial \sigma} = \phi \cdot \frac{-\sqrt{\frac{q}{1-q}}}{\left(\mu - \sigma \sqrt{\frac{q}{1-q}}\right)^2} + \frac{\beta}{1-\beta} \frac{[\mu - 1] \sqrt{\frac{q}{1-q}}}{\left(\mu - \sigma \sqrt{\frac{q}{1-q}}\right)^2}. $$

(-) franchise value mechanism  (+) agency cost mechanism

Therefore, $\alpha^L_1$ is decreasing in $\sigma$ when $\phi > \frac{\beta}{1-\beta} (\mu - 1)$, i.e. when the franchise value mechanism dominates the agency cost mechanism.

Recall that the slope of $\alpha^L_1$ in $\sigma$ is crucial in determining risk-taking in securitization. In the benchmark model with no bailouts ($\phi = 0$), $\alpha^L_1$ is increasing in $\sigma$. When $\phi$ is sufficiently high, the *franchise value mechanism* dominates the *agency cost mechanism*, and $\alpha^L_1$ becomes decreasing in $\sigma$. A declining $\alpha^L_1$ in $\sigma$ implies that banks are more likely to securitize riskier assets.

Contrary to the conventional wisdom that government bailouts induce risk shifting from the banking sector to the public sector, this model unveils a novel mechanism. The existence of bailouts weakens banks’ ability to overcome agency problems. The probabilistic nature of the bailout plays a key role in inducing a misalignment of the BHC’s and outside investors’ perception of the cost of default in traditional banking. The bank is risk neutral and thus values the expected
Table 2: Output changes from securitization w/ bailout

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>Mean of output before secu.</th>
<th>Mean of output after secu.</th>
<th>Vol. of output before secu.</th>
<th>Vol. of output after secu.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>change (%)</td>
<td>change (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>9.65</td>
<td>9.65</td>
<td>0.207</td>
<td>0.207</td>
</tr>
<tr>
<td>0.2</td>
<td>3.73</td>
<td>9.65</td>
<td>0.115</td>
<td>0.207</td>
</tr>
<tr>
<td>0.3</td>
<td>2.82</td>
<td>9.65</td>
<td>0.098</td>
<td>0.207</td>
</tr>
<tr>
<td>0.4</td>
<td>2.26</td>
<td>9.65</td>
<td>0.087</td>
<td>0.207</td>
</tr>
<tr>
<td>0.5</td>
<td>1.89</td>
<td>9.65</td>
<td>0.079</td>
<td>0.207</td>
</tr>
</tbody>
</table>

bailout, but investors do not value it at all (since they are infinitely risk-averse). Because of the misalignment, government bailouts exacerbate the moral hazard, and thus reduce total investment irrespective of the funding mode. Moreover, for high-risk assets, this misalignment is especially large under deposit funding. Infinitely risk-averse outside investors value probabilistic bailouts at 0, while the bank entity values it very much as the bank entity can continue operating with low agency costs. This effect encourages intermediaries to finance high-risk assets via shadow banking. If the misalignment is not present, government bailouts would not exacerbate the moral hazard, as both outside investors and the BHC value the bailout equally. If government bailouts realize with probability one, outside investors and the BHC will collectively invest in high-risk assets and shift the risk to the public sector. The conventional view on government bailouts predicts excessive risk-taking by bank entities. However, prior to the recent financial crisis, risky assets were concentrated in the shadow banking sector (empirical fact IV), consistent with the prediction of this novel channel. Figure 11 in Appendix B illustrates how the region of securitization changes with $\phi$.

4.4 Output analysis

This section conducts the same output analysis as in Section 3.5, but assuming a bailout probability $\phi = 0.99$ after a default. Table 2 shows the mean and standard deviation of period-two output before and after the introduction of securitization.

Securitization still increases expected output, as investment is boosted by overcoming agency costs. However, the increase in expected output comes with an increase in volatility. On the one hand, the increase in investment itself increases volatility, since all assets are risky. More importantly, the reduction of agency costs increases the capital utilization efficiency defined as the maximum level of investment per unit of capital, thus allowing the BHC to invest in riskier assets down the rank that otherwise wouldn’t be exploited.

4.5 Policy implications

There is empirical evidence that underscores the marked variation in the performance of different classes of securitized assets during and after the financial crisis (Segoviano et al., 2013). This
model points to the role of government bailouts in affecting risk preference under securitization. Systemically important intermediaries have a higher chance of receiving government bailouts than small intermediaries. The variation of the possibility of bailouts may contribute to the variation in the performance of securitized assets across different origination intermediaries.

The positive contribution of the paper is to point out that, besides risk transfer and regulatory arbitrage, there is also moral hazard involved in securitization, and the moral hazard has important implications on banking behaviors. Moreover, the paper provides a new understanding of how government bailouts affect shadow banking. These new perspectives should be considered by regulators to ensure sound policy making.

The model completely abstracts from regulatory arbitrage, yet it can still generates the result that, when securitization becomes available, banks finance more risky assets off-balance sheet, as long as there is a possibility of a government bailout. Therefore, the model suggests that, even if regulatory arbitrage can be cleaned up, banks may still securitize bad assets, especially too-big-to-fail banks. In the model, risk taking in securitization is an efficient equilibrium outcome that is inherently neither good nor bad per se, but the stability of the system critically hinges on the sufficiency of reserves held on-balance sheet to honor guarantees. From the perspective of the delegation theory of regulation, regulators should monitor on behalf of investors to ensure that banks hold adequate reserves for the guarantees they provide.

5 Moral hazard in monitoring

This section adds moral hazard in monitoring to the benchmark static and dynamic models. Ex-post monitoring affects the returns on risky assets, and hence it is important to discuss the implications of funding modes and the form of guarantees for banks’ monitoring decisions. To focus on how the funding mode affects ex-post monitoring decisions, I compare the monitoring incentive when only deposit funding is available to the monitoring incentive when only securitization is available. In the dynamic setting, the benchmark moral hazard, i.e. ex-post diverting assets, naturally gives rise to the moral hazard of weak monitoring.

Monitoring increases the expected return of the risky asset, but is costly. Specifically, the BHC can monitor the asset after origination at a cost of $C$ per unit of investment. The cost of monitoring, $C$, is publicly observable, but the monitoring action is unobservable and non-verifiable. If the BHC monitors, the low-state return is $\bar{L}$, otherwise it is $L < \bar{L}$. The high-state return is unaffected by monitoring. Without loss of generality, I assume that the BHC only defaults in the low state. In order to affect the level of investment, monitoring must change the low-state return, as outside investors are infinitely risk-averse.

Let $\bar{\mu}$ denote the mean return of a monitored asset, and $\mu$ the mean return of an unmonitored asset. I assume that the expected net unit profit from the risky asset is positive when the BHC monitors, i.e. $C < \bar{\mu} - 1$, and when the BHC does not monitor, i.e. $\mu > 1$. 
The timeline of the actions is the following. Both outside investors and the BHC observe $C$ at the very beginning. Under each funding mode, investors present two compensation schemes for the BHC to pick. Investors observe the BHC’s choice, and form an ex-ante belief about the BHC’s ex-post monitoring action. Funds are provided according to this belief. After the asset is originated, the BHC decides whether to monitor the project. Finally, returns are realized, and the BHC chooses between defaulting or not. As in the benchmark, in the event of default, the BHC seizes a portion $\alpha$ of assets held on-balance sheet. The sequence of events is summarized in Figure 10.

**Definition of equilibrium** The equilibrium is defined as in Section 2.3 with an additional condition that in equilibrium the ex-ante belief must be consistent with the ex-post monitoring action.

Given this notion of equilibrium, there are three possible outcomes: (1) a monitoring equilibrium, where investors ex-ante expect the BHC to monitor, and it indeed monitors; (2) a no-monitoring equilibrium, where investors ex-ante expect the BHC to shirk, and it indeed shirks; and (3) no equilibrium, where investors’ ex-ante belief is not consistent with the BHC’s ex-post action.

The analysis centers on deriving conditions on the monitoring cost that must hold for each kind of outcome. There is a unique threshold level of monitoring cost below which the monitoring equilibrium exists. When the threshold is high, the economy can arrive at a monitoring equilibrium even when monitoring is costly, and vice versa. In the static benchmark model, I show how agency costs interact with monitoring decisions. Next, I introduce monitoring into the dynamic model and show that securitization reduces monitoring incentives.

**5.1 Static benchmark**

I first characterize the conditions for each outcome under deposit funding, and then repeat the analysis for securitization. To serve as a benchmark, the first-best cutoff level of the monitoring
cost in the absence of moral hazard in monitoring under deposit funding is given by:

\[
\hat{C}_{FB}^B = (\bar{\mu} - 1) - (\mu - 1) \frac{1 - \bar{L} + \alpha \bar{L}}{1 - \bar{L} + \alpha \bar{L}}.
\]

The right-hand-side is the total benefit of monitoring from the increases in both the unit expected profit and the achievable leverage.

Since monitoring is not verifiable, any compensation scheme designed to induce monitoring must alter payments contingent on the low-state return. The realization of the low-state return conveys precise information on the BHC’s monitoring action, i.e. if it turns out to be \( \bar{L} \), the BHC must have been monitoring, and otherwise it must not have been monitoring. The high-state return conveys no information regarding the BHC’s action. Therefore, the efficient compensation scheme to induce monitoring must satisfy the following conditions: (1) depositors get a non-contingent return if the BHC indeed monitors (given depositors’ infinite risk-aversion), and (2) conditional on the level of investment, the BHC’s expected payoff from monitoring is not lower than its payoff from shirking.

Therefore, in a monitoring equilibrium, the compensation scheme must take the following form:

\[
\omega^m = \begin{cases} 
H - \bar{L} + \alpha \bar{L} + \lambda & \text{if } H \text{ is realized,} \\
\alpha \bar{L} + \lambda & \text{if } \bar{L} \text{ is realized,} \\
\alpha L & \text{otherwise,}
\end{cases}
\]

where \( \omega \) is the BHC’s payoff, and the superscript \( m \) stands for monitoring. \( \lambda \) is a non-negative scalar capturing the compensation for the BHC’s cost of monitoring. The payoff when \( L \) is realized is the total value that the BHC can seize in a default.

In the no-monitoring equilibrium, investors do not need to compensate the bank for the monitoring cost, and the compensation scheme is simply

\[
\omega^{nm} = \begin{cases} 
H - L + \alpha L & \text{if } H \text{ is realized,} \\
\alpha L & \text{otherwise.}
\end{cases}
\]

where the superscript \( nm \) stands for no-monitoring.

With a sufficiently low \( C \) and the optimal \( \lambda \), the monitoring scheme is sufficient to induce ex-post monitoring. Therefore, if the bank chooses the optimal monitoring scheme, investors know for sure that the bank will indeed monitor. Otherwise, investors believe that the bank will shirk.

I use backward induction to first derive the optimal \( \lambda \) and then the threshold \( C \). Conditional on choosing the monitoring scheme and having originated the project, the optimal \( \lambda \) ensures that the bank would indeed monitor, by making the equilibrium expected profit equal to the off-equilibrium expected profit from shirking. The optimal \( \lambda \) is characterized as follows:
Lemma 6. In the monitoring scheme, the optimal $\lambda$ to induce ex-post monitoring is given by

$$\lambda = \max \left\{ 0, \frac{C}{1-q} - \alpha (\bar{L} - L) \right\}.$$

This lemma states that when $C \leq \alpha (1-q)(\bar{L} - L)$, the optimal $\lambda = 0$, i.e. when monitoring is sufficiently cost-less relative to its positive effect on the expected return, the bank monitors voluntarily. When $C > \alpha (1-q)(\bar{L} - L)$, extra compensation that materializes only in the good low state and the high state is needed to induce the bank to monitor.

Since $C$ is observable, outside investors offer the optimal $\lambda$ given $C$ and let the bank choose one compensation scheme. The bank chooses the monitoring scheme if the expected profit is no less than the expected profit from not monitoring. The comparison of the profits from the two schemes yields a threshold $C$ below which the bank chooses the monitoring scheme.

Lemma 7. (Threshold monitoring cost when only deposit funding is available) When only deposit funding is available, the economy arrives at a monitoring equilibrium if the monitoring cost is smaller than

$$\hat{C}^D = (1-q)(\bar{L} - L).$$

The economy follows the no-monitoring equilibrium when the monitoring cost is larger than $\hat{C}^D$.

One can check that $\hat{C}^D < \hat{C}_B^{FB}$. Because monitoring is non-contractible, investors must compensate the bank for monitoring, which reduces the bank’s leverage and hence the benefit of monitoring.

Now I repeat the analysis for the case of securitization. Again to serve as a benchmark, the first-best cutoff level of the monitoring cost in the absence of moral hazard in monitoring under securitization is given by:

$$\hat{C}_S^{FB} = (\bar{\mu} - 1) - (\mu - 1) \frac{1 - \bar{L} + \alpha (H - \bar{L})/(1-\alpha)}{1 - L + \alpha (H - L)/(1-\alpha)}.$$

Note that under securitization, the assets on-balance sheet are the reserves. In a monitoring equilibrium, the amount of reserves is $\frac{H - L}{1-\alpha}$. In the high state, the bank keeps all the reserves. In the low state with $\bar{L}$, the bank keeps $\alpha$ of them plus extra compensation $\lambda$ for monitoring. However, if the bank shirks and $L$ is realized, the bank has insufficient reserves and defaults on its guarantees. In this case, the BHC seizes $\alpha$ of the reserves set aside ex-ante. Therefore, the monitoring and shirking payoff schemes are given by:

$$\omega^m = \begin{cases} \frac{H - L}{1-\alpha} + \lambda & \text{if } H \text{ is realized}, \\ \alpha \frac{H - L}{1-\alpha} + \lambda & \text{if } \bar{L} \text{ is realized}, \\ \alpha \frac{H - L}{1-\alpha} & \text{otherwise}. \end{cases}$$

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Following the same analysis, one can easily derive the threshold monitoring cost under securitization.

**Lemma 8. (Threshold monitoring cost when only securitization is available)** When only securitization funding is available, the economy arrives at a monitoring equilibrium if the monitoring cost is smaller than

\[
\hat{C}_S = \frac{(\bar{\mu} - 1)(1 - \bar{L} + \alpha \frac{H - L}{1 - \alpha}) - (\mu - 1)(1 - \bar{L} + \alpha \frac{H - L}{1 - \alpha})}{(\bar{\mu} - 1)/(1 - q) + 1 - \bar{L} + \alpha \frac{H - L}{1 - \alpha}}.
\]

The economy follows the no-monitoring equilibrium when the monitoring cost is larger than \(\hat{C}_S\).

One can check that \(\hat{C}_S < \hat{C}_{FB}^S\). To determine the BHC’s incentives to monitor, I compare the threshold monitoring cost under the two funding modes in Lemma 7 and Lemma 8.

**Proposition 5. (Monitoring incentives in a static model)** The threshold level of monitoring cost under securitization is higher than under deposit funding, i.e. \(\hat{C}_S > \hat{C}_D\).

If we regard \(C\) as a stochastic variable that is revealed at the beginning of period 1, for any distribution of \(C\), the probability of a monitoring equilibrium is higher under securitization than under deposit funding. This result critically hinges on the assumption that monitoring only increases the low-state return. The monitoring action affects the profit of the BHC via two channels: (1) leverage and (2) agency costs. Under deposit funding, monitoring increases the low-state return and hence the leverage. However, the increase in the low-state return elevates agency costs. On the contrary, under securitization, monitoring increases the low-state return and reduces the associated agency cost. Therefore, the benefit of monitoring is greater under securitization than under deposit funding, giving the BHC more incentives to monitor. The result will be reversed in the dynamic setting, as I now show.

### 5.2 Dynamic framework

In the dynamic framework, the BHC can use its continuation value to commit to monitor, rather than relying on incentive payments. Contrary to the result in the state model, securitization induces less monitoring. Again to serve as a benchmark, the first-best cutoff level of the monitoring cost in the absence of moral hazard in monitoring irrespective of the funding mode is given by:

\[
\hat{C}_{FB} = (\bar{\mu} - 1) - (\bar{\mu} - 1) \frac{1 - \bar{L}}{1 - \bar{L}}.
\]
In the dynamic setting, the BHC’s payoff in the event of default is crucial for its incentives to monitor. Under deposit funding, if the bank shirks and the risky asset doesn’t yield enough return to fully repay depositors, the bank will default. Conditional on a level of investment determined ex-ante, in a default, the bank seizes $\alpha L$ per unit of investment. Meanwhile, if the bank monitors, its low state payoff is $\alpha \bar{L}$. Therefore, the monitoring action affects the BHC’s ex-post payoff in the low state.

On the contrary, under securitization, if the bank shirks, the reserves will not be sufficient to fully honor the guarantees. In a default, the bank seizes $\alpha R$ per unit of investment. Note that the size of reserves $R$ is determined ex-ante, and hence the BHC’s ex-post payoff in the low state is not affected by the monitoring action. Therefore, in the dynamic setting, the bank has less incentive to monitor securitized assets. This result is consistent with empirical fact (I).

Moreover, implicit guarantees further weaken the incentive to monitor. Intuitively, with implicit guarantees, failing to honor guarantee payments doesn’t trigger a legal default, which makes shirking more tempting. Therefore, the use of implicit guarantees further weakens monitoring incentives.

The relevant thresholds of the monitoring cost are summarized in the following proposition, which is derived in Appendix A.

**Proposition 6. (Monitoring incentives in a dynamic model)** Under deposit funding, the maximum monitoring cost in a monitoring equilibrium is given by $\hat{C}_B = \min \{ \hat{C}_{mh}^B, \hat{C}_{FB}^B \}$, where

$$\hat{C}_{mh}^B = \left[ \frac{\beta(1-q)}{1-\beta} (\bar{\mu} - 1) + \alpha (1-q)(\bar{L} - L) \right] / \left[ 1 + \frac{\beta(1-q)}{1-\beta} \right];$$

In securitization with explicit guarantees, it is given by $\hat{C}_{ex}^S = \min \{ \hat{C}_{ex,mh}^S, \hat{C}_{FB}^S \}$, where

$$\hat{C}_{ex,mh}^S = \left[ \frac{\beta(1-q)}{1-\beta} (\bar{\mu} - 1) \right] / \left[ 1 + \frac{\beta(1-q)}{1-\beta} \right];$$

In securitization with implicit guarantees, it is given by $\hat{C}_{im}^S = \min \{ \hat{C}_{im,mh}^S, \hat{C}_{FB}^S \}$, where $\hat{C}_{im,mh}^S$ is the solution to the following equation if $C \leq \hat{C}_B^S$:

$$\left( \frac{\hat{C}_{im}^S}{1-L} \right) = \frac{\beta(1-q)}{1-\beta} \left[ \frac{\bar{\mu} - 1 - \hat{C}_{im}^S}{1-L} - \frac{\bar{\mu} - 1 - \hat{C}_{im}^S}{1-L + \alpha L} \right];$$

or the solution to the following equation otherwise:

$$\left( \frac{\hat{C}_{im}^S}{1-L} \right) < \frac{\beta(1-q)}{1-\beta} \left[ \frac{\bar{\mu} - 1 - \hat{C}_{im}^S}{1-L} - \frac{\mu - 1}{1-L + \alpha L} \right].$$

Also $\hat{C}_{im,mh}^S < \hat{C}_{ex,mh}^S < \hat{C}_{mh}^S$, and hence $\hat{C}_{im}^S \leq \hat{C}_{ex}^S \leq \hat{C}_{B}^S$. 

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6 Tranching

This section explores the optimality of tranching versus securitization with guarantees in the presence of agency costs and imperfect information on asset quality. Securitization with guarantees suffers agency costs due to the need to hold reserves to honor guarantees. A way to avoid agency costs is to tranche the asset into a safe tranche and an equity tranche, and only sell the safe tranche. With this structure, there are no assets on-balance sheet for the bank to seize from investors, and therefore no default risk. However, as only pieces of the underlying assets are sold, it is harder for outside investors to identify the quality of the asset.

To allow for ex-ante asymmetric information on asset quality, I assume that there are two types of assets (a good type and a “lemon” type), and the origination bank has to pay to signal. With the advancement of information technology, arguably, the cost of signaling has been declining for all agents. Hence the relevant question to ask is: when is a universal signal credible enough to induce a separating equilibrium? The analysis focuses on the lower bound of the signaling cost above which a separating equilibrium exists. The result shows that this threshold is lower when assets are securitized in whole-piece, suggesting that a whole-piece has an advantage in overcoming adverse selection. This result is consistent with Farhi and Tirole (2015), who show that bundles encourage information-equalizing investments, and thereby facilitate trade. The trade-off between overcoming adverse selection and agency costs determines the optimal security design.

6.1 Setup

Each BHC has access to one asset, and the quality of the asset is revealed only to the bank before it raises funds. A good asset yields $H > 1$ in the high state and $L < 1$ in the low state, while a “lemon” yields the same in the high state but $L - \delta$ in the low state. Each BHC can send a positive signal at the same cost $C$ per unit of investment. After observing the signal, investors form beliefs and provide funds to the bank. For simplicity, I label a BHC with a good asset a “good bank”, and that with a “lemon” a “bad bank.” I impose the following necessary condition for both good and bad banks to signal:

$$C < qH + (1 - q)(L - \delta).$$

As investors are infinitely risk-averse, without loss of generality, I focus on pure strategy equilibria. As in most signaling problems, two types of equilibria may arise – pooling and separating. In a pooling equilibrium, both good and bad banks send signals. As investors can’t distinguish the “lemons”, out of risk aversion they provide funds as if all assets are “lemons.” In a separating equilibrium, only good banks send signals, and investors provide funds accordingly. In the following section, I characterize the range of signaling costs that support a separating equilibrium.


6.2 Signaling in securitization with guarantees

For a separating equilibrium to exist, two incentive compatibility constraints must be satisfied – one that ensures a bad bank would not signal, and one that ensures a good bank would signal.

Let \( \mu = qH + (1 - q)L \) denote the expected return on a good asset. The low-state return of a “lemon” is \( L - \delta \), and hence, conditional on a separating belief, the required unit reserve is \( \frac{1}{1 - \alpha} (H - L + \delta) \) if the bank does not signal. Therefore, conditional on a separating belief, the ex-ante pledgeable return of a bank that does not signal is \( L - \delta - \frac{\alpha}{1 - \alpha} (H - L + \delta) \). Hence, the equilibrium payoff of a bad bank that does not signal is given by:

\[
\pi_{eq}^b = \frac{A}{1 - L + \delta + \frac{\alpha}{1 - \alpha} (H - L + \delta)} [\mu - 1 - (1 - q)\delta]
\]

whereas the off-equilibrium payoff for a bad bank that signals is:

\[
\pi_{offeq}^b = \frac{A}{1 - L + \delta + \frac{\alpha}{1 - \alpha} (H - L + \delta)} [\mu - 1 - (1 - q)\delta - C].
\]

The incentive compatibility constraint to ensure that a bad bank does not signal is \( \pi_{eq}^b \geq \pi_{offeq}^b \), which yields the minimum signaling cost under whole-piece securitization for a separating equilibrium to exist:

\[
C^W = \left[ \mu - 1 - (1 - q)\delta \right] \frac{\delta}{1 - L + \frac{\alpha}{1 - \alpha} (H - L) + \frac{\delta}{1 - \alpha}}.
\]

Intuitively, the cost of signaling must be high enough to outweigh the benefit of signaling for a bad bank. In a separating equilibrium, signaling increases the level of investment by \( \frac{\delta}{1 - L + \frac{\alpha}{1 - \alpha} (H - L) + \frac{\delta}{1 - \alpha}} \), and each unit of investment generates a net profit of \( [\mu - 1 - (1 - q)\delta] \).

Similarly, in a separating equilibrium, the equilibrium payoff of a good bank that signals is:

\[
\pi_{eq}^g = \frac{A}{1 - L + \frac{\alpha}{1 - \alpha} (H - L)} [\mu - 1 - C];
\]

whereas the off-equilibrium payoff of a good bank that does not signal is

\[
\pi_{offeq}^g = \frac{A}{1 - L + \delta + \frac{\alpha}{1 - \alpha} (H - L + \delta)} [\mu - 1].
\]

The incentive compatibility constraint to ensure that a good bank indeed signals is \( \pi_{eq}^g \geq \pi_{offeq}^g \), which gives us the maximum signaling cost under whole-piece securitization for a separating equilibrium to exist:

\[
C^W = \left[ \mu - 1 \right] \frac{\delta}{1 - L + \frac{\alpha}{1 - \alpha} (H - L) + \frac{\delta}{1 - \alpha}}.
\]

Intuitively, for a good bank, the cost of signaling must be smaller than the benefit. In a
separating equilibrium, signaling increases the level of investment by $$\frac{\delta}{1-L+\frac{\alpha}{\sigma}H-L+\frac{1}{\sigma}}$$, and each unit of investment in the good asset generates net profits of $$[\mu - 1]$$.

It is easy to see that $$C^W > C^W$$, and any signaling cost between the two bounds can generate a separating equilibrium. The lower bound is of particular interest, since given the advancement of information technology, signaling is arguably becoming less costly for all agents in the economy, and hence fewer signals are effective. When faced with an overwhelming amount of information, investors are concerned with the credibility of cheap signals. The above analysis derives the range of signals that are credible.

6.3 Signaling in tranching

This section repeats the same exercise for tranching. Note that in tranching, no seizable assets are held on the bank entity’s balance sheet, and hence there is no agency cost. Under tranching, the bank sells a claim to the minimum return, the safe tranche, and keeps the residual return, the equity tranche, on-balance sheet. The price of the safe tranche of a good asset is $$L$$, and the price of that for a “lemon” is $$L - \delta$$. The levels of investment of a good and bad bank are given by $$\frac{A}{1-L}$$ and $$\frac{A}{1-L+\delta}$$.

In a separating equilibrium, the equilibrium payoff of a bad bank that does not signal is given by $$\pi^b_{eq} = \frac{A}{1-L+\delta} [\mu - 1 - (1-q)\delta]$$, whereas the off-equilibrium payoff is $$\pi^b_{offeq} = \frac{A}{1-L} [\mu - 1 - (1-q)\delta - C]$$. Using the incentive constraint $$\pi^b_{eq} \geq \pi^b_{offeq}$$, the minimum signaling cost that can generate a separating equilibrium under tranching is given by:

$$C^T = [\mu - 1 - (1-q)\delta] \frac{\delta}{1-L+\delta}$$.

Similarly, in a separating equilibrium, the equilibrium payoff of a good bank that signals is $$\pi^g_{eq} = \frac{A}{1-L} [\mu - 1 - C]$$, whereas the off-equilibrium payoff is $$\pi^g_{offeq} = \frac{A}{1-L+\delta} [\mu - 1]$$. Using the incentive compatibility constraint $$\pi^g_{eq} \geq \pi^g_{offeq}$$, we get the maximum signaling cost that can generate a separating equilibrium under tranching:

$$\overline{C}^T = [\mu - 1] \frac{\delta}{1-L+\delta}$$.

Again, it is obvious that $$\overline{C}^T > C^T$$, and any signaling cost between the two bounds can generate a separating equilibrium when assets are trached.

6.4 Optimal security structure

In this section, I first compare the range of signaling costs for a separating equilibrium under whole-piece securitization versus tranching, and then derive the condition under which tranching is optimal.
The impact of tranching on the separating range of signaling costs is determined by the differential effect of signaling on the level of investment. Signaling reduces adverse selection, whose magnitude is captured by \( \delta \). In tranching, given the absence of agency costs, adverse selection is the only friction that affects the BHC’s profit. As a result, signals have larger effects on profits under tranching, increasing the temptation for a bad bank to signal. In contrast, agency costs in whole-piece securitization reduce the benefit of signaling, thereby increasing the credibility of low-cost signals. Therefore, the minimum signaling cost must be higher under tranching to ensure that bad banks do not signal. Formally, one can show that \( C_T > C_W \). This result suggests that whole-piece securitization has an advantage in overcoming adverse selection when signaling is cheap.

When \( C \in (C^T, C^W) \), whole-piece securitization generates a separating equilibrium while tranching does not. In this region, the BHC’s expected profits from whole-piece securitization and tranching are given by

\[
\Pi^W = \frac{A}{1 - L + \frac{\alpha}{1 - \alpha} (H - L)} \left[ \mu - 1 - C \right]; \\
\Pi^T = \frac{A}{1 - L + \delta} [\mu - 1].
\]

Therefore, the condition for optimal tranching is as follows:

**Proposition 7.** *(The optimality of tranching)* If \( C \in (C^W, C^T) \), tranching is optimal when the return structure of the asset satisfies

\[
\frac{\alpha}{1 - \alpha} (H - L) > \frac{\mu - 1 - C}{\mu - 1} \delta - \frac{1 - L}{\mu - 1} C;
\]

For \( C \in [0, C^W] \cup [C^T, \infty) \), tranching is always optimal.

This result suggests that, tranching is the optimal security design when assets are similar ex-ante and risky ex-post (that is, \( \delta \) is low but \( (H - L) \) is high). Intuitively, when assets are more heterogeneous ex-ante, the cost of not being able to credibly signal one’s type is high, and therefore tranching is dominated by whole-piece securitization, which is more efficient in overcoming adverse selection. Conversely, when assets are highly risky, the high agency costs imposed by the use of guarantees render whole-piece securitization relatively unprofitable.

Relating this result to the shadow banking system prior to the recent financial crisis, I interpret the good and “lemon” assets as two types within a given category of asset. The return differential \( \delta \) captures the diversity of ex-ante individual asset quality within a category. The high- and low-state returns, \( H \) and \( L \), represent the average range of returns of good assets within the category. From the lens of this simple model, the perception that mortgage assets in general are risk-less and the introduction of subprime mortgages can fuel the use of whole-piece securitization with guarantees.
On one hand, the introduction of subprime mortgages enlarged $\delta$, making ex-ante asset quality in the mortgage-backed security market more heterogeneous. On the other hand, the booming housing market and the credit expansion made the return variability $(H - L)$ of prime mortgage assets very small. These two developments led to the above condition being violated, resulting in a preference for securitization with guarantees over tranching.

In practice, both securitization with guarantees and tranching exist in the shadow banking system. However, prior to the crisis, very few assets were completely tranched, especially the so-called equity tranches. These risky tranches were commonly insured to obtain an investment grade in order to be sold. Among all outstanding ABCPs, over 70% were covered by credit and liquidity guarantees (Acharya et al., 2013). This simple model explains why securitization with guarantees was prevalent prior to the crisis.

7 Conclusion

This paper offers an economic rationale for securitization based on minimizing moral hazard that can explain “securitization without risk transfer” and securitization by non-bank financial institutions. The paper builds a banking model with securitization and focuses on the moral hazard that insiders e.g. managers in financial institutions, have incentives to divert assets. This moral hazard can be generally interpreted as insiders’ incentives to engage in ex-post activities that benefit themselves but can hurt outside investors.

The paper shows that securitization can reduce this moral hazard by increasing the remoteness of assets from managers in financial institutions. Even when intermediaries provide guarantees and the resulting risk-sharing structures are equivalent under securitization and deposit funding, the magnitudes of the moral hazard are different under the two funding modes, thereby explaining securitization without risk transfer.

Under deposit funding, intermediaries hold assets on-balance sheet, and the moral hazard is greatest for low-risk assets that yield sizable returns in bad states. By contrast, under securitization, agency problems are most severe for high-risk assets that require large reserve holdings for guarantees. The agency-cost-reducing motive implies that banks securitize low-risk assets and hold high-risk assets on-balance sheet.

Introducing probabilistic government bailouts unveils a novel channel through which bailout expectations exacerbate the moral hazard and reduce total investment by creating a misalignment of incentives between outside investors and banks. This misalignment is especially large for high-risk assets if they are financed on-balance sheet. To reduce misalignment, banks securitize riskier assets. Government bailouts thus have the effect of inducing risk taking in securitization.

This agency cost perspective and the existing theories are not mutually exclusive, and all are likely to have played a role in the crisis. The agency cost perspective is able to explain some securitization behaviors that other theories cannot. More importantly, in the post-crisis era where
regulatory loopholes are, to some extent, closed down, the agency cost perspective is very likely to be a more relevant theory of securitization. The paper shows that, besides risk transfer and regulatory arbitrage, moral hazard also plays an important role in affecting securitization decisions. In particular, when the chance of getting government bailouts is sufficiently high, banks securitize riskier assets. To ensure financial stability, policy makers must go beyond capital requirements and address the reserve requirements for guarantees.

The paper also discusses the implications of different forms of guarantees. With explicit guarantees, banks securitize assets with either low information-intensity or low risk. By contrast, with implicit guarantees, banks only securitize assets with high information-intensity and low risk. The use of guarantees reduces the dependence of banks’ ex-post payoff on monitoring actions, weakening the monitoring incentive.

The discussion of tranching versus securitization with guarantees explains the prevalence of securitization with guarantees prior to the crisis. When mortgage assets are sufficiently heterogeneous ex-ante (the introduction of subprime mortgages), and the prime ones are perceived to be sufficiently safe ex-post (booming housing market and low interest rate), securitization with guarantees dominates.

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**Appendix A**

**Corollary 1**

*Proof.* From Proposition 1, securitization strictly dominates if

\[
\alpha_S \frac{H - L}{1 - \alpha_S} < \alpha_B L.
\]

Assuming \(\alpha_S = \alpha_B\), the above condition becomes

\[
\frac{H - L}{1 - \alpha} < L,
\]
which yields the threshold

\[ \alpha < \alpha_0 = 2 - H/L. \]

The monotonicity follows from above equation. \qed

**Corollary 2**

*Proof.* Let \( \mu \) and \( \sigma \) denote the expectation and the standard deviation of the binomial distribution. It is easy to get

\[ H = \mu + \sigma \sqrt{\frac{1-q}{q}}, \]
\[ L = \mu - \sigma \sqrt{\frac{q}{1-q}}. \]

The expression for \( \alpha_0 \) follows. \qed

**Lemma 2**

*Proof.* From the condition \( H - L < \alpha H \), one can get the threshold

\[ \alpha_1^{DH} = 1 - \frac{L}{H}. \]

From (16) and (17), the threshold information intensity in the two cases are respectively and hence the threshold

\[ \alpha_1^H = \frac{\beta}{1-\beta} \left[ E(x) - 1 \right] \frac{1}{H}, \]
\[ \alpha_1^L = \frac{\beta}{1-\beta} \left[ E(x) - 1 \right] \frac{1}{L}. \]

Therefore, if \( \alpha \in ((0, \alpha_1^{DH}) \cap (0, \alpha_1^L)) \cup (\alpha_1^{DH}, 1) \cap (0, \alpha_1^H), \) the bank can credibly commit. Since \( \alpha_1^L > \alpha_1^H \), this range is equivalent to a region with a unique threshold \( \alpha_1 \) given by

\[ \alpha_1 = \min \left\{ \max \{\alpha_1^{DH}, \alpha_1^H\}, \alpha_1^L \right\}. \]

The monotonicity follows from above equations. \qed

**Lemma 3**

*Proof.* From (18), it is easy to see that the threshold information intensity is given by

\[ \alpha_2 = \frac{\beta}{1-\beta} \left[ E(x) - 1 \right] \frac{1}{H-L}. \]
The monotonicity follows from above equation.

**Proposition 3**

Proof. With implicit guarantees, the ex-post incentive compatibility constraint is given by

\[(H - L)X^{FB} \leq \beta \left( V^{FB} - V^B_d \right), \]

where \(V^B_d = \frac{1}{1 - \beta} \cdot \frac{A}{1 - L + \alpha L} \left[ \mathbb{E}(x) - 1 \right] \) and \(V^{FB} = \frac{1}{1 - \beta} \cdot \frac{A}{1 - L} \left[ \mathbb{E}(x) - 1 \right]. \) This condition can be written as

\[(H - L) \frac{A}{1 - L} \leq \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \cdot \left[ \frac{A}{1 - L} - \frac{A}{1 - L + \alpha L} \right], \]

which is equivalent to

\[\frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \cdot \frac{A}{1 - L} - (H - L) \frac{A}{1 - L} \geq \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \cdot \frac{A}{1 - L + \alpha L}. \]

The LHS can be written as

\[\frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \cdot \frac{A}{1 - L + \phi S}, \]

where

\[\phi S = \frac{H - L}{1 - \beta} \cdot \frac{\mathbb{E}(x) - 1}{1 - L} \cdot \frac{H - L}{1 - \beta} = \frac{R(1 - L)}{\beta V^{FB} - R}. \]

If \(\alpha L \geq \phi S, \) the ex-post incentive compatibility constraint holds and the BHC can commit. Therefore, the threshold \(\alpha_{IM} \) is given by \(\alpha_{IM} = \phi S / L. \)

\[\frac{\partial \alpha_{IM}}{\partial H} \geq 0 \text{ and } \frac{\partial \alpha_{IM}}{\partial L} \leq 0 \text{ follow from the above equations.} \]

**Lemma 4**

Proof. ICCH can be written as

\[\alpha H \frac{A}{1 - L} \leq \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \cdot \left[ \frac{A}{1 - L} - \phi \frac{A}{1 - L + \alpha L} \right], \]

from which one can get

\[\alpha^H = \phi \left[ \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{L}{H} - 1 + L \right] \frac{1}{L} + (1 - \phi) \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{H}. \]

Similarly, ICCL can be written as

\[\alpha L \frac{A}{1 - L} \leq \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \cdot \left[ \frac{A}{1 - L} - \phi \frac{A}{1 - L + \alpha L} \right], \]
from which one can get
\[
\alpha_1^L = \phi \left[ \frac{\beta}{1 - \beta} \left( \mathbb{E}(x) - 1 \right) - 1 + L \right] \frac{1}{L} + (1 - \phi) \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{L}.
\]

If \( \alpha \in ((0, \alpha_1^{DH}) \cap (0, \alpha_1^L)) \cup (\alpha_1^{DH}, 1) \cap (0, \alpha_1^H) \), the bank entity can commit. Since \( \alpha_1^L > \alpha_1^H \), the threshold information intensity is given by
\[
\alpha_1 = \min \left\{ \max \{\alpha_1^{DH}, \alpha_1^H\}, \alpha_1^L \right\}.
\]

\[\square\]

Lemma 5

Proof. ICCS can be written as
\[
\alpha (H - L) X_{FB} \leq \phi \beta \left( V_{FB} - \max \{V_d^S, V_d^B\} \right) + (1 - \phi) \beta V_{FB}
\]

Hence, the threshold \( \alpha_2^B \) is a linear combination of the thresholds from the following two conditions:
\[
\begin{align*}
\alpha (H - L) X_{FB} & \leq \beta V_{FB}, \\
\alpha (H - L) X_{FB} & \leq \beta \left( V_{FB} - \max \{V_d^S, V_d^B\} \right).
\end{align*}
\]

The first condition yields
\[
\alpha_2^{con1} = \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{H - L}.
\]

The second condition yields
\[
\alpha_2^{con2} = \min \left\{ \alpha_2^S, \alpha_2^D \right\},
\]
where
\[
\begin{align*}
\alpha_2^S &= \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{L}{H - L} - (1 - L), \\
\alpha_2^D &= \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{L}{H - L} - (1 - L).
\end{align*}
\]

The threshold \( \alpha_2^B \) is given by
\[
\begin{align*}
\alpha_2^B &= \phi \alpha_2^{con2} + (1 - \phi) \alpha_2^{con1}, \\
&= \phi \min \left\{ \alpha_2^S, \alpha_2^D \right\} + (1 - \phi) \frac{\beta}{1 - \beta} \left[ \mathbb{E}(x) - 1 \right] \frac{1}{H - L}.
\end{align*}
\]
Corollary 3

Proof. \( \alpha^L_1 = \phi \left[ \frac{\beta}{1-\beta} \left( \mathbb{E}(x) - 1 \right) - 1 + L \right] \frac{1}{L} + (1 - \phi) \frac{\beta}{1-\beta} \left( \mathbb{E}(x) - 1 \right) \frac{1}{L} \).

\[
\therefore \frac{\partial \alpha^L_1}{\partial \sigma} = \phi \left[ \frac{\beta}{1-\beta} \left( \mu - 1 \right) \sqrt{\frac{q}{1-q}} \right] - \left( 1 - \phi \right) \frac{\beta}{1-\beta} \left( \mu - 1 \right) \sqrt{\frac{q}{1-q}} + \left( 1 - \phi \right) \frac{\beta}{1-\beta} \left( \mu - 1 \right) \sqrt{\frac{q}{1-q}}.
\]

Lemma 6

Proof. After the asset is originated, the level of investment is fixed from the BHC’s perspective. Using the monitoring compensation scheme, the expected return of a bank who chooses the monitoring scheme and indeed monitors is

\[
\pi^m_{eq} = \left[ q \left( H - \bar{L} + \alpha \bar{L} + \lambda \right) + (1 - q) \left( \alpha \bar{L} + \lambda \right) - C \right] X_B - A,
\]

whereas that of a bank who chooses the monitoring scheme but shirks is

\[
\pi^m_{offeq} = \left[ q \left( H - \bar{L} + \alpha \bar{L} + \lambda \right) + (1 - q) \alpha \bar{L} \right] X_B - A.
\]

To induce the bank entity to indeed monitor after choosing the monitoring scheme, the following condition must hold

\[
\pi^m_{eq} \geq \pi^m_{offeq}.
\]

Therefore, the optimal non-negative incentive payment \( \lambda \) is given by

\[
\lambda = \max \left\{ 0, \frac{C}{1-q} - \alpha (L - \bar{L}) \right\}.
\]
Lemma 7

Proof. Conditional on investors’ belief in a monitoring equilibrium, investors’ payoff per unit of investment is \((1 - \alpha)\bar{L} - \lambda\). Hence, the level of investment is then given by

\[
X_B = \frac{A}{1 - \bar{L} + \alpha \bar{L} + \lambda}.
\]

The expected return of a bank who chooses the monitoring scheme and indeed monitors is given by

\[
\pi^m_{eq} = \frac{A}{1 - \bar{L} + \alpha \bar{L} + \frac{C}{1 - q}}[\bar{\mu} - 1 - C].
\]

The bank compares \(\pi^m_{eq}\) with the expected return from the shirking equilibrium given by

\[
\pi^s_{eq} = \frac{A}{1 - \bar{L} + \alpha \bar{L}}[\mu - 1].
\]

The bank would choose the monitoring scheme, if \(\pi^m_{eq} \geq \pi^s_{eq}\). Therefore, in a monitoring equilibrium, the following must hold

\[
\frac{A}{1 - \bar{L} + \alpha \bar{L} + \frac{C}{1 - q}}[\bar{\mu} - 1 - C] \geq \frac{A}{1 - \bar{L} + \alpha \bar{L}}[\mu - 1],
\]

which is equivalent to

\[
C \leq \hat{C}^D_1 = \frac{(\bar{\mu} - 1)(1 - \bar{L} + \alpha \bar{L}) - (\mu - 1)(1 - \bar{L} + \alpha \bar{L})}{(\bar{\mu} - 1)/(1 - q) + 1 - \bar{L} + \alpha \bar{L}} = (1 - q)(\bar{L} - L).
\]

Using the shirking scheme, the expected return of a bank that chooses the shirking scheme and indeed shirks is

\[
\pi^s_{eq} = [q(H - \bar{L} + \alpha \bar{L}) + (1 - q)\alpha \bar{L}]X_B - A,
\]

whereas that of a bank who chooses the shirking scheme but monitors is

\[
\pi^s_{offeq} = [q(H - \bar{L} + \alpha \bar{L}) + (1 - q)(\bar{L} - (1 - \alpha)\bar{L}) - C]X_B - A.
\]

To ensure that the bank indeed shirks in the shirking equilibrium, the shirking equilibrium payoff must be no less than the off-equilibrium payoff. Hence, the following condition must hold

\[
\pi^s_{eq} \geq \pi^s_{offeq},
\]

which is equivalent to

\[
(1 - q)\alpha \bar{L} \geq (1 - q)(\bar{L} - (1 - \alpha)\bar{L}) - C.
\]
Therefore, the minimum level of monitoring cost in a shirking equilibrium is

$$\hat{C}_2^D = (1 - q)(\bar{L} - L) = \hat{C}_1^D$$

Therefore, for any monitoring cost below $\hat{C}_2^D = \hat{C}_1^D = \hat{C}^D$, the economy will arrive at a monitoring equilibrium. $\square$

**Lemma 8**

*Proof.* After the asset is originated, the level of investment $X_S$ and the reserves $R = \frac{H - \bar{L}}{1 - \alpha}$ are fixed from the BHC’s perspective. Using the monitoring compensation scheme, the expected return of an SPV who chooses the monitoring scheme and indeed monitors is

$$\pi_{eq}^m = [q (R + \lambda) + (1 - q) (\alpha R + \lambda) - C] X_S - A,$$

whereas that of an SPV who chooses the monitoring scheme but shirks is

$$\pi_{off eq}^m = [q (R + \lambda) + (1 - q) \alpha R] X_S - A.$$

To induce the SPV to indeed monitor after choosing a monitoring scheme, the following condition must hold

$$\pi_{eq}^m \geq \pi_{off eq}^m.$$

Therefore, the optimal incentive payment $\lambda$ is given by

$$\lambda = \frac{C}{1 - q}.$$

Conditional on investors’ belief in a monitoring equilibrium, the BHC sets aside safe reserves in the amount of $R = \frac{H - \bar{L}}{1 - \alpha}$ per unit of investment. Hence, the level of investment is then given by

$$X_S = \frac{A}{1 - \bar{L} + \alpha \frac{H - \bar{L}}{1 - \alpha} + \lambda}.$$

The expected return of an SPV who chooses the monitoring scheme and indeed monitors is given by

$$\pi_{eq}^m = \frac{A}{1 - \bar{L} + \alpha \frac{H - \bar{L}}{1 - \alpha} + \frac{C}{1 - q}} [\bar{\mu} - 1 - C].$$

The bank compares $\pi_{eq}^m$ with the expected return from the shirking equilibrium given by

$$\pi_{eq}^s = \frac{A}{1 - \bar{L} + \alpha \frac{H - \bar{L}}{1 - \alpha}} [\mu - 1].$$
The bank would choose the monitoring scheme, if $\pi^{eq}_{m \leq q} \geq \pi^{eq}_{s \leq q}$. Therefore, in a monitoring equilibrium, the following must hold

$$\frac{A}{1 - L + \alpha \frac{H - L}{1 - \alpha} + \frac{C}{1 - q}} [\bar{\mu} - 1 - C] \geq \frac{A}{1 - L + \alpha \frac{H - L}{1 - \alpha}} [\hat{\mu} - 1] ,$$

which is equivalent to

$$C \leq \hat{C}^{S} = \frac{(\bar{\mu} - 1)(1 - L + \alpha \frac{H - L}{1 - \alpha}) - (\mu - 1)(1 - L + \alpha \frac{H - L}{1 - \alpha})}{(\bar{\mu} - 1)(1 - q) + 1 - L + \alpha \frac{H - L}{1 - \alpha}} > (1 - q)(\bar{L} - L).$$

Using the shirking scheme, the expected return of a bank that chooses the shirking scheme and indeed shirks is

$$\pi^{s}_{eq} = \left[ q \left( \frac{H - L}{1 - \alpha} \right) + (1 - q) \alpha \frac{H - L}{1 - \alpha} \right] X_{S} - A,$$

whereas that of a bank who chooses the shirking scheme but monitors is

$$\pi^{s}_{offeq} = \left[ q \left( \frac{H - L}{1 - \alpha} \right) + (1 - q) \left( \frac{H - L}{1 - \alpha} - (H - \bar{L}) \right) - C \right] X_{S} - A.$$

The bank would indeed shirk in the shirking equilibrium if $\pi^{s}_{eq} \geq \pi^{s}_{offeq}$. Hence,

$$(1 - q)\alpha \frac{H - L}{1 - \alpha} \geq (1 - q) \left( \frac{H - L}{1 - \alpha} - (H - \bar{L}) \right) - C.$$

Therefore, the minimum level of monitoring cost in a shirking equilibrium is

$$\hat{C}^{S}_{2} = (1 - q)(\bar{L} - L).$$

Since $\hat{C}^{S}_{1} > \hat{C}^{S}_{2}$, for any monitoring cost below $\hat{C}^{S}_{2}$, the economy will arrive at a monitoring equilibrium.

**Proposition 5**

**Proof.** Since $\hat{C}^{S}_{2} = (1 - q)(\bar{L} - L)$ and $\hat{C}^{S}_{1} > \hat{C}^{S}_{2}$, $\hat{C}^{S} > \hat{C}^{D} = (1 - q)(\bar{L} - L).$

**Proposition 6**

**Proof.** In the static model, the equilibrium type relies on incentive payment $\lambda$. In the dynamic setup, the bank can use its franchise value to commit instead of relying on $\lambda$.

I first derive the threshold monitoring cost under deposit funding. Conditional on an ex-ante belief that the bank entity will monitor ex-post, if the bank entity indeed monitors, its low-state return is $\alpha \bar{L}$. However, if the bank entity shirks ex-post, the risky asset yields a rate of return
$L$, and the bank entity would fail to repay depositors in full, which constitutes a default. In the event of default, the bank entity seizes $\alpha L$. Therefore, the bank entity's ex-post low-state return depends on its monitoring action.

The one-time unit gain from shirking is the monitoring cost minus the return difference, i.e. $C - \alpha (1 - q)(\bar{L} - L)$. After a default, the bank loses its franchise value. Therefore, the incentive compatibility constraints under deposit funding are as follow:

\[
\frac{C - \alpha (1 - q)(\bar{L} - L)}{1 - L} \leq \frac{\beta (1 - q)}{1 - \beta} \cdot \frac{\bar{\mu} - 1 - C}{1 - L} \quad \text{if } \alpha < \bar{\alpha}^B, \tag{20}
\]
\[
\frac{C - \alpha (1 - q)(\bar{L} - L)}{1 - L + \alpha L} \leq \frac{\beta (1 - q)}{1 - \beta} \cdot \frac{\bar{\mu} - 1 - C}{1 - L + \alpha L} \quad \text{otherwise}, \tag{21}
\]

where $\bar{\alpha}^B = \frac{\bar{\beta} \cdot \bar{\mu} - 1 - C}{1 - \bar{\beta}}$. When $\alpha < \bar{\alpha}^B$, the level of investment is $\frac{A}{1 - L}$. Otherwise, investment is $\frac{A}{1 - L + \alpha L}$. Condition (20) and (21) lead to a unique threshold level of $C$ as

\[
\hat{C}^B = \left[ \frac{\beta (1 - q)}{1 - \beta} (\bar{\mu} - 1) + \alpha (1 - q)(\bar{L} - L) \right] / \left[ 1 + \frac{\beta (1 - q)}{1 - \beta} \right].
\]

The economy arrives at the monitoring equilibrium only when the monitoring cost is lower than $\hat{C}^B$.

I now turn to characterize the threshold monitoring cost in securitization with explicit guarantees. Under securitization, the amount of reserves $R$ is determined ex-ante by outside investors’ belief. If the BHC monitors, it gets $\alpha R$ in the low state. If the BHC shirks, it will not have enough reserves to fully honor guarantees, and hence would default in the low state. In the event of default, the BHC seizes $\alpha R$. Therefore, the BHC’s ex-post low-state return is independent of the monitoring action, and the one-time unit gain from shirking is simply $C$. The incentive compatibility constraints under securitization with explicit guarantees are as follow:

\[
\frac{C}{1 - L} < \frac{\beta (1 - q)}{1 - \beta} \cdot \frac{\bar{\mu} - 1 - C}{1 - L} \quad \text{if } \alpha < \bar{\alpha}^S, \tag{22}
\]
\[
\frac{C}{1 - L + \frac{\alpha}{1 - \alpha} (H - L)} < \frac{\beta (1 - q)}{1 - \beta} \cdot \frac{\bar{\mu} - 1 - C}{1 - L + \frac{\alpha}{1 - \alpha} (H - L)} \quad \text{otherwise}, \tag{23}
\]

where $\bar{\alpha}^S = \frac{\bar{\beta} \cdot \bar{\mu} - 1 - C}{1 - \bar{\beta} - \frac{\alpha}{1 - \alpha} (H - L)}$. When $\alpha < \bar{\alpha}^S$, the level of investment is $\frac{A}{1 - L}$. Otherwise, investment is $\frac{A}{1 - L + \frac{\alpha}{1 - \alpha} (H - L)}$. Condition (22) and (23) lead to a unique threshold monitoring cost in securitization as

\[
\hat{C}^S_{\text{ex}} = \left[ \frac{\beta (1 - q)}{1 - \beta} (\bar{\mu} - 1) \right] / \left[ 1 + \frac{\beta (1 - q)}{1 - \beta} \right].
\]

Finally, I derive the threshold monitoring cost under securitization with implicit guarantees. Since guarantees are implicit, the BHC is not legally obligated to honor them ex-post. After a “default” on its guarantees, the BHC continues to operate as a discredited bank entity. Conditional
on having promised to monitor the SPV asset, if the BHC shirks, with probability \(1 - q\), it runs short of reserves and would default and seize \(\alpha R\). Since the BHC's ex-post low-state return is independent of the monitoring action, and the one-time unit gain from shirking is simply \(C\).

If \(C \leq \hat{C}^B\), the continued bank entity would monitor its asset, and the corresponding incentive compatibility constraint is

\[
\frac{C}{1 - L} < \frac{\beta (1 - q)}{1 - \beta} \left[ \frac{\mu - 1 - C}{1 - L} - \frac{\bar{\mu} - 1 - C}{1 - L + \alpha L} \right] \quad \text{if } \alpha > \alpha_{IM}; \quad (24)
\]

If \(C > \hat{C}^B\), the continued bank entity would not monitor, and the corresponding incentive compatibility constraint is

\[
\frac{C}{1 - L} < \frac{\beta (1 - q)}{1 - \beta} \left[ \frac{\bar{\mu} - 1 - C}{1 - L} - \frac{\mu - 1}{1 - L + \alpha L} \right] \quad \text{if } \alpha > \alpha_{IM}, \quad (25)
\]

where \(\alpha_{IM} = \frac{(H - L)/L}{\frac{\alpha}{1 - \alpha} + \frac{1 - \alpha}{1 - \alpha}}\). As the second term in the square bracket is positive in both (24) and (25), the threshold of monitoring cost with implicit guarantees, in either case, is smaller than that in securitization with explicit guarantees.

Therefore, we have \(\hat{C}^S_{im} < \hat{C}^S_{ex} < \hat{C}^B\).

\[\Box\]

**Proposition 7**

*Proof.* Tranching is optimal when \(\Pi^T > \Pi^W\). For \(C \in (C^W, C^T)\),

\[
\Pi^W = \frac{A}{1 - L + \frac{\alpha}{1 - \alpha} (H - L)} [\mu - 1 - C];
\]

\[
\Pi^T = \frac{A}{1 - L + \delta} [\mu - 1].
\]

It is easy to see that tranching is optimal if

\[
\frac{\alpha}{1 - \alpha} (H - L) > \frac{\mu - 1 - C}{\mu - 1} \delta - \frac{1 - L}{\mu - 1} C.
\]

\[\Box\]
Appendix B

Figure 11: Map of optimal funding modes and the probability of bailouts

Note that $\phi$ is the probability of getting a government bailout conditional on a default. The dark gray region is where the BHC is indifferent between deposit funding and securitization. The light gray region is where securitization is strictly preferred. The white region is where deposit funding is strictly preferred. As the probability of getting a government bailout increases, the lower bound of the region where securitization is strictly preferred becomes downward sloping.