Equity allocation and risk-taking in the intermediation chain

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Abstract

We build an equilibrium model of the capital structure and risk-taking in the originate-to-distribute intermediation chain in presence of absolute demand for safety by some investors and limited endowment by equity investors. Loan originators may expand investment by raising funds from intermediaries that diversify idiosyncratic risks to create safe securitized assets. Equity funding allows originators to improve their risk-taking incentives and intermediaries to absorb losses from their exposure to aggregate risk. The competitive allocation of equity renders the equilibrium Pareto constrained efficient. Consistent with the saving glut narrative of the expansion of securitization in the run-up to the crisis, an increase in the demand for safety leads to increases in the overall equity invested in intermediaries, the relative size of the intermediary sector and risk-taking at origination. Government policies that include fiscally neutral guarantees to the issuance of securitized assets lead to Pareto improvements in the economy, have ambiguous risk-taking effects at origination, and are preferable to guarantees to originators because of intermediaries' higher exposure to aggregate risk.

JEL Classification: G01, G20, G28

Keywords: capital structure, risk-taking, originate-to-distribute, diversification, spreads, saving glut

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1 Introduction

Financial intermediation has changed from an originate-to-hold model to an originate-to-distribute model in the last decades. There is a common view that an important driver for this transformation has been an increase in the demand for safe assets observed since the 2000s (Bernanke (2005), Bernanke et al. (2011)). Under the traditional originate-to-hold model, a single entity (a bank) originates the loans to borrowers, holds them in its balance sheet and finances them with deposits placed to investors. The modern originate-to-distribute intermediation model features different institutions along a larger chain (Brunnermeier (2009), Pozsar et al. (2013), Cetorelli and Peristiani (2012)). The institutions that originate loans (e.g. commercial banks, mortgage issuers) finance their lending by distributing some of their assets to other financial intermediaries (e.g. investment banks, securitization conduits). By pooling the idiosyncratic risks in the originators' assets, these intermediaries are able to create new safe securities that are are sold to meet the demand by end investors.

Bank's equity used to play a key role in the traditional intermediation chain both as a loss-absorption buffer that protects creditors and as a form of skin-in-the game that limits excessive risk-taking. The importance of financial firms' equity has nevertheless not vanished in the modern intermediation chain. The originators' equity helps to align their risk-taking incentives with those of the intermediaries onto which part of the risk is transferred.[1] The intermediaries' equity provides the credit enhancement necessary to absorb the losses resulting from the non-diversifiable part of the risk in the originators' assets.[2] This paper addresses the questions: What shapes the equity allocation along the different financial firms in the intermediation chain? How does the equity allocation affect risk-taking at origination? Does competition lead to an efficient equity allocation? How can a government with some safe assets improve welfare in the economy?

This paper develops a competitive equilibrium model of the originate-to-distribute intermediation chain. The model features absolute demand for safety by some investors and limited endowment by equity investors. The capital structure and risk-taking of loan origi-

[1]See Ashcraft et al. (2008) for a description of the key agency frictions that appear between the different agents in the intermediation chain.

[2]An example of such equity like securities are the junior tranches in securitization structures that are first to absorb the losses from the underlying pool of loans.

nators and intermediaries that engage in securitization, the expected returns of the funding sources, aggregate lending and the amount of securitized assets are all determined in equilibrium. In particular, the equity allocation along the chain is endogenous and in equilibrium trades-off the gains from improving risk-taking incentives at origination with those from an expansion of safe securitized assets.

The paper makes three main contributions to the existing literature. First, it provides a simple yet rich framework to understand the financial architecture of the securitization process in a competitive equilibrium environment whose empirical predictions are consistent with the saving glut narrative of the run-up to the Global Financial Crisis. Second, it describes the non-trivial welfare implications across investors associated with the emergence of securitization and emphasizes the importance of a frictionless allocation of equity along the intermediation chain for the constrained efficiency of the economy. Third, it finds that when a government has safe resources, fiscally neutral public guarantees to the issuance of securitized assets reduce the scarcity of safe securities in the economy, and lead to Pareto improvements in welfare if properly combined with lump-sum transfers across investors' types. Besides, these policies are preferrable to the introduction of guarantees to the issuance of safe securities by originators because of the higher exposure of intermediaries' assets to aggregate risk, and their effects on risk-taking at origination are ambiguous.

We model a two date competitive economy with two types of investors: savers and experts. Investors have one unit of endowment at the initial date, derive linear utility from consumption at either date and have a zero discount rate. Aggregate endowment is normalized to one. Savers have absolute preference for safety so that their measure determines the demand for safety in the economy.[3] Experts are skilled agents that can set-up and invest their wealth in the equity of one out of two financial firms: originators and intermediaries. Originators can issue loans under a constant returns to scale technology. The expert managing an originator can monitor the loans in order to increase the probability that they yield a high return. Monitoring is not contractible and involves a convex disutility cost for the expert, which leads to a moral hazard problem as in Holmstrom and Tirole (1997). Originators can expand lending and increase their equity return by issuing both non-contingent securities (*safe securities*) and contingent securities (*risky securities*) that are placed to savers and

[3]This assumption has been used, e.g., in Gennaioli et al. (2013).

intermediaries, respectively. Intermediaries, which are the other type of financial firm that experts can set-up and invest in, purchase the risky securities issued by many originators. Intermediaries have access to a “pooling” technology that allows them to diversify away the originators’ idiosyncratic risks and create additional securitized safe assets that can, in turn, be placed to savers. The “manufacturing” of new safe securities allows intermediaries to expand their balance sheets by purchasing more risky securities from originators, and to increase the return on their equity. The presence of aggregate risk that cannot be diversified imposes a maximum leverage constraint on intermediaries, as the equity provided by the expert needs to provide sufficient credit enhancement to ensure the safety of the securitized assets sold to savers.

Experts’ equity investment in the intermediation chain serves two different purposes. At origination, it provides experts skin-in-the game that increases their incentives to monitor the loans. The design of the risky security that is distributed to intermediaries thus trades-off the the gains from expanding lending (and increasing effective leverage) and the costs from more risk-taking as monitoring incentives get reduced. The cheaper the funding from intermediaries, the larger the part of its loan payoffs that the originator sells to intermediaries, increasing both originators’ leverage and their risk-taking. At intermediation, the expert’s equity is a cushion for aggregate risk losses. In equilibrium, free entry of experts induces the return of originators and intermediaries’ equity to be equal, so that experts’ choice ends-up trading off the risk-taking gains at origination and the diversification benefits at intermediation. Experts’ frictionless capability to allocate their skills and funds between originators and intermediaries and the existence of competitive markets for safe and risky securities ensure the validity of constrained versions of the welfare theorems. The competitive equilibrium of the economy is constrained Pareto efficient and any allocation in the constrained Pareto frontier can be achieved as the competitive equilibrium of the economy following some redistribution of wealth across investors’ types at the initial date.

The demand for safety in the economy, which is measured by the savers’ share of wealth, determines when securitization emerges. If demand for safety is low, originators’ capability to create safe securities directly from their loans is sufficient for the market for safe securities to clear at a high return that is equal to the return on originator’s equity. With a zero equity spread, incentives to expand the supply of safe assets through securitization are absent and intermediaries do not enter the economy. The risky part of originated loans is entirely held at originators and risk-taking is minimum. If the demand for safety is higher, the originators' capability to issue safe securities is not sufficient to keep the safe rate at its maximum level. Safe securities become scarce, the safe rate falls and a positive equity spread arises, which gives experts incentives to set-up intermediaries to exploit it. In fact, intermediaries can purchase risky securities from originators and resell their securitized safe tranche to savers who require a low rate, delivering a high equity return. Equity is thus reallocated from originators to intermediaries, and the distribution of risky securities out of originators leads to more risk-taking.

As the demand for safety keeps on increasing, the safe rate falls further. The widening equity spread, allows intermediaries to increase leverage and also leads experts to reallocate their funds and skills from originators to intermediaries. With higher leverage and overall equity, the intermediary sector expands. At the same time, the cheap financing offered by intermediaries leads originators to increase the risky part of their loans that is distributed, which increases their leverage but also leads to more risk-taking. Summing up: following an increase in the demand for safety, the model predicts a securitization boom, an increase in leverage along the intermediation chain and more risk-taking, and thus provides a single framework capturing the main features emphasized by the saving glut narrative of the run-up to the crisis.

We analyze the welfare implications of the emergence of securitization by comparing the utility of investors in the originate-to-distribute economy relative to that in a traditional originate-to-hold benchmark. Securitization involves the distribution by originators of risky securities that are pooled by intermediaries to expand safe securities supply, which leads to the following general welfare trade-off. On the one hand, the distribution of risks out of originators leads them to take more risk, which reduces aggregate surplus. On the other hand, the expansion of safe securities supply increases aggregate lending when the safe rate in the traditional economy is so low that not all the savers' endowment is channeled to finance loans, which increases aggregate surplus. We find that the aggregate lending effect on total surplus dominates if and only the demand for safety is sufficiently large. Besides, the modern intermediation chain always (weakly) increases the welfare of savers because securitization expands the supply of safe securities, which constitute their only investment opportunity. In contrast, experts' welfare gets reduced because of securitization when demand for safety is not too large. In these cases, the possibility for experts to engage in securitization leads to more competition in the supply of safe securities and ends up depriving experts of some of the scarcity rents they enjoyed in the traditional financial sector.

We finally extend the model to consider a risk-neutral government with some safe assets and analyze whether and how fiscally neutral public guarantees to the issuance of safe securities by financial firms can improve welfare. Financial firms compensate the government for the guarantees granted by paying a tax on profits. Given that originators' loans are exposed to both aggregate and idiosyncratic risk while intermediaries' assets are only exposed to aggregate risk, the *net* injection of funds by the government following negative aggregate shocks is larger when only guarantees to intermediaries are issued. Guarantees to intermediaries thus maximize the capability of the economy to issue safe securities, and are thus preferrable. We then show that the issuance of guarantees to intermediaries always leads to an increase in the safe rate and welfare gains to the savers. When demand for safety is so large that the economy is not able to achieve full investment, these guarantees increase the size of the intermediation sector, aggregate investment and experts' welfare. Yet, they also lead to an increase in risk-taking at origination. When instead demand for safety is low and the economy achieves full investment, guarantees on intermediaries may lead to welfare gains for experts. In this case, combining guarantees with a lump-sum transfer from savers to experts at the initial date allows to achieve Pareto gains and also decreases risk-taking at origination. These results shed new light on the equilibrium effects of public guarantees to the financial sector, the need to combine them with other redistributive policies and their interplay with risk-taking at origination.

The paper is organized as follows. Section 2 describes the related literature. Section 3 presents the model. Section 4 characterizes the equilibrium of a benchmark economy with no intermediaries. Section 5 analyzes the partial equilbrium of the economy with an exogenous safe rate. Section 6 characterizes the general equilibrium of the model, discusses the welfare effect from the emergence of securitization and shows that constrained versions of the Welfare Theorems hold. Section 7 analyzes optimal public guarantees to financial firms. Section 8 concludes. All the proofs of the formal results in the paper are in the Appendix.

2 Related literature

This paper belongs to vast literature on securitization. In practice, the securitization process involves several rounds of pooling, tranching and distribution of cash-flows generated by loans along an intermediation chain that exhibits different entities (Ashcraft et al. (2008), and Pozsar et al. (2013)). The objective of the pooling activity is to diversify the idiosyncratic risks of the underlying assets and that of the tranching activity is to split cash-flows into securities with different risk profiles. Early research focuses on the tranching and distribution of loan pay-offs and shows that it emerges as the optimal security design to overcome adverse selection problems (Gorton and Pennacchi (1990), DeMarzo and Duffie (1999)). DeMarzo (2004) extends this literature and developes an optimal security design model that features pooling and tranching along a longer intermediation chain. The paper exhibits endogenous risk retention along the chain but the risk of the originated loans is exogenous. The latter issue is addressed in a number of papers that analyze how moral hazard problems at origination are affected by the tranching and distribution of loans (Gorton and Pennacchi (1995), Parlour and Plantin (2008), Chemla and Hennessy (2014), and Daley et al. (2017)). These papers, though, only focus on the origination part of the originate-to-distribute intermediation chain and abstract from the diversification benefits associated with securitization. Another set of papers focus on the manufacturing of safe collateral by pooling risky securities and analyze how demand for safety drives the emergence of securitization (Gennaioli et al. (2013), Moreira and Savov (2017)). The issue of origination incentives is not addressed in these papers.[4]

Our paper contributes to the securitization literature by providing an equilibrium model of the intermediation chain that exhibits endogenous risk-taking at origination, safe collateral manufacturing through diversification, and endogenous risk retentions along the chain. To the best of our knowledge this is the first paper to provide an equilibrium theory of the entire intermediation chain. Our focus, which is novel in the literature, is on how the endogenous equity allocation along the chain affects both origination incentives and the creation of safe securitized assets.

[4]A final strand of the literature, stresses the role of regulatory arbitrage for the the emergence of securitization (Calomiris and Mason (2004), Acharya et al. (2009), Acharya et al. (2013)). These aspects are absent in our model.

Our paper is also related to a literature that analyzes how moral hazard problems shape risk-taking by financial intermediaries. The equilibrium relationship between bank capital requirements and risk-taking is analyzed in Repullo (2013) and in Martinez-Miera and Repullo (2018). The implications of saving gluts or low interest rate environments for monitoring and origination incentives are analyzed in Dell Ariccia et al. (2014), Martinez-Miera and Repullo (2017) and Bolton et al. (2018).[5] We embed similar agency frictions in a model of the financial architecture of the securitization business that captures the role played by the different players in the intermediation chain.

Some recent papers analyze the endogenous capital structure of non-financial firms and banks (Allen et al. (2015), Gornall and Strebulaev (2018), Diamond (2016)). Although the focus of these papers is different from ours, we share the interest on how market forces shape the equity allocation in the economy. A contribution of our paper to this literature is to endogenize the risk of the real assets in the economy, which in those papers is taken as exogenous and in our model affects and is affected by the equity allocation.

Finally, our paper also contributes to a large literature that studies the need and implications of public support to the financial sector following negative shocks (for recent contributions see, e.g., Diamond and Rajan (2012); Farhi and Tirole (2012); Keister (2015)). Most of the literature has highlighted a time consistency problem that makes public support optimal ex post but inefficient ex ante due to moral hazard. Our findings challenge this view because we show that public guarantees to securitized assets may lead to higher leverage and more risk-taking but still Pareto improve welfare from an ex ante perspective. Due to the market segmentation, public guarantees may have redistributional effects in our economy, which resembles the results in Carletti et al. (2017) on the welfare effects of changes in capital requirements. A final novel result we obtain is the optimality of concentrating the government's resources on granting guarantees on the issuance of the safe securities most exposed to aggregate risk.

[5]Other theories of the relationship between demand for safety and financial fragility are pursued by Caballero and Krishnamurthy (2009) or Ahnert and Perotti (2017).

3 The model

Consider an economy with two dates $t = 0, 1$ and two types of investors endowed at $t = 0$ with one unit of funds: experts and savers. Aggregate endowment is normalized to one. The overall wealth of savers is denoted with $\mu \in [0, 1]$, and that of experts is $1 - \mu$. Investors derive linear utility from consumption at either date and have a zero discount rate. At $t = 0$, each expert can set-up and manage one out of two types of financial firms, called *originators* and *intermediaries*.[6] Both types of financial firm have access to some constant return to scale investment possibilities that are funded as described below. Finally, at $t = 0$, the expert decides how to allocate his endowment as (inside) equity in his own firm, investment in securities issued by other financial firms, or consumption. At $t = 0$, savers can either invest in *safe securities* issued by financial firms or consume their endowment.

Since investors have linear utility and all their investment possibilities are scalable, for the ease of exposition, we focus on investment strategies in which the entire endowment of each investor is either allocated to exactly one of the investment possibilities or consumed.

We describe each of the financial firms that experts can create next.

Originators An originator is a financial firm that has access to a constant returns to scale project whose stochastic payoff is realized at $t = 1$. The per unit return of the project, that we denote A_z, can be either high ($z = H$) or low ($z = L$), where $A_H > A_L \geq 0$. We also refer to A_L as the safe return of the project and to $\Delta \equiv A_H - A_L$ as its risky return. The probability that the high return is realized coincides with the monitoring intensity $p \in [0, p_{\max}]$ exerted by the expert that sets up and manages the originator, where $p_{\max} < 1$.[7] The expert's monitoring choice is not observable and entails him a disutility cost per unit of the project given by a function $c(p) \geq 0$ satisfying:

Assumption 1 $c(p) = 0,\ c'(0) = 0, c'(p_{\max}) \geq \Delta, c''(p) > 0,$ *and* $c'''(p) \geq 0.$

Notice that a quadratic cost function satisfies the assumptions. Since there is a one-to-one map between monitoring intensity and the risk of the project, we will henceforth refer to p also as the project's risk.

[6]We could think that the management of the firm requires of expert's time, which cannot be split.
[7]Notice that since $p_{\max} < 1$, the risky payoff Δ is in fact never realized with probability one.

Let $\overline{p}$ be defined as:

$$\overline{p} = \arg\max_{p} \left\{ E[A_z|p] - c(p) \right\}. \tag{1}$$

We refer to $\overline{p}$ as the efficient risk choice. Assumption 1 implies that $\overline{p} \in (0, p_{\max}]$ and is given by the first order condition:

$$c'(\overline{p}) = \Delta. \tag{2}$$

We assume that:

Assumption 2 $E[A_z|\overline{p}] - c(\overline{p}) > 1$.

Assumption 3 $A_L < 1$.

The first assumption states that undertaking the project creates a surplus if efficient risk is chosen. The second assumption implies that the safe return of the project is not sufficient to allow for its funding to rely exclusively on safe securities.

At $t = 0$, an expert that starts an originator invests his unit of wealth in the firm (*inside equity)*, and can raise external funds to expand investment in the originator's project by issuing non-contingent claims (*safe securities*) and state-contingent claims (*risky securities*) whose repayment depends on the realization $z \in \{H, L\}$ of the originator's project. We use from now on the subindexes S and I to refer to safe and risky securities, respectively. We use the subindex I to refer to risky securities because they are purchased by intermediaries (the other type of financial firm, described next). When raising external funds, the originator takes as given the prices of these securities, which we express as their market expected returns R_S, R_I. The overall notional promise at $t = 1$ on the safe securities issued by the originator and their market price at $t = 0$ are denoted with D_S and x_S, respectively. The variables $D_I = (D_{I,z})_{z\in\{H,L\}}$ and x_I denote analogous objects for the (state-contingent) risky securities issued by the originator. Finally, we denote with $x \geq 1$ the total size of the originator's project.

After setting up an originator, the expert's problem consists of maximizing the return from its inside equity net of monitoring costs. In order to do so, the expert can lever up its initial wealth by issuing securities backed by its project payoff. Yet, the non-observability of the project's risk by external investors creates a moral hazard problem that may lead to excessive risk-taking. The originator then faces a trade-off between maximizing leverage and limiting moral hazard on the project risk choice.

Formally, for given returns R_S, R_I, on the two securities, the problem of the originator at $t = 0$ consists of the choice of a balance sheet tuple $(x, D_S, x_S, D_I, x_I, p)$ solving the maximization problem

$$\max_{(x,D_S,x_S,D_I,x_I,p)} R_{E,O} \equiv E\left[A_z x - D_S - D_{I,z}|p\right] - c(p)x, \tag{3}$$

subject to the *budget constraint*

$$1 + x_S + x_I = x, \tag{4}$$

the *state contingent overall repayment constraints*

$$D_S + D_{I,L} \leq A_L x, \tag{5}$$

$$D_S + D_{I,H} \leq A_H x, \tag{6}$$

the *securities' pricing constraints*

$$x_S = \frac{D_S}{R_S}, \tag{7}$$

$$x_I = \frac{E\left[D_{I,z}|p\right]}{R_I}, \tag{8}$$

and the *optimal risk choice constraint*

$$p = \arg\max_{p'} \left\{E\left[A_z x - D_S - D_{I,z}|p'\right] - c(p')x\right\}. \tag{9}$$

The objective function $R_{E,O}$ in (3) is the expected utility the expert obtains from investing its wealth in the originator, which amounts to the value of the residual equity claim net of the monitoring costs. We will henceforth refer to $R_{E,O}$ as the originator's equity return. The maximization of the equity return is subject to the following constraints. The budget constraint (4) states how the originator finances the x units of the project with its own funds and those obtained by issuing safe and risky securities. Constraints (5) and (6) ensure that the securities issued by the originator are repaid in each state $z \in \{H, L\}$. Constraints (7) and (8) provide the pricing equation of the securities given their market returns. Finally, constraint (9) characterizes the risk choice that maximizes the residual payoff of the expert managing the originator taking into account the repayments to the holders of the securities issued to obtain external funding.

Intermediaries An intermediary is a financial firm that issues safe securities by "pooling and tranching" the risky securities purchased from multiple originators. This securitization process allows the expert that manages the intermediary to lever up its investment in the firm. Yet, the presence of *aggregate risk* in the economy, which is described next, limits the intermediaries' leverage because the issuance of safe securities requires of the loss-absorption capacity against non-diversifiable risk provided by the intermediary's equity.

At $t = 1$ an aggregate shock θ that affects the return of the originators' projects is realized. The support of the shock is $[1-\lambda, 1/p_{\max}]$, with $\lambda \in (0,1)$. The distribution $F(\theta)$ of the aggregate shock has positive density (at least) in a neighborhood of $\theta = 1-\lambda$ and satisfies $E[\theta] = 1$. We assume that conditional on the realization of the aggregate shock θ, the high payoff of the project of an originator with risk choice p is θp. Hence, when $\theta > 1$ ($\theta < 1$) the conditional probability of a high payoff is larger (lower) than its unconditional value.[8] In addition, we assume that conditional on the realization of θ, the project payoffs are independent across originators. The *aggregate risk* parameter λ thus determines the diversification possibilities in the economy: when $\lambda \to 0$, the risk in the originators' projects is totally diversifiable, while when $\lambda \to 1$, it is not diversifiable at all.

We next describe the intermediaries formally. At $t = 0$, an expert that starts an intermediary has access to a technology that allows to purchase well diversified pools of risky securities issued by originators and to issue safe securities backed by the payoffs of the portfolio of risky securities. The intermediary takes as given the market returns and the design of the securities in the market. For the sake of expositional simplicity, we assume that all orginators design the same risky security, which, for a given market return R_I, is described by a tuple (x_I, D_I, p) satisfying the pricing equation (8).[9] The state-contingent return of the risky securities in the market, that we denote with $R_{I,z}$ for $z \in \{H, L\}$, is thus given by:

$$R_{I,z} = \frac{D_{I,z}}{x_I}. \tag{10}$$

[8]Notice that the assumption $\theta \leq 1/p_{\max}$ ensures that the conditional probability of the high return is upper bounded by 1. Besides, using that $E[\theta] = 1$, for an originator with risk choice p we have:

$$\Pr[A_z = A_H] = \int_{1-\lambda}^{1/p_{\max}} \Pr[A_z = A_H|\theta]dF(\theta) = \int_{1-\lambda}^{1/p_{\max}} \theta p dF(\theta) = pE[\theta] = p,$$

as expected.

[9]This is the case in equilibrium because as we will see, given market returns R_S, R_I, the maximization problem of the originator described in (3) - (9) has a unique solution.

We can thus more compactly describe the risky securities in the market by a tuple $(R_{I,H}, R_{I,L}, p)$ satisfying:

$$E[R_{I,z}|p] = R_I. \tag{11}$$

The expert managing and intermediary decides at $t = 0$ the amount y of funds to invest in a well-diversified pool of risky securities. This purchase is funded with the unit of wealth of the expert (inside equity) and with the funds x_S obtained from the issuance of safe securities with an overall notional promise B_S at $t = 1$.

For given market returns R_S, R_I and risky securities described by the tuple $(R_{I,H}, R_{I,L}, p)$ satisfying (11), the problem of the intermediary at $t = 0$ consists of choosing a balance sheet tuple (y, B_S, y_S) solving the maximization problem

$$\max_{(y,B_S,y_S)} R_{E,I} \equiv \int_{1-\lambda}^{1/p_{\max}} (E[R_{I,z}|p,\theta]\, y - B_S)\, dF(\theta) = R_I y - B_S, \tag{12}$$

subject to the *budget constraint*

$$1 + y_S = y, \tag{13}$$

the *repayment constraint*

$$B_S \leq \min_{\theta} E[R_{I,z}|p,\theta]\, y, \tag{14}$$

and the *pricing constraint*

$$y_S = \frac{B_S}{R_S}. \tag{15}$$

The objective function $R_{E,I}$ in (12) is the utility of the expert that sets-up an intermediary, which equals the expected residual payoff of the firm. We will henceforth refer to $R_{E,I}$ as the intermediary's equity return. Notice that the latter expression for $R_{E,I}$ in (12) immediately results from (11). That expression simply captures that the expected return on the y units of risky securities purchased by the intermediary is R_I and that safe debt is always repaid. The maximization of the equity return is subject to the following constraints. The budget constraint (13) states how the intermediary finances its purchase of risky securities from originators with its own funds and those obtained by issuing safe securities. The constraint (14) ensures that the safe securities issued by the intermediary are repaid always in full and takes into account that, by the law of large numbers, the payoff of the intermediary's pool of risky securities at $t = 1$ is a function of the risk choice of the originators p and the realization of the aggregate shock θ. Constraint (15) provides the pricing equation of the safe securities given their market return.

We denote E_O, E_I the measures of experts that set-up at $t = 0$ an originator and an intermediary, respectively. E_O, E_I also represent the aggregate amounts of (inside) equity in each sector.

Equilibrium definition A competitive equilibrium consists of choices for active originators and intermediaries described by balance sheet tuples $(x^*, D_S^*, x_S^*, D_I^*, x_I^*, p^*), (y^*, , B_S^*, y_S^*)$, respectively, overall amounts E_O^*, E_I^* of equity in originators and intermediaries, respectively, and expected returns R_S^*, R_I^*, R_E^* on safe debt, risky funding to originators, and financial firms' equity, respectively, such that:

1. The choices of originators and intermediaries satisfy the maximization problems in (3) - (9) and (12) - (15), respectively.

2. The return on equity obtained by an expert that sets-up any financial firm is R_E^* and the experts' decision to set-up a financial firm instead of investing on safe securities or consuming is optimal.

3. Savers' investment and consumption decisions are optimal.

4. The markets for safe and risky securities clear.

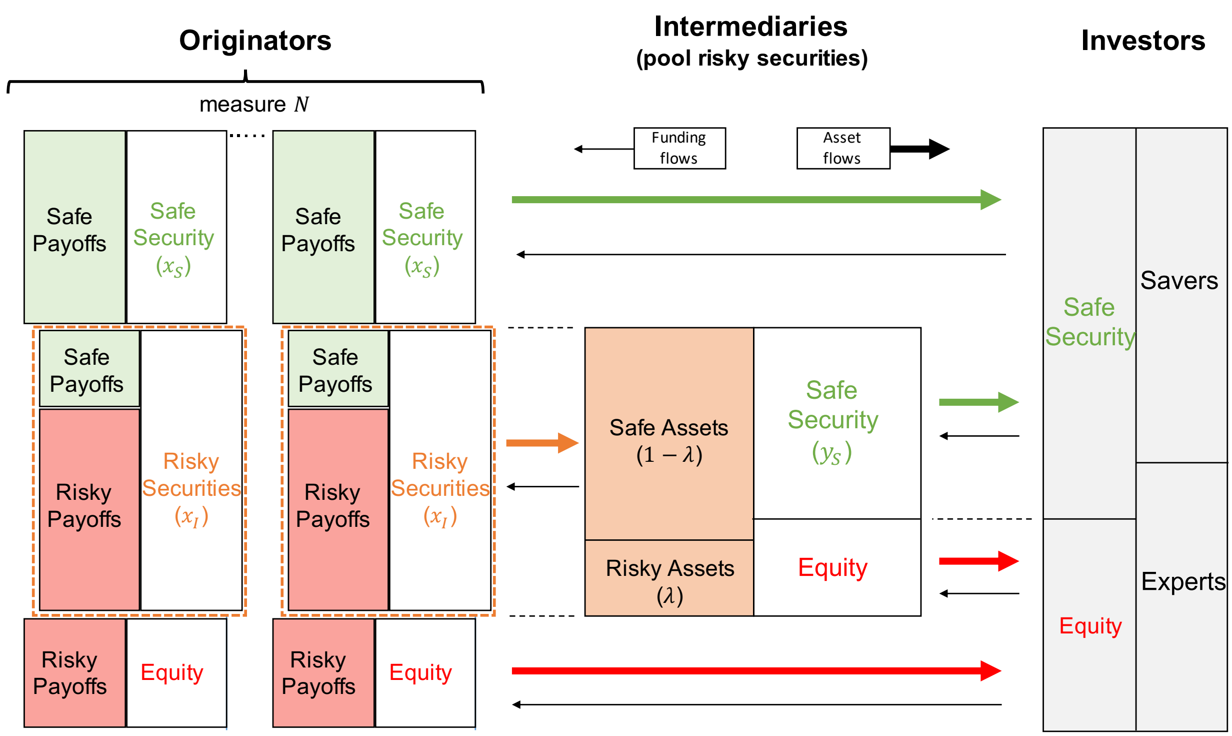
Figure 1 graphically illustrates the equilibrium funding structures, the financing and securities flows in the economy and the market clearing conditions.

4 Benchmark: equilibrium without securitization

We first consider an economy in which experts cannot set-up intermediaries. This provides a benchmark to understand both the economic forces that drive the emergence of securitization and its effects on the welfare of the two agent types, aggregate lending and risk-taking.

Consider an expert that has set-up an originator and has to decide its project size (or leverage) x at $t = 0$. In absence of intermediaries, the originator can raise external funding only by issuing safe securities. For a given safe rate R_S, the originator's problem is as described in (3) - (9) with the additional constraints $x_I = D_{I,L} = D_{I,H} = 0$.

Figure 1: Asset distribution and flow of funds



Note. Illustration of the asset distribution and funding flows along the intermediation chain.

The optimal risk choice condition in (9) can be written as:

$$p = \arg\max_{p'} \{E[A_z x - D_S|p'] - c(p')x\} =$$
$$= \arg\max_{p'} \{[E[A_z|p'] - c(p')]\, x - D_S\} = \overline{p}, \tag{16}$$

where recall that $\overline{p}$ is defined in (1) and denotes the efficient risk choice. Since by definition safe debt is always repaid in full, the expert fully appropriates the marginal benefits from monitoring and thus his risk choice is efficient. As we will see in the next section, this is not anymore the case when the originator issues risky securities.

We denote with

$$R_A(p) \equiv E[A_z|p] - c(p), \tag{17}$$

the expected return of the project of an originator with risk choice p net of monitoring costs. For the sake of brevity, we will simply refer to $R_A(p)$ as the return of the originators' assets. Using this definition, constraints (4) and (7) in the originator's problem and equation (16), the expression for the return $R_{E,O}$ on the originator's equity in (3) can be written as:

$$R_{E,O} = R_S + (R_A(\overline{p}) - R_S)x. \tag{18}$$

This standard portfolio choice expression states that the originator's return on equity exceeds the safe rate by an amount that is proportional to leverage (x) and the spread between the net return on the originator's assets and the safe rate ($R_A(\overline{p}) - R_S$). The next lemma, that immediately results from the clearing condition in the market for safe securities, states that such spread is indeed positive in equilibrium (notice that from here on we denote equilibrium variables in this benchmark economy with a b supraindex):

Lemma 1 *The equilibrium safe rate R_S^b satisfies*

$$1 \leq R_S^b \leq R_A(\overline{p}). \tag{19}$$

We illustrate how the equilibrium is determined when returns satisfy the inequalities in Lemma 1 strictly. Suppose thus that:

$$1 < R_S^b < R_A(\overline{p}). \tag{20}$$

From the expression for $R_{E,O}$ in (18) we have that the expert finds optimal to issue as much safe securities as possible to maximize project size. The safe debt promise constraint (7) is thus binding and we have from (4) and (7) that equilibrium project size is given by:

$$x^b = \frac{1}{1 - A_L/R_S^b}. \tag{21}$$

Using this equality and (18) we have that in equilibrium the originator's return on equity satisfies:

$$R_{E,O}^b = \frac{R_A(\overline{p}) - A_L}{1 - A_L/R_S^b}. \tag{22}$$

The expression above exhibits an intuitive leveraged return decomposition. The numerator captures the residual cash-flow of each unit of the project after the repayment of safe securities and net of the monitoring costs. The denominator represents the funding provided by the expert to each unit of the project. Notice that $R_{E,O}^b$ is a decreasing function of R_S^b.

From Assumption 3, (20) and (22) we have that $R_{E,O}^b > R_S^b > 1$ and thus the entire wealth of experts $(1 - \mu)$ is invested in originators and that of savers (μ) in safe securities.

The economy exhibits *full investment*: all the endowment is invested in originators' projects. Taking into account that each of the measure $1-\mu$ of originators has project size x^b, the equilibrium equality between the aggregate demand and supply of funds in the economy can be written as:

$$1 = (1-\mu)x^b. \tag{23}$$

Using this equation, (21) and (22), we finally obtain the following expressions for the equilibrium returns of safe securities and equity:

$$R_S^b = \frac{A_L}{\mu}, \tag{24}$$

$$R_{E,O}^b = \frac{R_A(\overline{p}) - A_L}{1-\mu}. \tag{25}$$

Intuitively, these equations state that in equilibrium the safe rate equals the ratio of the overall safe return of originators' projects and savers' wealth, and the return on equity that of the overall expected risky return of originators' projects (net of monitoring costs) and the expert's wealth. Notice that these expressions imply that the safe rate (equity return) is decreasing (increasing) on savers' wealth μ so that using Assumptions 2 and 3 we deduce that the equilibrium returns satisfy the inequalities in (20) if and only if the savers' wealth lays in an intermediate region. Otherwise, one of the inequalities in Lemma 1 is binding.

Proposition 2 provides a complete formal characterization of the equilibrium in the economy without securitization.

Proposition 2 *Consider a benchmark economy without securitization. Let* μ *be savers' overall wealth and* $\underline{\mu} \equiv \frac{A_L}{R_A(\overline{p})}$. *Let* R_S^b *and* $R_{E,O}^b$ *be the equilibrium return on safe debt and originator's equity, respectively,* x^b *the originators' leverage and* E_O^b *the aggregate equity in originators. We have:*

(i) If $\mu \leq \underline{\mu}$ *then there is full investment and:*

$$R_S^b = R_{E,O}^b = R_A(\overline{p}),\ x^b \in \left[\frac{1}{1-\mu}, \frac{1}{1-A_L/R_A(\overline{p})}\right] \text{ and } E_O^b = \frac{1}{x^b} \leq 1-\mu.$$

(ii) If $\mu \in \left(\underline{\mu}, A_L\right]$ *then there is full investment and:*

$$R_S^b < R_A(\overline{p}) < R_{E,O}^b, x^b = \frac{1}{1-\mu} \text{ and } E_O^b = 1-\mu.$$

(iii) If $\mu > A_L$ then there is no full investment and:

$$1 = R_S^b < R_A(\overline{p}) < R_{E,O}^b, x^b = \frac{1}{1 - A_L} < \frac{1}{1 - \mu} \text{ and } E_O^b = 1 - \mu.$$

The proposition describes how the equilibrium of the economy depends on the savers' wealth, which can be interpreted as a measure of the demand for safety in the economy. Figure 2 illustrates the results in the proposition. Originators can only pledge the safe payoff of their project in order to borrow from savers. When the demand for safety is low ($\mu \leq \underline{\mu}$), the safe payoff of the originators' project is sufficiently large to deliver in equilibrium a high safe rate that equals the expected net return of the originators' project and there is no equity spread. As a result, all the endowment in the economy is invested in originators' projects but there is Modigliani-Miller indifference in the capital structure of originators and in some equilibria a fraction of the experts invest their endowment in safe securities. As savers' wealth increases, it becomes more difficult for originators to supply the amount of safe debt necessary to cover its demand from savers at a rate as high as the expected net return of the originators' project. For an intermediate demand for safety ($\mu \in \left(\underline{\mu}, A_L\right]$), originators' aggregate supply of safe debt becomes scarce and the market clearing for safe debt requires a fall on the safe rate, which in turn leads to an increase in the equity return that induces all experts to invest their entire endowment in originators' equity. In this region, the scarcity of safe payoffs leads to a positive equity spread but full lending is still achieved. As the demand for safety keeps on increasing within this region, the safe rate falls which allows originators to increase leverage. When the demand for safety is large ($\mu > A_L$), the safe rate falls to one and some savers opt to consume their endowment. Safe payoffs are so scarce that additional increases in the savers' wealth cannot be used to fund increases in the scale of the profitable project of the originators and are instead consumed at the initial date.

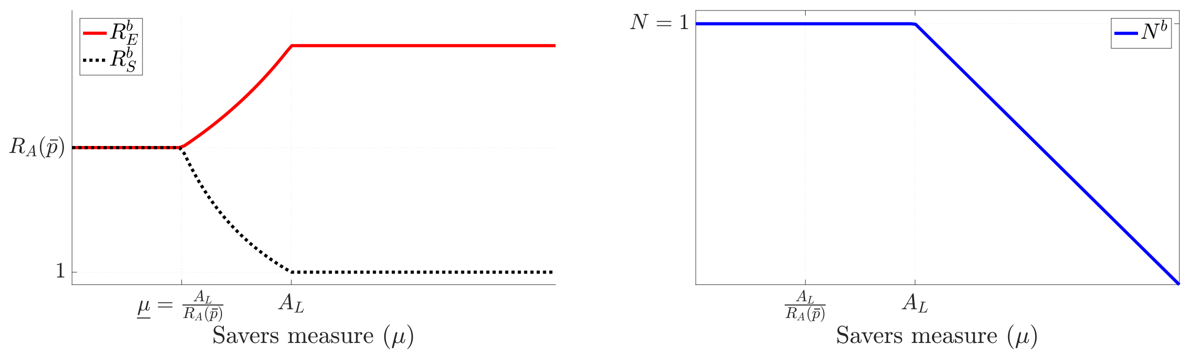
5 Partial equilibrium: exogenous safe rate

We go back in this section to an economy in which experts can also set-up intermediaries at the initial date. Before starting the formal analysis, we intuitively describe the role the intermediary can play in the economy.

Consider a situation in which in the benchmark economy with no intermediary described in the previous section, a positive spread between the return on the originator's equity and

Figure 2: Equilibrium with intermediaries

(a) Returns on risky & safe securities (b) Aggregate investment



the safe rate emerges ($R_E^b > R_S^b$). Suppose that an expert has the option to set-up an intermediary. By creating this financial firm and contibuting with its own wealth as credit enhancement, the expert can purchase risky securities issued by a a pool of originators, diversify their idiosyncratic risk and finance a fraction of its portfolio with safe securities. Since the safe rate is lower than the originator's equity return, the intermediary can offer originators a rate R_I on their risky securities that is slightly lower than the originator's equity return R_E^b. At such a rate, originators find this alternative funding mode attractive, as by issuing risky securities at a rate $R_I < R_E^b$ they can expand their project size and obtain a higher return on internal funds. Besides, an expert that obtains levered access to the risky securities markets by setting-up an intermediary also obtains a return on own funds higher than that in the benchmark economy. Thus, the possibility to exploit the equity to safe securities spread gives incentives for experts to create intermediaries.

In this section, we analyze formally the economy with intermediaries in a partial equilibrium context with an exogenously fixed safe rate R_S. The following lemma, which extends Lemma 1, provides the relevant range of values for R_S and its equilibrium relationship with R_I :

Lemma 3 *The general equilibrium value of the safe rate, R_S^*, satisfies*

$$1 \leq R_S^* \leq R_A(\overline{p}).$$

Besides, for a given exogenous safe rate $R_S \in [1, R_A(\overline{p})]$, if a partial equilibrium exists, then *the associated equilibrium returns $R_I^*(R_S)$ and $R_E^*(R_S)$ satisfy*

$$R_S \leq R_I^*(R_S) \leq R_E^*(R_S),$$

with equality in either of the inequalities if and only if $R_S = R_A(\overline{p})$.

The lemma makes two statements. First, it provides bounds on the general equilibrium safe rate that result from savers' possibility to consume at $t = 0$ and the maximum expected return at $t = 1$ of the productive assets in the economy. Second, for an exogenously fixed safe rate, the lemma states that, in partial equilibrium, the expected return on risky securities lays between between the return on safe securities and that on equity. This results from the fact that the assets of the intermediaries consist of risky securities, while their funding sources consist of safe securities and the equity of their experts.

Lemma 3 also states that, as in the benchmark economy with no intermediaries, when the exogenous safe rate satisfies $R_S = R_A(\overline{p})$ there is no spread between the return on equity, risky securities and safe securities. In this case a Modigliani-Miller type of capital structure indifference arises both for originators and intermediaries. Besides, any possible equilibrium is payoff equivalent for the two investor types to the any of the equilibria with no intermediaries described in the previous section in the indifference region.

Using Lemma 3 but avoiding the notational complexities of having to deal with equilibrium indeterminacy, we conduct the partial equilibrium analysis in the rest of the entire Section 5 under the maintained assumption that the exogenous safe rate satisfies:

$$1 \leq R_S < R_A(\overline{p}).$$

This assumption allows also to focus the financial firms' problems to the case in which the market returns taken as given by the firms satisfy $R_I > R_S$.

The partial equilibrium analysis is split in three steps. First, we consider the originator's problem and describe its dependence on the ratio between the return on equity and that of risky securities, R_E/R_I, which we call the *intermediary funding discount*. Second, we derive from the intermediary's problem a *funding discount pass-through equation* that provides a relationship between the returns of the three funding sources in the economy (equity, risky securities and safe securities). Third, we analyze the determination of the equilibrium returns on the risky funding forms (equity and risky securities) and the allocation of experts' wealth across originators and intermediaries.

5.1 Originators' problem and the intermediary funding discount

In this subsection we consider the originators' problem at the initial date for given returns $R_S \in [1, R_A(\overline{p}))$ and $R_I > R_S$. The problem consists of the choice of a balance sheet tuple $(x, D_S, x_S, D_I, x_I, p)$ solving the maximization problem (3) - (9).

Using the pricing equations (7) and (8), the return on the originator's equity is given by:

$$R_{E,O} = R_A(p) + (R_A(p) - R_S)x_S + (R_A(p) - R_I)x_I. \tag{26}$$

This expression extends that in (18) by including a third term that captures the (positive or negative) spread experts obtain by issuing risky securities to expand project size. Finally, $R_{E,O}$ also depends on the risk choice of the originator, which we analyze next.

Using (5), the optimal risk choice condition in (9) takes the form

$$p = \arg\max_{p'} \left\{ p' \left(\Delta - \left(\frac{D_{I,H} - D_{I,L}}{x} \right) \right) - c(p') \right\}. \tag{27}$$

Comparing to (1), the expression shows that the risk choice is affected by $\frac{D_{I,H}-D_{I,L}}{x}$, which corresponds to the increase in repayments to the holders of risky securities the originator has to make per unit of the project under the H payoff. Let us highlight that the risk choice does not depend on the notional promise on safe securities D_S, because this promise is paid in the two states.

Since the issuance of safe securities is cheaper than that of risky securities, and it does not affect risk choices we can prove that:

Lemma 4 *For given $R_S \in [1, R_A(\overline{p}))$ and $R_I > R_S$, any solution to the originator's problem satisfies:*

$$D_S = A_L x \text{ and } D_{I,L} = 0.$$

The lemma states that the originator exhausts its capability to issue safe securities. As a result, the promise on risky securities under the L payoff of the project is necessarilly zero and these securities are described by their payoff under the H payoff of the project.

We denote with

$$d_I = D_{I,H}/x. \tag{28}$$

the risky security promise under the high payoff per unit of the project. For the sake of brevity, we will henceforth refer to d_I as the *risky security promise*.

Using Lemma 4, the optimality condition (27) can be rewritten in the following compact form:

$$p = \arg\max_{p'} \left\{ p'(\Delta - d_I) - c(p') \right\}.$$

The expression above implies that the optimal risk choice p is characterized by the following first order condition that only depends on d_I:

$$\Delta - d_I = c'(p). \tag{29}$$

From Assumption 1 and the optimality condition above we have that:

Lemma 5 *For given $R_S \in [1, R_A(\overline{p}))$ and $R_I > R_S$, the originators' optimal risk choice is a function $\widehat{p}(d_I)$ of the risky security promise d_I satisfying*

$$\frac{\mathrm{d}\widehat{p}(d_I)}{\mathrm{d}d_I} < 0, \widehat{p}(0) = \overline{p} \textit{ and } \widehat{p}(\Delta) = 0. \tag{30}$$

The lemma states that as the risky security promise d_I increases the originator's project becomes riskier (p decreases). The reason is that when d_I is larger, the expert's incentives to undertake the costly monitoring get reduced, since the value created by this action is to a larger extent appropriated by the holders of the risky securties. The non-observability of the monitoring intensity thus creates a moral hazard problem that increases the project risk when risky securities are issued.

Using constraints (4) - (8), Lemma 4 and Lemma 5, we can rewrite (after some algebra) the originator's return on equity in (26) as:

$$R_{E,O}(d_I) = \frac{R_A(\widehat{p}(d_I)) - A_L - \widehat{p}(d_I)d_I}{1 - A_L/R_S - \widehat{p}(d_I)d_I/R_I}. \tag{31}$$

The expression above exhibits an intuitive leveraged return decomposition that extends that in (22). Recall that, for each unit of the project, the originator issues safe securities with promise A_L and risky securities with promise d_I which are repaid with probability $\widehat{p}(d_I)$. Taking this into account, the numerator of (31) captures the expected residual cash-flow generated by each unit of the project after repayment of the securities issued to raise funding and net of the monitoring costs. The denominator represents the funding provided by the expert to each unit of the project, and takes into account the pricing of safe and risky securities given the market returns R_S and R_I, respectively.

From our discussion so far, the originator's maximization problem (3) - (9) can be written as:

$$\max_{d_I \in [0,\Delta]} R_{E,O}(d_I). \tag{32}$$

The following lemma characterizes the solution of the originator's problem.

Lemma 6 *For given $R_S \in [1, R_A(\overline{p}))$, there exist $\overline{R}_I > \underline{R}_I \geq R_S$ such that if $R_I \in \left(\underline{R}_I, \overline{R}_I\right)$, then the solution d_I^* to (32) is unique, satisfies*

$$(R_{E,O}(d_I) - R_I)\left(\frac{1}{R_I}\frac{\mathrm{d}(\widehat{p}(d_I)d_I)}{\mathrm{d}d_I}\right) + \frac{\mathrm{d}R_A(\widehat{p}(d_I))}{\mathrm{d}d_I} = 0, \tag{33}$$

and leads to $R_{E,O}(d_I^*) > R_I$. Besides, if $R_I \geq \overline{R}_I$ then $d_I^* = 0$ is the unique solution to (32), while if $R_I \leq \underline{R}_I$, then $R_{E,O}(d_I)$ becomes infinity for d_I sufficiently large. Finally, the thresholds $\underline{R}_I, \overline{R}_I$ are given by:

$$\begin{aligned}\overline{R}_I &= \frac{R_A(\bar{p})}{1 - A_L/R_S}, \\ \underline{R}_I &= \max\left(\frac{1 - A_L/R_S}{\max_{d_I}\left(\widehat{p}(d_I)d_I\right)}, R_S\right).\end{aligned}$$

The lemma characterizes the originators' optimal risky security promise d_I for given returns R_S, R_I. Specifically, for an intermediate range of values of R_I, the optimal risky security promise is characterized by the first order condition in (33), whose interpretation we describe next. The first term captures the per unit of the project gains from an increase in the risky security promise and can be interpreted as a standard *leverage effect*. An increase in d_I allows the originator to raise additional funds from risky securities amounting to $(1/R_I)\mathrm{d}(\widehat{p}(d_I)d_I)/\mathrm{d}d_I$ per unit of the project. The additional issuance of risky securities is retributed at a return R_I, but frees up an equal amount of inside equity that (in combination with external financing) allows to increase project size and to obtain a return $R_{E,O}$. Each marginal shift of funding per unit of the project from inside equity to risky debt allows the originator to obtain a spread $R_{E,O} - R_I$ that is positive for intermediate values of R_I. The second term in (33), which from Lemma 5 is negative, captures the per unit of the project costs from an increase in the risky security promise and can be interpreted as an *incentives effect*. An increase in d_I weakens the originator's incentives to monitor, which entails a reduction in the net return of each unit of the project R_A. The condition in (33) states that the optimal risky security promise trades off the gains from increasing leverage and the losses due to the worsening of monitoring incentives at origination.

Lemma 6 also characterizes when the originators' risky external funding problem exhibits corner solutions. If the return on risky securities is sufficiently high, originators do not rely on this funding form, while if it is sufficiently low, the financial constraints are so weak that the originator can unboundedly increase leverage and its return on equity. The latter, of course, cannot happen in equilibrium since securities' markets would not clear.

We next focus on the optimality condition (33) *in equilibrium.* Let $\chi^*(R_S) \equiv R_E^*(R_S)/R_I^*(R_S)$ be the ratio of the equilibrium expected return on equity and risky securities, which from Lemma 3 satisfies $\chi^*(R_S) > 1$. The optimality condition can be rewritten as

$$\underbrace{(\chi^*(R_S) - 1)\,\frac{\mathrm{d}(\widehat{p}(d_I)d_I)}{\mathrm{d}d_I}}_{\text{Leverage effect (+)}} + \underbrace{\frac{\mathrm{d}R_A(\widehat{p}(d_I))}{\mathrm{d}d_I}}_{\text{Incentives effect (-)}} = 0, \tag{34}$$

The decomposition highlights the key role played by the ratio $\chi^*(R_S)$ for the relative importance of the leverage and incentive effects in the determination of the optimal risky security promise d_I. When in equilibrium $\chi^*(R_S)$ is large, risky securities consitute a much cheaper funding source than equity, and thus the incentives for the originator to expand leverage by switching, for each unit of the project, some equity funding with risky securities funding are strong. In fact, we can interpret the ratio $\chi^*(R_S)$ as a marginal funding discount offered by the intermediaries that buy risky securities to originators. We will from now on refer to $\chi^*(R_S)$ as the *intermediary funding discount.*

Taking into account that both $\frac{\mathrm{d}(\widehat{p}(d_I)d_I)}{\mathrm{d}d_I}$ and $\frac{\mathrm{d}R_A(\widehat{p}(d_I))}{\mathrm{d}d_I}$ do not depend on the exogenous safe rate R_S, the optimality condition in (34) also implies that in equilibrium the risky security promise d_I, and hence the project risk choice p, can be expressed as a function *only* of the equilibrium risky intermediary funding discount $\chi^*(R_S)$. Formally, we have the following crucial result:

Proposition 7 *For given $R_S \in [1, R_A(\overline{p}))$, suppose an equilibrium exists and let $R_I^*(R_S)$, $R_E^*(R_S)$, $d_I^*(R_S)$ and $p^*(R_S)$ denote the associated equilibrium variables. Let $\chi^*(R_S) = R_E^*(R_S)/R_I^*(R_S) > 1$ be the intermediary funding discount. There exists a function $\widehat{d}_I(\chi)$ defined for $\chi > 1$ such that*

$$d_I^*(R_S) = \widehat{d}_I(\chi^*(R_S)) \text{ and } p^*(R_S) = \widehat{p}\left(\widehat{d}_I(\chi^*(R_S))\right), \tag{35}$$

where

$$\frac{\mathrm{d}\widehat{d}_I(\chi)}{\mathrm{d}\chi} > 0, \frac{\mathrm{d}\widehat{p}\left(\widehat{d}_I(\chi)\right)}{\mathrm{d}\chi} < 0, \frac{\mathrm{d}\left(\widehat{p}\left(\widehat{d}_I(\chi)\right)\widehat{d}_I(\chi)\right)}{\mathrm{d}\chi} > 0, \text{ and } \lim_{\chi\to 1} \widehat{d}_I(1) = 0.$$

The proposition states that, in (partial) equilibrium, the only relevant variable to determine originators' risky securities promise d_I^* and risk choice p^* is the intermediary funding discount χ^*. Putting it differently, as the exogenous safe rate R_S varies, the originators' choices (d_I^*, p^*) change in a way that is determined by the effect of the change of R_S on the intermediary funding discount χ^*. Besides, the proposition states that an increase in the equilibrium intermediary funding discount χ^* (due to a change in R_S) increases the risky debt promise d_I^* and its expected payoff $p^* d_I^*$ but induces more risk-taking (p^* decreases). The intuition stems from the equilibrium optimality condition for d_I in (33), that shows that when χ^* is larger the leverage effect becomes more important and the originator finds optimal to sell more risky securities to the intermediary to expand its leverage and project size, but this reduces monitoring incentives. The last result in Proposition 7 is that as the intermediary funding discount χ^* approaches 1 the originators' issuance of risky securities becomes negligible. In fact, in absence of a funding discount from intermediries, the issuance of risky securities weakens monitoring incentives without entailing a benefit from an expansion in leverage.

5.2 Intermediary's problem and the funding discount pass-through equation

In this section we analyze the intermediary's problem and derive a funding discount pass-through equation that links the intermediary funding discount, $\chi^*(R_S) = R_E^*(R_S)/R_I^*(R_S)$, and the ratio of return on equity and safe securities, $R_E^*(R_S)/R_S$.

Consider a given return on intermediary funding satisfying $R_I > R_S$. Recall that in (10) we defined $R_{I,z}$ to be the return of the risky securities issued by the originators and purchased by intermediaries. From Lemma 4 and (11) we have that

$$R_{I,L} = 0, R_{I,H} = R_I/p. \tag{36}$$

An expert setting up and investing its wealth in an intermediary chooses at $t = 0$ a balance sheet tuple (y, B_S, y_S) solving the maximization problem (12) - (15). Using constraints (13) and (15), the intermediary's return on equity $R_{E,I}$ can be written as the following function of its asset size (or leverage) y :

$$R_{E,I} = R_S + (R_I - R_S)y. \tag{37}$$

The expression implies that the intermediary makes a spread $R_I - R_S > 0$ on each unit of investment in risky securities. The intermediary's return on equity is thus maximized with maximum leverage so that the intermediary finds optimal to exhaust its capability to issue safe securities against its portfolio of risky securities. From (14) and (36), the optimal promise B_S on safe securities satisfies:

$$\begin{aligned} B_S &= \min_{\theta} E\left[R_{I,z}|p,\theta\right] y = \min_{\theta} \left[\theta p R_{I,H} + (1-\theta p)\, R_{I,L}\right] y = \\ &= (1-\lambda) R_I y. \end{aligned} \tag{38}$$

The expression states that a fraction $1 - \lambda$ of the return of the intermediary's assets is safe and can be used to issue safe securities. This illustrates the benefits of the diversification achieved through securitization: while the lowest return of each of the risky securities issued by an originator is zero, the lowest return of a diversified pool of those contracts is a fraction $1 - \lambda$ of their expected return R_I. In this way securitization expands the supply of safe securities in the economy.

Using (38), the pricing constraint for the intermediary's safe securities in (15) can be rewritten as:

$$R_S y_S = (1-\lambda) R_I y, \tag{39}$$

and from this expression, $R_{E,I}$ in (37) can be rewritten as:

$$R_{E,I} = \lambda R_I y. \tag{40}$$

Equations (39) and (40) capture how the safe and risky parts of the payoffs of the intermediary's pool of securities are pledged to safe security investors and the expert who holds the intermediary's equity, respectively.

Besides, from (13) and (39) we can derive the following expression for the intermediary's optimal leverage y:

$$y = \frac{1}{1-(1-\lambda)\frac{R_I}{R_S}} \text{ if } \frac{R_I}{R_S} \leq \frac{1}{1-\lambda}. \tag{41}$$

The intermediary's leverage increases in the relative spread between the intermediary's return on assets and the safe rate, R_I/R_S. The reason is that as R_I/R_S increases, the safe part of the return of the intermediary's assets, $(1-\lambda)R_I$, grows faster than the rate of return R_S required by the investors who finance that part of the intermediary's assets. The intermediary can thus raise more funds per unit of the project by issuing safe securities, which increases leverage. Indeed, as $R_I/R_S \to 1/(1-\lambda)$ the intermediary's leverage would tend to infinity, which imposes the equilibrium upper bound $1/(1-\lambda)$ on R_I/R_S. Besides, expression (41) implies that the intermediary's leverage decreases as the aggregate risk parameter λ increases because with less diversification possibilities its capability to issue safe securities is reduced. Indeed, as $\lambda \to 1$, there are no diversification possibilites in the economy and the intermediary's leverage tends to one, while as $\lambda \to 1 - R_S/R_I$, they are so large that the intermediary could entirely fund its assets with safe securities and its leverage would tend to infinity.

From (40) and (41), we get the following accounting identity that captures how the intermediary "passes" its funding cost to originators:

$$\frac{1}{R_I} = (1-\lambda)\frac{1}{R_S} + \lambda\frac{1}{R_{E,I}}. \tag{42}$$

In fact, taking into account that the cost of a funding form equals the inverse of the expected return it delivers to investors, the LHS in the expression above coincides with the cost of the funding provided by the intermediary to originators and the RHS captures the average cost of the intermediary's funding. Notice that the latter takes into account that the return of the intermediary's assets is pledged to the holders of the safe securities and equity liabilities of the intermediary in proportions $1-\lambda$ and λ, respectively.

Using that in equilibrium the return on equity on both originators and intermediaries equals $R_E^*(R_S)$, we immediately obtain from (42) the following result:

Proposition 8 *For a given safe rate $R_S \in [1, R_A(\overline{p}))$, suppose an equilibrium exists and let $R_E^*(R_S)$ and $\chi^*(R_S)$ denote the associated equilibrium variables. They satisfy:*

$$\chi^*(R_S) = (1-\lambda)\frac{R_E^*(R_S)}{R_S} + \lambda. \tag{43}$$

The proposition provides an equilibrium *funding discount pass-through equation* that states that the funding discount (relative to the cost of equity funding) χ^* offered by the intermediary to originators amounts to the weighted average of the "discounts" with which the intermediary finances its portfolio of risky securities. In fact, in equilibrium a fraction $1-\lambda$ of the return of the intermediary's assets are used to issue safe securities which have a cost advantage relative to equity of R_E^*/R_S, while the residual fraction λ is used to compensate the expert holding the intermediary's equity at no discount relative to the originators' equity.

From the funding discount pass-through equation in (43), we have that the effect of changes in aggregate risk λ on the intermediary funding discount χ^* go in the same direction as those on its leverage y discussed above. It is in fact the intermediary's capability to lever up issuing cheap safe securities what allows it to offer attractive funding to originators. Consequently, as the aggregate risk parameter λ increases and from (41) the intermediary is less levered, the funding discount χ^* it offers to originators diminishes. When $\lambda \to 1$, we have that $\chi^* \to 1$ and intermediary funding is not cheaper than equity. When in contrast $\lambda \to 0$, we have that $\chi^* \to R_E^*/R_S$ and intermediary funding is as cheap as the issuance of safe securities.

Similarly, if changes in the exogenous safe rate R_S lead to an increase in the relative equity spread, R_E^*/R_S, the funding discount pass-through equation implies that the intermediary can offer a larger funding discount χ^*. Then equation (40) implies that the intermediary's leverage y must necessarily increase as well.

5.3 Equilibrium with exogenous safe rate

In this section we finish the characterization of the equilibrium of the economy for an exogenous safe rate and provide comparative statics results on this variable. The analysis is split as follows: We first focus on the determination of the equilibrium returns R_E^* and R_I^* and describe the main properties of the financial firms' balance sheets and their dependence on R_S. After that, we focus on the clearing conditions for the different financing instruments in the economy and describe experts' wealth allocation across the equity of originators and intermediaries and aggregate investment. For the sake of notational simplicity we will drop for the remaining of this section the dependece of the equilibrium variables on the safe rate except in the statement of formal results.

The returns of the risky funding sources For given R_S, let $\chi^* = R_E^*/R_I^*$ be the equilibrium intermediary funding discount. Using the functions $\widehat{p}(d_I)$ defined by the optimality condition for the risk choice in (29), and $\widehat{d}_I(\chi)$ defined in Proposition 7 and capturing the optimal risky promise made by the originator as a function of the intermediary funding discount, we can use (31) to rewrite the originator's equilibrium return on equity as the following function of R_S and χ^* :

$$R_E^*(R_S,\chi^*) = \frac{\widehat{p}(\widehat{d}_I(\chi^*))\Delta - c(\widehat{p}(\widehat{d}_I(\chi^*))) + (\chi^* - 1)\widehat{p}(\widehat{d}_I(\chi^*))\widehat{d}_I(\chi^*)}{1 - A_L/R_S}. \tag{44}$$

The function $R_E^*(R_S,\chi^*)$ satisfies:

$$\frac{\partial R_E^*(R_S,\chi^*)}{\partial R_S} < 0 \text{ and } \frac{\partial R_E^*(R_S,\chi^*)}{\partial \chi^*} = \widehat{p}(\widehat{d}_I(\chi^*))\widehat{d}_I(\chi^*) > 0, \tag{45}$$

where for the partial derivative with respect to χ^* we have used the optimality condition in (34) and that $\frac{dR_A(p)}{dp} = \Delta - c'(p)$. Besides, plugging the function in (44) into the funding discount pass-through equation (43), we obtain

$$\chi^* = (1-\lambda)\frac{R_E^*(R_S,\chi^*)}{R_S} + \lambda, \tag{46}$$

which provides an equilibrium relationship between R_S and χ^*. The following lemma states that for a given exogenous safe rate the the equation above uniquely determines the equilibrium intermediary funding discount, and, using (44) also the returns on the risky funding sources. Formally:

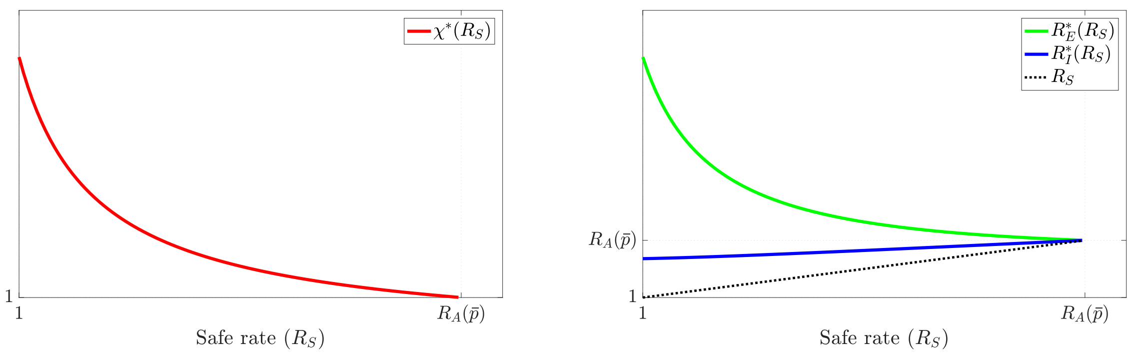
Proposition 9 *For given $R_S \in [1, R_A(\overline{p}))$, there is a unique partial equilibrium of the economy. Let $\chi^*(R_S), R_E^*(R_S)$ be the equilibrium intermediary funding discount and return on equity, respectively. They are characterized by the satisfaction (44) and (46). Besides, $R_E^*(R_S)$ is strictly decreasing in R_S with $\lim_{R_S\to R_A(\overline{p})} R_E^*(R_S) = R_A(\overline{p})$ and $\chi^*(R_S)$ is strictly decreasing in R_S, with $\lim_{R_S\to R_A(\overline{p})} \chi^*(R_S) = 1$. Finally, the equilibrium return on intermediary funding is given by $R_I^*(R_S) = \frac{R_E^*(R_S)}{\chi^*(R_S)}$ and its dependence on R_S is ambiguous.*

The proposition states that in equilibrium both the intermediary funding discount and the return on equity are strictly decreasing in the safe rate. The intuition is as follows. Suppose that R_S increases, then (45) implies that there is a reduction on the return on the originators' equity R_E^*. This reduction results both from the increase in the funding cost of the originator and the associated decrease in its leverage. As a result, the relative equity spread R_E^*/R_S falls and the funding discount pass-through equation (43) implies that the

Figure 3: Equilibrium with exogenous safe rate

(a) Intermediary discount χ^*

(b) Returns on risky securities



intermediary funding discount χ^* drops. From (45) this implies that the return on equity R_E^* is further reduced. This second round effect emerges because the reduction in the equity spread makes the funding of the intermediary less advantageous, which further reduces the originators return on equity.

Financial firms balance sheets Proposition 9 describes how the intermediary funding discount χ^* and equilibrium returns R_I^*, R_E^* depend on the safe rate R_S. The analysis in Section 5.1 and 5.2 describes how the optimal balance sheets of the financial firms depend on these equilibrium prices.

The following formal result highlights how some of the characteristics of the financial firms' balance sheet depends on the safe rate:

Proposition 10 *For given $R_S \in [1, R_A(\overline{p}))$, let $d_I^*(R_S), p^*(R_S), x^*(R_S)$ be the originator's equilibrium risky security promise, risk choice, and leverage, respectively. They satisfy*

$$\begin{aligned} \frac{dd_I^*(R_S)}{dR_S} &< 0, \frac{dp^*(R_S)}{dR_S} > 0, \ \frac{d\left(p^*(R_S)d_I^*(R_S)\right)}{dR_S} < 0, \frac{dx^*(R_S)}{dR_S} < 0 \text{ and} \qquad (47) \\ \lim_{R_S \to R_A(\overline{p})} d_I^*(R_S) &= 0, \lim_{R_S \to R_A(\overline{p})} p^*(R_S) = \overline{p} \text{ and } \lim_{R_S \to R_A(\overline{p})} x^*(R_S) = 1 \end{aligned}$$

Besides, let $y^*(R_S)$ be the intermediary's equilibrium leverage. It satisfies

$$\frac{dy^*(R_S)}{dR_S} < 0 \text{ and } \lim_{R_S \to R_A(\overline{p})} y^*(R_S) = 1.$$

The proposition describes how the financial firms' equilibrium balance sheets respond to an increase in the safe rate. When R_S increases, the equity spread falls and the intermediary is less capable of offering cheap funding to originators, that is, its funding discount χ^* falls (Proposition 9). This in turn leads originators to pledge a lower part of their risky payoffs for the issuance of risky securities, improving incentives at origination, that is, d_I^* falls and p^* increases (Proposition 7). Finally, the increase in R_S reduces the external funding raised by the originator both with safe and risky securities, which reduces its leverage, that is, x^* falls. In addition, the fall in the intermediary's funding discount associated with an increase in R_S also leads, in equilibrium, to a reduction in the intermediary's leverage (equation (40)).

The equity allocation We next move to the equilibrium allocation of expert's endowment between the equity of the two financial firms. Recall that E_O^* and E_I^* denote the aggregate amount of experts' funds invested in the equity of originators and intermediaries, respectively.

The determination of the equity allocation across the two sectors results from two equilibrium conditions. First, the clearing of the market for risky securities, which can be written as:

$$E_O^* x_I^* = E_I^* y^*, \tag{48}$$

where the LHS captures the overall supply of risky securities by originators and RHS accounts for its overall demand by intermediaries.

Second, in equilibrium the return experts obtain from investing in the equity of each of the financial firms must be the same, which implies that:

$$\left[R_A(p^*) - A_L - p^* d_I^*\right] x^* = \lambda R_I^* y^*, \tag{49}$$

The LHS corresponds to the return of the originators' equity and is expressed as the product of the expected residual payoff of each unit of the project and project size. The RHS captures the return of the intermediary's equity, which corresponds to the fraction λ of the expected payoff of the intermediary's assets that is risky and thus pledged to equity investors.

We can obtain from (48), (49) and Proposition 10 the following result:

Proposition 11 *For a given $R_S \in [1, R_A(\overline{p}))$, let $E_O^*(R_S)$, $E_I^*(R_S)$ be the equilibrium amounts of equity invested in the originators and intermediaries, respectively. They satisfy the relationship*

$$\frac{E_I^*(R_S)}{E_O^*(R_S)} = \frac{p^*(R_S) d_I^*(R_S)}{R_A(p^*(R_S)) - A_L - p^*(R_S) d_I^*(R_S)} \lambda. \tag{50}$$

Besides, $E_O^*(R_S)$ *is strictly increasing in* R_S *and* $E_I^*(R_S)$ *is strictly decreasing in* R_S*. Finally,* $\lim_{R_S \to R_A(\overline{p})} E_O^*(R_S) = 1$ *and* $\lim_{R_S \to R_A(\overline{p})} E_I^*(R_S) = 0$.

The intuition for the proposition is as follows. Equation (50) provides an expression for the ratio of equity invested in intermediaries relative to that in originators as the product of two factors. The first one captures how the risky part of the net expected payoff of the originators' projects, $R_A(p^*) - A_L$, is tranched into debt placed to the intermediary with expected payoff $p^* d_I^*$ and inside equity placed to experts with expected payoff $R_A(p^*) - A_L - p^* d_I^*$. The second factor is the aggregate risk parameter λ, that accounts for the fraction of the tranche placed to the intermediary that remains risky after the diversification and has to be funded with equity.

Proposition 11 also describes how the equity allocation along the chain is affected by the safe rate. An increase in R_S decreases the relative equity spread R_E^*/R_S and the funding discount χ^* offered by intermediaries to originators (Proposition 9). The lower funding discount, leads originators to reduce the part of the risky payoffs of their projects that backs the issuance of risky securities to intermediaries (Proposition 7), and hence to increase the part which contributes to the retribution of inside equity. The two effects are formally captured in the first factor in the RHS of (50): the numerator decreases with R_S, while the denominator increases. The marginal "retranching" of the risky payoffs of the originators' projects leads to a contraction of intermediaries' balance sheets (Proposition 10), and a reallocation of experts' funds from the equity of intermediaries to that of originators. Finally, as $R_S \to R_A(\overline{p})$ all the experts invest in originators and intermediaries exit the economy.

Aggregate investment Overall investment in the economy, N^*, equals the aggregate amount of funding raised by originators from their three sources of financing, that is:

$$N^* = E_O^* + E_O^* x_S^* + E_O^* x_I^*. \tag{51}$$

Using the market clearing for risky securities (48) and the intermediary's budget constraint (13), we can rewrite N^* as:

$$N^* = (E_O^* + E_I^*) + (E_O^* x_S^* + E_I^* y_S^*). \tag{52}$$

This equation captures the *end financing flow* from investors to projects in the economy. The first term in parentheses accounts for overall investment in financial firms' equity, and the second term includes the overall issuance of safe securities by financial firms.

Since $R_E^* > R_I^* > R_S$, each expert finds optimal to set up a financial firm and invest its entire endowment in its equity, so that

$$E_O^* + E_I^* = 1 - \mu. \tag{53}$$

Besides, each financial firm exhausts its capacity to issue safe securties, so that the overall funding raised with safe securities by originators and intermediaries is given by the following aggregate pricing constraints:

$$E_O^* x_S^* = \frac{A_L N^*}{R_S}, \tag{54}$$

$$E_I^* y_S^* = \frac{(1-\lambda) p^* d_I^* N^*}{R_S}. \tag{55}$$

The expressions discount at the rate R_S the overall safe part of the assets' payoff of the two types of financial firms.

Combining (52) - (55) we obtain the following result:

Proposition 12 *For a given $R_S \in [1, R_A(\overline{p}))$, the equilibrium aggregate investment $N^*(R_S)$ is given by*

$$N^*(R_S) = \frac{1-\mu}{1 - (A_L + (1-\lambda) p^*(R_S) d_I^*(R_S)) / R_S}. \tag{56}$$

Besides, $N^*(R_S)$ is decreasing in R_S.

The proposition provides an expression that shows how the *overall leverage* of the experts' endowment along the intermediation chain determines aggregate investment in the economy. Indeed, the numerator of (56) accounts for experts' aggregate wealth, which is invested as equity in financial firms. The denominator is a leverage multiplier that captures how much equity funding is needed per unit of the project. The overall "downpayment" by experts per unit of investment corresponds to the the difference between the unit investment cost and the overall amount that is financed with safe securities. The latter consists of the sum of the safe securities funding raised directly by the originator (A_L/R_S) and that raised indirectly by the intermediary ($(1-\lambda)p^* d_I^*/R_S$). As the safe rate R_S increases, the intermediary funding discount χ^* falls and the part of the risky pay-off that is pledged to the intermediary to back safe securities issuance decreases. Besides, an increase in R_S means that the rate at which investors discount safe payoffs increases. The two effects lead to a reduction in the overall value of the safe securities issued by the financial sector, which decreases the overall leverage of the experts' endowment and aggregate investment.

6 Equilibrium and welfare analysis

In this section we determine the equilibrium of the economy with an endogenous safe rate, analyze the welfare implications of the emergence of securitization, and show that the equilibrium of the economy is Pareto constrained efficient.

6.1 Equilibrium with endogenous safe rate

We first characterize the equilibrium of the economy with and endogenous safe rate and its dependence on savers' aggregate wealth μ. Using the characterization of the equilibrium of the economy with an exogenous safe rate conducted in the previous section, we only need to determine the value of the safe rate that ensures that aggregate investment in the economy equals investors' overall investment in financial firms.[10]

We conjecture an equilibrium with a safe rate R_S^* satisfying

$$1 < R_S^* < R_A(\bar{p}), \tag{57}$$

which, from Proposition 9, implies that in equilibrium $R_E^* > R_S^*$.

In such an equilibrium savers and experts find optimal to invest their endowment in safe securities and equity, respectively, so that aggregate investment satisfies $N^* = 1$. We obtain thus from (56) the following expression for R_S^* that extends that in (24) for the benchmark economy:

$$R_S^* = \frac{A_L + (1-\lambda)p^*(R_S^*)d_I^*(R_S^*)}{\mu}. \tag{58}$$

Taking into account that aggregate investment equals the overall endowment in the economy, $N^* = 1$, the numerator in the expression above captures the overall safe payoffs backing the safe securities issued by originators (A_L) and intermediaries ($(1-\lambda)p^*(R_S^*)d_I^*(R_S^*)$). As in the benchmark economy, expression (58) thus states that the equilibrium safe rate equals the ratio of safe payoffs in the economy and savers' wealth.

[10]Equivalently, the equilibrium safe rate can also be found by imposing the clearing of the market for safe securities.

Equation (58) and Proposition 10 imply that R_S^* is decreasing in μ. As in the benchmark economy, this implies that the safe rate satisfies (57) for an intermediate region of the savers' wealth. Otherwise, one of the two inequalities in (57) is binding. Proposition 13 formally establishes the existence and uniqueness of equilibrium (up to the already mentioned M-M indifference when spreads are zero) and describes how equilibrium returns, originators' risk and aggregate investment depend on savers' wealth.

Proposition 13 *The equilibrium of the economy is unique up to Modigliani-Miller type of indifference when there is no equity spread. Let μ be savers' overall wealth and $\underline{\mu} < \overline{\mu}$ the constants defined as*

$$\underline{\mu} = \frac{A_L}{R_A(\overline{p})}, \overline{\mu} = A_L + (1-\lambda)p^*(1)d_I^*(1),$$

Let R_S^*, R_E^*, p^*, N^* be the equilibrium safe rate, return on equity, originator's risk choice, and aggregate investment, respectively. We have:

(i) If $\mu \leq \underline{\mu}$, then intermediaries do not enter and:

$$R_S^* = R_E^* = R_A(\bar{p}), p^* = \overline{p} \text{ and } N^* = 1.$$

(ii) If $\mu \in (\underline{\mu}, \overline{\mu}]$, then intermediaries enter and:

$$R_S^* < R_A(\bar{p}) < R_E^*, p^* < \overline{p} \text{ and } N^* = 1.$$

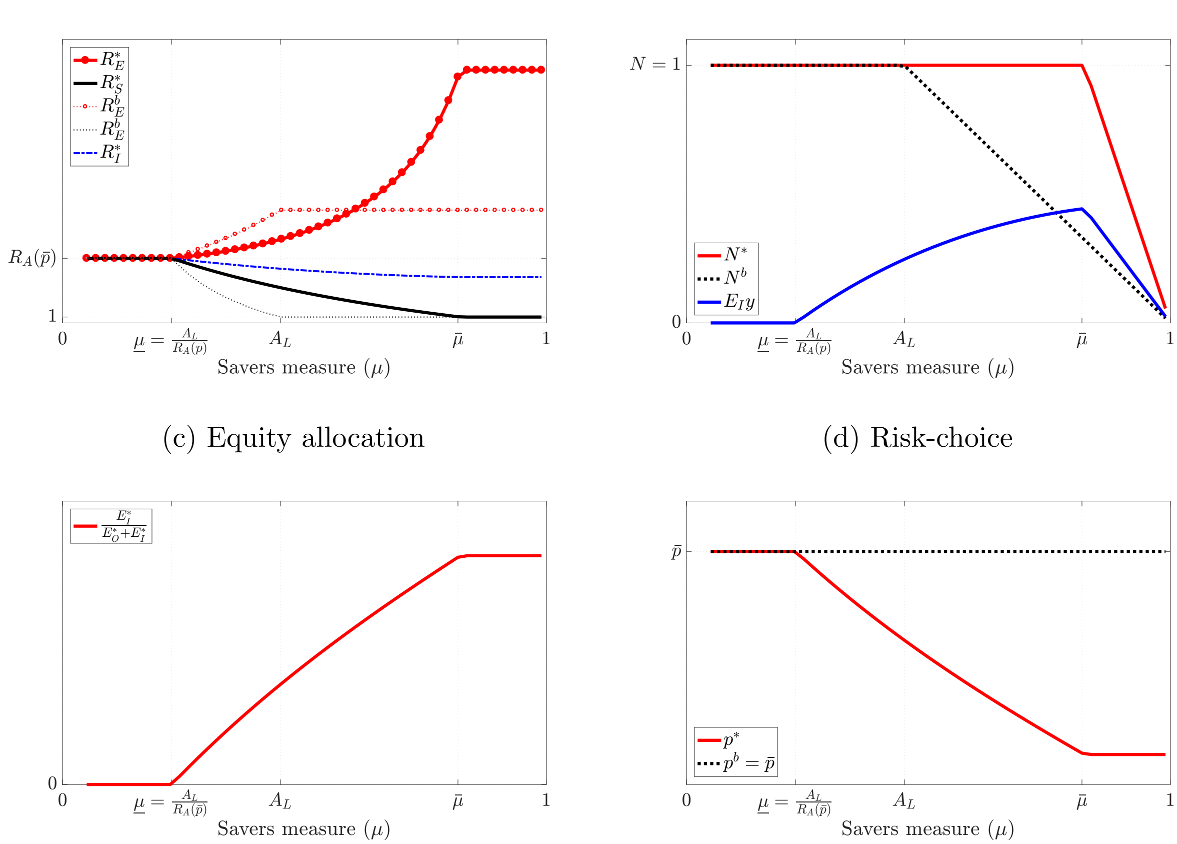
(iii) If $\mu > \overline{\mu}$, then intermediaries enter and:

$$1 = R_S^* < R_A(\bar{p}) < R_E^*, p^* < \overline{p} \text{ and } N^* = \frac{1-\mu}{1-\overline{\mu}} \in (N^b, 1),$$

where N^b is the equilibrium aggregate investment in the benchmark economy with no intermediaries

The proposition describes how the main equilibrium variables depend on the demand for safety in the economy, which is captured by savers' wealth μ. Figure 4 illustrates the results in the proposition and also exhibits some other equilibrium variables not discussed in the proposition. When the demand for safety is low ($\mu \leq \underline{\mu}$), the originators' safe payoffs are enough to deliver a high return on safe securities. There is no equity spread and thus no

Figure 4: Equilibrium with intermediaries



(a) Returns on risky & safe securities

(b) Aggregate investment

(c) Equity allocation

(d) Risk-choice

intermediation either. As the demand for safety increases ($\mu \in (\underline{\mu}, \overline{\mu}]$), the safe securities supplied by originators become scarce, which gives rise to a positive equity spread. When that happens, intermediaries can use their ability to create safe securities through securitization to exploit the equity spread, so intermediation endogenously emerges. As originators pledge to intermediaries a fraction of their risky payoffs, the supply of safe securities increases but incentives at origination deteriorate, which leads to more risk-taking ($p^* < \bar{p}$). As the demand for safety keeps on increasing in this region, the safe rate drops and the equity spread widens. This leads to a reallocation of experts' wealth from originators to intermediaries, which contributes to the increase in risk-taking. In this intermediate region the financial sector is able to create sufficient safe securities to achieve full investment of the economy's endowment. This is not anymore the case when demand for safety becomes very large ($\mu > \overline{\mu}$) because the safe rate falls to one and some saver opt to consume their endowment.

6.2 Welfare effects from emergence of securitization

We next address the welfare effects associated with the emergence of securitization. Specifically, we evaluate the equilibrium utility for savers and experts as well as overall utility in the economy with intermediaries and compare them to those in the benchmark economy without intermediaries. The analysis highlights that, while savers always benefit from the emergence of intermediaries, in some cases experts are harmed.

Since investors have linear utilities with zero discount, the equilibrium expected utility of savers and experts in the economy with intermediaries coincides with the expected return on safe securities, R_S^*, and equity, R_E^*, respectively. Aggregate welfare in the economy, which we denote with W^*, can be written as:

$$W^* = (1 - N^*) + N^* E[A_z|p^*] - N^* c(p^*). \tag{59}$$

The expression results from the observation that aggregate welfare coincides with expected aggregate consumption by savers and experts net of the monitoring costs incurred by some experts. The first term in (59) includes the consumption at $t = 1$ by savers, and the second one captures the expected consumption by the two investor types at $t = 2$, which coincides with the expected payoff of the originators' projects. The last term includes the monitoring costs incurred by the experts that set-up originators.

The welfare variables in the benchmark economy with no intermediaries can be described in an analogous manner. Using the definition of the net return on the originators' assets $R_A(p)$ in (17) and recalling that equilibrium variables in the benchmark economy were denoted with a superscript b in Section 4, the welfare effect due to the emergence of securitization for savers, experts and the aggregate economy, are defined as:

$$\Delta R_S = R_S^* - R_S^b, \Delta R_E = R_E^* - R_E^b \text{ and } \Delta W = W^* - W^b.$$

We can write the expression for the aggregate welfare effect from securitization as:

$$\Delta W = \underbrace{(N^* - N^b)(R_A(p^*) - 1)}_{\text{Gain from increase in investment (+)}} - \underbrace{N^b(R_A(\bar{p}) - R_A(p^*))}_{\text{Cost from increase in risk (-)}}. \tag{60}$$

The expression for the welfare effect is decomposed as the difference of two terms. The first one captures the the value created by the expansion in investment allowed by the additional safe securities created by intermediaries. Notice that Propositions 2 and 13 imply that $N^* \geq N^b$ and strictly so when $\mu > \overline{\mu}$. gains from the increase in investment associated with intermediation and the losses due to the induced increase in risk-taking at origination. The second term accounts for the costs implied by the increase in originators' risk induced by the emergence of intermediaries ($p^* \leq p^b = \bar{p}$ from Proposition 13).

The following formal result provides a characterization of how welfare gains (and losses) from intermediation depend on savers' endowment:

Proposition 14 *Let μ be savers' overall wealth and $\underline{\mu}, \overline{\mu}$ the constants defined in Proposition 13, which satisfy $\underline{\mu} < A_L < \overline{\mu}$. Let ΔR_S, ΔR_E, and ΔW be the welfare gains for savers, experts, and the aggregate economy due to the emergence of intermediation. They satisfy:*

(i) Savers: $\Delta R_S \geq 0$ for any $\mu \geq 0$, and $\Delta R_S > 0$, if and only if $\mu \in (\underline{\mu}, \overline{\mu})$.

(ii) Experts: there exists $\mu'_E \in (A_L, \overline{\mu})$ such that $\Delta R_E < 0$ if $\mu < \mu'_E$ and $\Delta R_E > 0$ if $\mu > \mu'_E$.

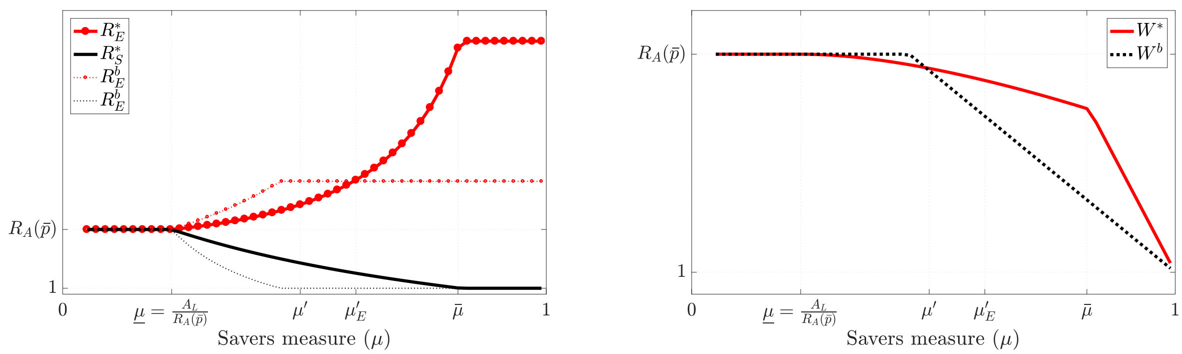
(iii) Aggregate: there exists $\mu' \in (A_L, \overline{\mu})$ with $\mu' < \mu'_E$ such that $\Delta W < 0$ if $\mu < \mu'$ and $\Delta W > 0$ if $\mu > \mu'$.

The proposition describes the welfare effects associated with the emergence of intermediation. Figure 5 illustrates these results. The proposition states that savers' always weakly benefit from the entry of intermediaries and that experts only benefit if the demand for safety is sufficiently high. More precisely, for a low safety demand ($\mu \leq \underline{\mu}$), the equity spread is zero and intermediaries play no economic role. The equilibria of the two economies coincide. If demand for safety increases sufficiently ($\mu > \underline{\mu}$), a positive spread arises, which makes intermediaries' business of creating safe securities out of a pool of risky securities issued by originators valuable in the economy. For a medium safety demand ($\underline{\mu} < \mu < A_L$), the entire endowment of savers and experts is invested in originators' projects in the two economies. While in this region the entry of intermediaries does not affect aggregate investment, it do leads to some reallocation of experts' wealth from the equity of originators to that of intermediaries. The reduction of originators' exposure to risk, reduces their incentives to monitor the projects ($p^* < \bar{p}$), which reduces net expected output from the projects and aggregate

Figure 5: Equilibrium with intermediaries

(a) Welfare: Savers & Experts

(b) Aggregate welfare



welfare. Besides, the entry of intermediaries has redistributive effects: The associated expansion of the supply of safe securities pushes up the return paid to savers, reducing the return on equity. When the demand for safety is high ($\mu > A_L$), safe payoffs are so scarce in the benchmark economy that full investment is not feasible. The safe securities created by intermediaries relax originators' financing constraints, increasing aggregate investment. In this region, the entry of intermediaries leads both to aggregate welfare gains from the increase in investment they allow (first term in (60)) and losses from higher risk at origination augment (second term in (60)), and these two opposed effects are increasing in demand for safety.

Proposition 14 states that when demand for safety is sufficiently large ($\mu > \mu'$), the investment expansion effect dominates and the entry of intermediaries increases aggregate welfare. Even more, at higher values of the demand for safety ($\mu > \mu'_E > \mu'$), the investment expansion effect is so important that experts' welfare increases with the entry of intermediaries. In this region, securitization leads to a Pareto improvement in the economy.

6.3 Constrained efficiency of the equilibrium

In this section, we describe the problem of a "constrained" Social Planner (SP) and show that constrained versions of the Welfare Theorems hold in this economy.

We consider a SP that at the initial date can take decisions that are constrained by the three main preference and technological assumptions in the model: *i)* savers derive utility at $t = 1$ only from safe payoffs; *ii)* only originators can invest in projects at $t = 1$ and the project risk choice is unobservable; iii) only intermediaries can pool risky pay-offs at $t = 1$ and distribute their safe part to savers. Notice that the later assumption implies that the SP cannot do the pooling of the resources in the economy at $t = 1$ and distribute its safe part as consumption to savers. This task can only be conducted by intermediaries.

At $t = 0$ the SP decides which experts set-up and manage financial firms, allocates investors' funds into originators and consumption, and how the pay-off of the originators' projects at $t = 1$ will be distributed to the experts managing originators, the intermediaries, and savers, and how the payoffs transferred to intermediaries, after being pooled, are distributed to the experts managing intermediaries and savers.

Notice that since the two financial firms have access to constant return to scale technologies, we can simply assume that there is one representative originator managed by one expert with access to a well diversified pool of project and a representative intermediary managed by one expert that is the only agent that can pool the risky part of the originators' projects. For brevity, we refer to the exper manging the originator and intermediary simply as the originator and intermediary, respectively.

Taking this into account a SP allocation at $t = 0$ can be formally described by: the investment amount $N \in [0, 1]$ by the originator, the part $d_I \in [0, \Delta]$ of the risky payoff of each unit of the project that is transferred and pooled by the intermediary, aggregate consumption at $t = 0$ of the savers, the originator and the intermediary $(C_{S,0}, C_{O,0}, C_{I,0})$, and aggregate consumption at $t = 1$ by the savers $C_{S,1}$, *expected* consumption at $t = 1$ net of monitoring costs by the originator $C_{O,1}$, and *expected* consumption at $t = 1$ by the intermediary $C_{I,1}$. Notice that by construction the risk-choice of the originator is given by the function $\hat{p}(d_I)$ defined in Lemma (5).

An allocation $(N, d_I, C_{S,0}, C_{O,0}, C_{I,0}, C_{S,1}, C_{O,1}, C_{I,1})$ is *constrained feasible* if it satisfies the following four conditions.

Consumption at $t = 0$ equals the amount of funds that are not invested in the originator's projects:

$$C_{S,0} + C_{O,0} + C_{I,0} = 1 - N. \tag{61}$$

Savers consumption at $t = 1$ is limited by the overall amount of safe pay-offs

$$C_{S,1} \leq [A_L + (1-\lambda)\hat{p}(d_I)d_I]N. \quad (62)$$

The aggregate expected consumption of savers and the intermediary at $t = 1$ equals the expected pay-off of the project that is distributed out of the originatorintermediary's expected consumption amounts :

$$C_{S,1} + C_{O,1} = [A_L + \hat{p}(d_I)d_I]N. \quad (63)$$

Aggregate expected consumption at $t = 1$ net of monitoring costs equals the aggregate expected pay-off of the project net of monitoring costs:

$$C_{S,1} + C_{O,1} + C_{I,1} = R_A(\hat{p}(d_I))N. \quad (64)$$

We assume that the SP assigns weights λ^S, λ^E to the utility of savers and experts, respectively, which in particular means that she weights equally the welfare of the experts along the intermediation chain. The weighted expected aggregate welfare of a constrained feasible allocation is given by:

$$\begin{aligned} W_{\lambda^S,\lambda^E} &= \lambda^S(C_{S,0} + C_{S,1}) + \lambda^E(C_{O,0} + C_{O,1} + C_{I,0} + C_{I,1}) = \\ &= \lambda^E(1 - N + R_A(\hat{p}(d_I))N) + \left(\lambda^S - \lambda^E\right)(C_{S,0} + C_{S,1}), \end{aligned} \quad (65)$$

where in the last equality we have used the aggregate resource constraints at each date in (61) and (64). Notice that this expression only depends on investment N, the risky payoff that is distributed d_I, and the aggregate consumption allocated to savers at each date $C_{S,0}, C_{S,1}$. The interpretation of (65) is as follows. The first term gives weight λ^E to the aggregate utility in the economy, which coincides with aggregate expected surplus net of monitoring costs. The second term gives additional weight $\lambda^S - \lambda^E$ to the aggregate consumption of savers.

For given weights λ^S, λ^E we say that an allocation $(N, d_I, C_{S,0}, C_{S,1})$ is constrained efficient if it is a solution to the weighted expected aggregate welfare problem given by

$$\max_{(N,d_I,C_{S,0},C_{S,1})} \lambda^E(1 - N + R_A(\hat{p}(d_I))N) + \left(\lambda^S - \lambda^E\right)(C_{S,0} + C_{S,1}), \quad (66)$$

subject to

$$C_{S,0} \leq 1 - N, \quad (67)$$

$$C_{S,1} \leq [A_L + (1-\lambda)\hat{p}(d_I)d_I]N. \quad (68)$$

Finally, the *Pareto constrained efficient allocations* of the economy consists on all the allocations that are constrained efficient for some weights λ^S, λ^E.

It is easy to prove that (67) is necessarilly binding in any solution to the problem of the SP because the originators' project is valuable. This means that only savers might consume at $t = 0$. Besides, when the SP does not weight savers more than experts ($\lambda^S \leq \lambda^E$) then trivially $N = 1, d_I = 0$ and first best investment and risk-choice are achieved.

In contrast, when the SP weights more savers than experts ($\lambda^S > \lambda^E$) she faces a trade-off in its d_I choice between between worsening origination incentives and creating safe payoffs that relax the safe pay-off constraint (68) and allow to increase savers' consumption at $t = 1$. Using that (68) is also necessarilly binding in any solution, the FOC for an optimum d_I is given by

$$\left(\frac{\lambda_S}{\lambda_E} - 1\right)\left[(1-\lambda)\frac{\mathrm{d}\hat{p}(d_I)d_I}{\mathrm{d}d_I}\right] + \frac{\mathrm{d}R_A(\hat{p}(d_I))}{\mathrm{d}d_I} = 0.$$

Notice that using the equilibrium funding discount pass-trhough equation (43), the FOC above is equivalent to the equilibrium FOC for the optimal d_I choice of the originator in (34) provided that the SP weights and the equilibrium returns satisfy $\lambda_S/\lambda_E = R_E^*/R_S^*$. This suggests that the competitive equilibrium outcome is Pareto constrained efficient. Conversely, if after some initial date transfers across investors any possible equity spread R_E^*/R_S^* can be induced, then all the Pareto constrained efficient allocations would be achieved as an equilibrium outcome of the economy.

Building on these intuitions we can formally prove that constrained versions of the Welfare Theorems hold in this economy:

Proposition 15 *The equilibrium of the economy leads a Pareto constrained efficient allocation. Any Pareto constrained allocation can be achieved as the equilibrium of the economy following some initial date transfers across investors at the initial date.*

The reason why Welfare Theorems hold in this economy is that experts can freely set-up and invest in the two financial firms, which leads the SP to face the same trade-off than experts in equilibrium. For the SP, the way to improve savers utility is to create safe pay-offs, which implies deteriorating origination incentives and reducing the aggregate expected pay-offs that can be allocated to experts. The possibility of experts to freely reallocate from originators to intermediaries, and viceversa, and trade risky and safe securities in competitive markets, implies that the relative gains from creating safe pay-offs are represented in prices and returns, which lead to efficient allocations. In fact, it can be proved that when experts' investments are exogenously fixed the resulting equilibrium is not necessarilly constrained efficient.

7 Optimal public guarantees and risk-taking

In this Section, we consider a government with resources at $t = 1$ and analyze whether and how fiscally neutral public guarantees to the issuance of safe securities can improve welfare. The objective of these policies is to enhance the financial firms' capability to issue safe securities, thereby mitigating their scarcity in the economy. The analysis sheds new light on the welfare distributional effects from public guarantees to the financial sector and their interplay with risk-taking at origination. We find that public guarantees should be granted only to the issuance of safe securities by intermediaries and that, when combined with appropriate lump-sum transfers from savers to experts at the initial date, they Pareto improve the allocation in the economy. Besides, the impact of these policies on originators' risk-taking is ambiguous.

Formally, we extend the model to introduce a risk-neutral government with some assets whose payoff at $t = 1$ is $X > 0$.[11] The government can use its resources at $t = 1$ to provide guarantees to the issuance of safe securities by originators and intermediaries. We require the guarantees to be fiscally neutral, that is, each financial firm must fairly compensate in expectation athe government for access to the guarantees. The government thus faces at $t = 1$ disbursements from the guarantees issued to some of the firms and receives revenues from the compensation from other firms. We assume crucially that the government cannot pool its revenues at $t = 1$ to create safe securities that contribute to the repayment of guarantees. This could result from the assumption that the pooling of risky revenues is an activity that takes the government some time, so that those revenues would be at the disposal of the government only at a future date $t = 2$ in which savers do not derive utility from consumption. Experts instead have the skills to process pools of risky revenues received at $t = 1$ within that date, which allows them to create safe securities with payoff at $t = 1$ out

[11] We assume for simplicity that the payoff of the government assets at $t = 1$ is deterministic but all our results would hold with minor changes if the payoff were an increasing function of the aggregate shock z.

of pools of risky securities with payoff at that same date. Finally, the government can also conduct lump-sum transfers across agents at $t = 0$. We analyze how these policy tools allow to Pareto improve the allocation in the economy and their risk-taking effects at origination.

We next describe with some detail the policies at the disposal of the government, its resource constraint and the problem of the government:

Guarantee to intermediaries' issuance of safe securities For a given market return R_I and realization $\theta \in [1-\lambda, 1/p_{\max}]$ of the aggregate shock at $t = 1$, the return of the intermediaries's pool of risky securities is θR_I. In the baseline model, the intermediary can only pledge the safe return $(1-\lambda)R_I$ of its assets for the issuance of safe securities. A guarantee to the intermediaries' issuance of safe securities is described by an aggregate shock threshold $\overline{\theta} \in [1-\lambda, 1]$, and transfers $T_{\overline{\theta}}$ from the government to the intermediaries conditional on the aggregate shock θ and each intermediary's size y amounting to

$$T_{\overline{\theta}}(\theta, y) = \min(\overline{\theta} - \theta, 0) R_I y. \tag{69}$$

By construction, the government makes a subsidy to the intermediary when $\theta \leq \overline{\theta}$, so that the *after guarantees* safe payoff of an intermediary of size y satisfies

$$\min_{\theta \in [1-\lambda, 1/p_{\max}]} (\theta R_I y + T_{\overline{\theta}}(\theta, y)) = \overline{\theta} R_I y. \tag{70}$$

The expression above shows that the guarantee allows the intermediary to pledge a fraction $\overline{\theta} \geq 1 - \lambda$ of the return of its assets to issue safe securities. In fact, the guarantee threshold $\overline{\theta} = 1 - \lambda$ corresponds to the case of no guarantees, and $\overline{\theta} = 1$ to full guarantees.

The intermediary must compensate the government for the guarantee out of its residual claim. Under the assumption, which is satisfied in equilibrium, that an intermediary of size y exhausts its capability to issue safe securities ($B_S = \overline{\theta} R_I y$), the intermediary is able to repay in expectation the guarantee if and only if

$$\int_{1-\lambda}^{1/p_{\max}} T_{\overline{\theta}}(\theta, y) dF(\theta) \leq \int_{1-\lambda}^{1/p_{\max}} \max\left(\theta - \overline{\theta}, 0\right) R_I y dF(\theta). \tag{71}$$

The LHS of the inequality above corresponds to the expected cost of the guarantee for the government. The RHS accounts for the expected residual claim, a fraction of which must be used to repay the guarantee.

Using that by assumption $E[\theta] = 1$, it is easy to check that inequality (71) is equivalent to the condition $\overline{\theta} \leq 1$ on the guarantee threshold, which is always satisfied. Unsurprisingly, this means that the intermediary is able to repay in expectation any possible public guarantee against its exposure to aggregate risk. Besides, for a given balance sheet tuple for the intermediary, the presence of a fiscallly neutral guarantee does not affect the value of the residual claim.

The discussion above shows that when a fiscally neutral guarantee with threshold $\overline{\theta}$ is introduced, the only change to the intermediary's problem (12) - (15) is the safe repayment constraint (14), which becomes

$$B_S \leq \min_{\theta} \left(E\left[R_{I,z}|p,\theta\right] y + T_{\overline{\theta}}(\theta, y) \right) = \min_{\theta} \left(\theta R_I y + T_{\overline{\theta}}(\theta, y) \right) = \overline{\theta} R_I y,$$

where in the last equality we have used (70). Comparing to the expression for (14) in (38), we conclude that the introduction of a guarantee with threshold $\overline{\theta} \geq 1 - \lambda$ amounts to a "reduction" on the aggregate risk parameter to which the intermediaries are exposed from λ to $1 - \overline{\theta}$.

Guarantee to the originators' issuance of safe securities The return of the originators' projects can be either A_H or A_L depending on an idiosyncratic shock. In the baseline model, the originator can only pledge the safe return A_L of the project for the issuance of safe securities. A guarantee to the originators' issuance of safe securities consists on a per unit of the project transfer $\sigma \geq 0$ from the government to the originator when the L return is realized and a per unit of the project tax $\sigma' \geq 0$ the originator pays to the government when the H return is realized. Similar steps as those taken in Section 5.1 allow to derive the following risk-choice optimality condition for a given risky security promise d_I:

$$\Delta - d_I - (\sigma + \sigma') = c'(p). \tag{72}$$

Comparing to the analogous expression in the baseline model in (29), we have from Assumption 1 that the guarantee weakens the originators' incentives to monitor the project and leads to more risk-taking (p decreases for a given d_I).

Besides, for a given risk choice p, the fiscal neutrality of the guarantee can be written as:

$$p\sigma' = (1 - p)\sigma. \tag{73}$$

Using this fair pricing equality, we can rewrite the optimal risk-choice condition (72) as

$$\Delta - d_I - \frac{\sigma}{p} = c'(p), \tag{74}$$

which defines p as a function of d_I and σ.[12] Finally, as in the intermediary case, for a given balance sheet tuple for the originator, the presence of a fiscallly neutral guarantee does not affect the value of the residual claim.

The discussion above then implies that when a fiscally neutral guarantee described by σ is introduced, the originator's problem analyzed in Section 5.1 is only affected by the new risk choice optimality condition given by (74).

The government's resource constraint Recall that by assumption the government cannot process at $t = 1$ the taxes raised from the originators whose projects deliver a H return, so its only resources to satisfy guarantees at $t = 1$ amount to X. It is easy to check that the government disbursements are decreasing in the realization of the aggregate shock θ. Hence, for given guarantees to the financial firms described by the pair $(\overline{\theta}, \sigma)$, and values of the endogenous variables E_I, E_O, x, y, p, the governments' resource constraint is given by:

$$E_I \left(\overline{\theta} - 1 + \lambda\right) R_I y + E_O x \left[1 - (1 - \lambda)p\right] \sigma \leq X. \tag{75}$$

The intuition for the expression above is as follows. The LHS includes the disbursements made by the government to satisfy the guarantees to all the intermediaries and the originators whose projects have an L return under the aggregate shock $\theta = 1 - \lambda$. The RHS accounts for the resources of the government.

Initial date transfers The government can also conduct lump-sum transfers across agent types at $t = 0$. We assume that transfers are financed with an homogenous tax on wealth on the investor type that is taxed, and the funds raised are distributed proportionally to the other investor type. We can thus describe the initial date transfer by the (positive or negative) amount $\tau \in [-(1 - \mu), \mu]$ of funds distributed from savers *to* experts.

[12]When d_I and σ are large enough the equation might not have a solution, which puts an upper bound on the maximum guarantee that can be repaid by the originator. Besides, when a solution exists it might be multiple, but in that case we assume the largest one is selected as this choice would be optimal for the originator from an exante perspective.

The government's problem A *feasible* government policy consists of guarantees described by $(\overline{\theta}, \sigma)$ and a lump-sum transfers τ, such that the competitive equilibrium of the economy they induce satisfies (74) and (75). Notice that the *no intervention* government policy, described by $\overline{\theta} = 1 - \lambda, \sigma = 0, \tau = 0$, is trivially a feasible policy. Finally, we say that a feasible government policy is *optimal* if it induces an equilibrium outcome that i) Pareto improves the outcome of the no intervention policy and ii) is not Pareto improved by the equilibrium outcome of any other feasible government policy.

We start the analysis of optimal policies by describing how guarantees to financial firms can improve welfare and comparing two types of guarantees. The scarcity of safe pay-offs in the economy reduces aggregate surplus relative to a first-best outcome because of two reasons. First, it increases risk at origination as some of the risky payoffs of these firms are sold to intermediaries to manufacture safe securities, reducing originators' incentives to monitor. Second, it sometimes impedes full investment. The government has neither monitoring nor pooling skills, but its access to safe payoffs at the final date and its capability to be exposed to risk may nevertheless help to expand the supply of safe securities by the financial sector. In particular, the guarantees to intermediaries allow them to rely on less own funds to issue safe securities, which reduces the experts' funds scarcity. Similarly, the guarantees to originators provide these firms an instrument to expand the issuance of safe securities that, as opposed to securitization, does not need of the contribution of the own funds of other experts later on in the intermediation chain. In both cases, the government plays a loss absorbing role against aggregate shocks that mitigates the scarcity of experts' funds.

However, there is a crucial difference between the two guarantees that stems from the different exposure of originators and intermediaries to the sources of risk. Originators are exposed both to aggregate and idiosyncratic risk and, thus, even in bad aggregate shocks some originators obtain an H return and are taxed by the government. The taxes to originators necessary to finance the guarantees, on the one hand, erode monitoring incentives (see (74)) and, on the other hand, create some revenues for the government that it is not able to pool to create safe securities that contribute to the overall safe pay-offs that are pledged by the financial sector to savers.[13] In contrast, intermediaries are only exposed to aggregate

[13]In fact, the safe part of the taxes raised by the government per unit of originator project amounts to $(1 - \lambda)p\sigma'$, which corresponds to the product of the fraction of projects that succeed under the worst aggregate shock ($(1 - \lambda)p$) and the per unit of the project tax σ'.

risk, which implies that in bad aggregate shocks the government satisfies the guarantees to all the intermediaries and is repaid by none. In presence of guarantees to intermediaries, no safe colateral that is "carved-out" from the originators' risky payoffs (and because of that reduces monitoring incentives) is left "idle" in the hands of the government.

Formalizing the arguments above we have that:

Lemma 16 *The restriction to no guarantees to originators does not affect the set of allocations achieved by optimal policies. Besides, if X is small using guarantees to originators is never part of an optimal policy.*

The lemma states that guarantees to originators never create value in the economy when the government has also grant guarantees to intermediaries. The reason is that, due to the originators' exposure to idiosyncratic risk, guarantees to these firms create some "unpooled" resources from taxation with a safe part that erode monitoring incentives at origination but are not used for the issuance of safe securities. Instead, since intermediaries' balance sheets pool all idiosyncratic risks, guarantees to these firms ensure that all the potential safe colateral from the pooling of risky payoffs from originators is in fact part of the supply of safe securities. When the government safe resources are large, whether or not some potential safe colateral remains idle is irrelevant because the government itself has a sufficient capability to contribute to the supply of safe securities issuance.and the two guarantees are perfect subsitutes.[14] Yet, as the lemma states, if the resources of the government are small then the "idle" safe colateral associated with guarantees to originators reduces welfare and these guarantees are never part of optimal policies.

Lemma 16 allows to restrict from now on to policies that only include guarantees to intermediaries. We can prove that:

Proposition 17 *Optimal policies strictly Pareto improve the baseline economy and satisfy:*

- *If the baseline economy exhibits full investment ($\mu \leq \overline{\mu}$), they induce less risk-taking at origination.*

[14] When X is sufficiently large, the government can issue large guarantees to the originators (big σ) and induce no entry of intermediaries so that all the experts' endowment (after lump-sum transfers) is invested in originators. Equivalently, the government could issue full guarantees to the intermediaries ($\overline{\theta} = 1$), which would allow intermediaries to operate without equity, and again would lead all the experts' endowment to be invested in originators.

- *If the baseline economy does not exhibit full investment ($\mu > \overline{\mu}$), they increase investment and, for X small, they increase risk-taking.*

The proposition states that optimal policies strictly Pareto improve the economy. The reason is that guarantees on intermediaries are equivalent to a reduction in the maximum exposure to aggregate risk of intermediaries. This expands the Pareto frontier of allocations in the economy and due to the Second Welfare type of theorem in Proposition 15 implies that, after properly setting lump-sum transfers across investors at the initial date, guarantees strictly Pareto improve the economy.

Proposition 17 also provides some results on the risk-taking effects of the optimal policies. When demand for safety is small, the baseline economy exhibits full investment. In this case optimal policies, which strictly Pareto improve the economy and thus strictly increase aggregate surplus, must necessarilly lead to a reduction in risk-taking at origination. In absence of lump-sum transfers, the guarantees to intermediaries always strictly improve savers' wealth but in some situations they may reduce that of experts, so that a positive lump-sum transfer from savers to experts at the initial date is needed. When demand for safety is large then there is no full investment. When the government resources are small, in absence of lump-sum transfers the guarantees on intermediaries improve welfare by expanding safe securities' supply and increasing investment. Yet, the economy is not able to increase the safe securities return above one, so that all the welfare gains are appropriated by experts and the relative equity spread increases. This in particular implies that the intermediary's funding discount increases, and so does risk-taking. Besides, lump-sum transfer from experts to savers would allow the latter to appropriate some of the welfare gains from guarantees but they would exacerbate the demand for safety and thus risk-taking.

A final consideration is that the government can not fully solve the financial frictions stemming from absolute demand for safety and moral hazard at origination even if its resources are unbounded. The reason is that guarantees are a subsitute for the need of expert's funds in the pooling and tranching activities that create safe assets through securitization. Yet, the expansion of safe securities supply beyond the safe return A_L of the originators' project necessarilly involves a reduction of originators' exposure to the risk of the projects, which leads to a reduction on monitoring incentives. Since this cannot be avoided, the best that can do a government that is not constrained in its safe resources is to induce experts' endowment to be fully invested in originators.

To conclude, the Section shows that guarantees can increase welfare in a Pareto sense if suitably combined with lump-sum transfers. If the government has limited resources our findings highlight the importance of directing them towards guarantees to intermediaries. Finally, the risk-taking at origination effects of the introduction of optimal policies are ambiguous.

8 Conclusion

We present an equilibrium model of the capital structure and risk-taking in the originate-to-distribute intermediation chain in presence of absolute demand for safety by some investors and limited endowment by equity investors. Loan originators can finance the risky part of their assets through equity or by obtaining funding from intermediaries. The latter implies the transferring of risk outside the balance sheet and affects originators' risk-taking incentives. Intermediaries can pool the acquired idiosyncratic risks to issue safe securities and expand their balance sheets. But, the presence of aggregate risk implies that intermediaries rely on equity to do securitization. Equity investment in the intermediation chain serves two different purposes. At origination, it provides experts skin-in-the game that increases their incentives to monitor the loans. At intermediation, equity is a cushion for aggregate risk losses.

Following an increase in the demand for safety, the model predicts a securitization boom. The demand for safe assets leads to the reallocation equity from originators to intermediaries and implies an increase in leverage along the intermediation chain, the relative size of the intermediary sector and risk-taking at origination. We thus provides a single framework that captures the main features emphasized by the saving glut narrative of the run-up to the crisis.

We show that the frictionless capability to allocate equity between originators and intermediaries and the existence of competitive markets for safe and risky securities ensure the validity of constrained versions of the welfare theorems. The competitive equilibrium of the economy is constrained Pareto efficient and any allocation in the constrained Pareto frontier can be achieved as the competitive equilibrium of the economy following some redistribution of wealth across investors' types at the initial date.

We analyze the welfare implications of the emergence of securitization by comparing the originate-to-distribute economy relative to the traditional originate-to-hold benchmark. Securitization leads to the following general welfare trade-off. On the one hand, the distribution of risks out of originators leads to more risk-taking and reduces aggregate surplus. On the other hand, the expansion of safe securities supply increases aggregate lending when in the traditional economy all endowment cannot be channeled to finance loans, which increases aggregate surplus. We find that the aggregate lending effect on total surplus dominates if and only if the demand for safety is sufficiently large. Instead, if the demand for safety is not large enough, excessive risk-taking leads to aggregate losses and implies redistributive effects. Safety investors always benefit from the increased supply of safe assets. While the possibility to engage in securitization leads to more competition in the supply of safe securities and ends up depriving equity investors of some of the scarcity rents they enjoyed in the traditional financial sector.

We also show that when a government has safe resources, fiscally neutral public guarantees to the issuance of securitized assets can reduce the scarcity of safe securities in the economy, and lead to Pareto improvements in welfare if properly combined with lump-sum transfers across investors' types. Besides, these policies are preferable to the introduction of guarantees to originators because of the higher exposure of intermediaries' assets to aggregate risk. The issuance of guarantees to intermediaries always leads to an increase in the safe rate and welfare gains to the savers, but their effects on risk-taking at origination are ambiguous. These results shed new light on the equilibrium effects of public guarantees to the financial sector, the need to combine them with other redistributive policies and their interplay with risk-taking at origination.

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