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Discussion paper

A Shot at Regulating Securitization

BY

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Abstract

In order to incentivize stronger issuer due diligence effort, European and U.S. authorities are amending securitization-related regulations to force issuers to retain an economic interest in the securitization products they issue. The idea is that if loan originators and securitizers have more *skin in the game* they will more diligently screen the loans they originate and securitize. This paper uses a simple model to explore the economics of equity and mezzanine tranche retention in the context of systemic risk, accounting frictions and reduced form informational asymmetries. It shows that screening levels are highest when the loan originating bank retains the equity tranche. However, most of the time a profit maximizing bank would favor retention of the less risky mezzanine tranche, thereby implying a suboptimal screening effort from a regulator's point of view. This is mainly due to lower capital charges, loan screening costs and lower retention levels. This distortion gets even more pronounced in case the economic outlook is positive or profitability is high, thereby making the case for dynamic and countercyclical credit risk retention requirements. Finally, the paper also illustrates the importance of loan screening costs for the retention decision and thereby shows that an unanimous imposition of equity tranche retention might run the risk of shutting down securitization markets.

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1 Introduction

In the aftermath of the global financial crisis, European and U.S. authorities are putting in place new regulations that will force securitizers to retain economic exposure to the assets that they securitize assets in order to better align their interests with those of investors. More specifically, the Article 122a of the European Capital Requirements Directive and Section 941 of the U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act both impose a five percent minimum credit risk retention rate. The European version allows for several options, including retaining just the equity tranche, or equal amounts of all tranches (vertical slices).¹ U.S. rulemakers have yet to finalize the specifics of their retention requirements.

However, a number of recent papers have shown that both the size and form of the retention are critical to incentivizing due diligence. They show, for example, that the implementation should be flexible in order to achieve broad-based incentive alignments. Fender and Mitchell (2009) and Kiff and Kisser (2010) demonstrate that the optimal retention scheme, defined in terms of which tranches are retained and their thickness, depends critically on assumptions about the quality of the loan pool and the economic conditions expected during the life of the securitization. The Board of Governors of the Federal Reserve System (2010) stresses the importance of considering the economics of the underlying assets and securitization structure and, along with IMF (2009), the potential for other incentive alignment mechanisms to complement other forms of mandated risk retention.

¹Securitization is a process in which different assets or portfolios of cash flow generating securities are pooled together and then sold to third parties. This paper focuses on structured finance which further implies that cash flows of the entire portfolio are tranching into several slices which differ with respect to their risk-return characteristics. Tranche holders are paid in a specific order, starting with the senior tranches (least risky) working down through various levels to the equity tranche (most risky). If some of the expected cash flows are not forthcoming (e.g., some loans default), then, after any cash flow buffers are depleted, the payments to the equity tranche are reduced. If the equity tranche is depleted, then payments to the mezzanine tranche holders are reduced, and so on up to the senior tranches.

This paper compares the effects of equity and mezzanine tranche retention and thereby builds on the moral hazard model of Fender and Mitchell (2009), which in turn is influenced by Innes (1990). In that model, a loan originator has the option of securitizing a loan portfolio by selling different tranches to individual investors. While the initial proportion of "good" and "bad" borrowers is given exogenously, the originator can exert costly screening effort before the loan is made to increase expected return. Because the setup includes a systemic risk component, debt financing is not necessarily the optimal contract - a result which has been also found in Chiesa (2008). Specifically, the optimality of debt depends on the systemic outlook, the quality of the loan pool, idiosyncratic default probabilities and on how much credit exposure the loan originating institution retains.²

The innovation of this paper is to introduce accounting related frictions into the principal-agent problem and thereby allow the bank to maximize expected profits by choosing both the optimal amount of loan screening as well as the optimal retention size. The actual retention decision is driven by a tradeoff between accounting-related benefits of securitization, regulatory capital charges and reduced form adverse selection costs. Results show that equity retention usually best incentivizes diligent loan screening but at the same time a profit maximizing bank is likely to retain the mezzanine tranche due to lower loan screening costs and regulatory capital charges. Also, the higher the loan's promised return and/or the more positive the economic outlook, the larger the opportunity costs of retention, and hence the more profitable is mezzanine tranche retention. The main public policy implication of these results is that credit risk retention requirements should be based on accurate estimates of potential screening and opportunity costs, and be conditioned on the economic outlook.

²Note that because the model does not distinguish between loan originators and loan securitizers, the terms originator and securitizer will be used interchangeably.

Poorly designed retention schemes run the danger of actually shutting down securitization markets.

This paper relates to literature dealing with principal agent problems and credit risk transfer (CRT). Innes (1990) models a principal-agent problem between a risk-neutral entrepreneur with access to an investment project who makes an unobservable effort choice influencing the probability of success and an outside investor who provides the necessary funding for the project. Given limited liability of the entrepreneur, Innes (1990) shows that debt financing is the optimal contract in the context of unobservable and noncontractable effort choice. Chiesa (2008) models a loan originating bank which needs outside financing and extends the setup to allow for a systemic risk component. Because a high return does not necessarily mean that the bank has engaged in monitoring but instead can be the result of a favorable realization of the systemic risk factor, Chiesa (2008) is able to show that a pure debt contract is not optimal whereas CRT with limited credit enhancements enhances loan monitoring and expands financial intermediation. Fender and Mitchell (2009) adapt their setting to the case of asset securitization and develop a simple screening model in which a loan originating institution can screen borrowers and has the option to securitize its loan portfolio. Using a dynamic model, Hartman-Glaser, Piskorski, and Tchisty (2010) focus on the optimal contract for mortgage backed securities between an originator and outside investors. Under some technical assumptions, they are able to show that the optimal contract consists of a one time payment to the originator after having observed a default-free waiting period. Finally, Keys, Mukherjee, Seru, and Vig (2010) investigate whether securitization lead to lax screening and confirm empirically that conditional on being securitized, there is a positive relation between the ease of securitization and observed defaults.

More generally, the paper also relates to the literature on informational asymmetries. The "lemons problem", as coined by Akerlof (1970), shows that markets may break down in the context of informational asymmetries. Leland and Pyle (1977) use a signaling model to show how agency costs can be mitigated in the context of a partial firm sale. They model an entrepreneur with superior information regarding future prospects of assets in place who wants to sell part of his holdings to diversify risk. The entrepreneur can signal quality by retaining a larger fraction of the asset and thereby mitigate the agency problem. Gorton and Pennacchi (1995) focus on the subsequent adverse selection problem a bank faces if it engages in loan sales. However, they show that implicit contract features such as the retention of part of the loan and or implicit guarantees against default can make loan sales possible and thereby reduce agency problems. While Morrison (2005) shows that credit derivatives may destroy the signaling value of debt and thereby cause disintermediation and lower welfare, Niccolo and Pelizzon (2006) demonstrate that even in the context of credit risk transfer, banks may signal their own types by using first-to-default contracts. Similarly, DeMarzo (2005) shows that if assets are not only pooled but also tranching into different risk categories, banks can signal the quality of the sold loan portfolio by retaining interest in the equity tranche, thereby confirming optimality of a (standard) debt contract.

The paper proceeds as follows. Section [2] introduces the model and Section [3] presents the numerical analysis. Section [4] concludes and elaborates on the main policy implications.

2 Optimal Retention and Screening Policy

Similar to Fender and Mitchell (2009), we model a bank which extends individual loans to borrowers and then has the option of securitizing the loan portfolio and selling different tranches to individual investors.³ Outside investors and the bank are assumed to be risk-neutral and the risk-free interest rate is set to zero. A performing loan returns $R > 1$ while there is zero recovery for a defaulting loan.

The simplified economy consists of a continuum of good and bad borrowers who differ in their ability to repay the loan. The proportion of "good" borrowers is captured by the parameter θ which is given exogenously. The bank can exert costly screening effort e to increase the probability of lending to a good quality borrower. Denoting α_G and α_B as the revised probabilities of lending to good and bad borrowers, it is assumed that

$$\alpha_G(e) = (\theta + e) \tag{1}$$

$$\alpha_B(e) = (1 - \theta - e) \tag{2}$$

Screening borrowers is costly, which is captured by the cost function $c(e)$ which is assumed to be increasing in e and convex, i.e. $c(0) = 0$, $c'(e) > 0$ and $c''(e) > 0$. Similar to Carletti (2004) and Duffie (2008), we assume a quadratic cost function, i.e. we set $c(e) = \frac{\phi}{2}e^2$ to account for the convexity in effort costs. It is further assumed that at the time when the loans are extended, the originator has already decided if and in what form the loan portfolio

³The total amount of loans made to different borrowers is normalized to one.

	Good Borrower	Bad Borrower
High State	0	PD
Low State	PD	1

Table 1: Default Probabilities in the context of systemic risk

will be securitized. Effort level is chosen accordingly and then different tranches of the portfolio are sold to outside investors. Outside investors are only willing to make payments equal to the expected value of future cash flows conditional on the optimal effort level of the originator.

Finally, following Chiesa (2008) and Fender and Mitchell (2009) we introduce a systemic risk factor and assume that the economy can be either in a high or a low state and that the corresponding probabilities are given by p_L and p_H . The state of the economy has a distinct impact on each borrower. In the high state, the good borrower is always able to repay the loan while the bad borrower may default with a probability PD . In the low state, the bad borrower always defaults with probability one while the good borrower only does so with a probability of PD . Table [1] summarizes the assumption.

Summing up, we can now define the expected cash flows of the entire loan portfolio in the low and the high state of nature of the economy.⁴

$$P_L(e) \equiv [(1 - PD)(\theta + e)] R \quad (3)$$

$$P_H(e) \equiv [(\theta + e) + (1 - PD)(1 - \theta - e)] R \quad (4)$$

⁴Note that due to having assumed that there is a continuum of good and bad borrowers with corresponding subcontinua depending on their idiosyncratic default probabilities, it follows that expected and realized cash flows of the individual states of nature coincide.

It follows that the expected cash flow of the entire portfolio is given by $P(e) = p_L P_L(e) + p_H P_H(e)$. The bank has the option to create a structured product and sell different tranches to outside investors. For simplicity, it is assumed that the structured product consists of a senior tranche, a mezzanine tranche and an equity tranche and that equity and tranche holders retain a fraction t of the loan portfolio. In this case, promised payments to more senior tranche holders are given by $R(1 - t)$. For the case of mezzanine tranche retention, it is assumed that equity and mezzanine tranche are of the same size t such that payments to more senior tranche holders are given by $R(1 - 2t)$.

Due to the systemic risk component, the monotone likelihood ratio property does not always hold which is why debt financing, i.e. equity tranche retention, is not necessarily the optimal contract. While the non-optimality of debt also depends on the systemic outlook and the idiosyncratic default probabilities, the thickness of the respective tranches is most relevant as has been illustrated by Kiff and Kisser (2010). However, it is important to recognize that the systemic outlook, the quality of the loan pool and individual default probabilities are exogenous factors to the bank while the size of retention, or skin in the game, would be chosen by the bank.

In order to make the retention decision practically relevant, some market friction is needed. DeMarzo (2005) assumes that the source of market friction is superior valuation ability of banks which is why they profit from increasing volume, i.e. buying undervalued assets and selling them at market prices. However, if banks sell everything then they face a lemons problem as they are not able to signal the quality of their assets for sale. Alternatively, Fender and Mitchell (2009) argue that banks can benefit from accounting loopholes as an upfront sale of the loan portfolio allows for early recognition of profits. This effect may even

get exacerbated if managerial compensation is linked to short-term profits. To capture this intuition, we assume that whenever the bank sells more senior tranches and those tranches are expected to be fully paid back, then it may be able to value the corresponding upfront payments at a premium to its notional amount. On the other hand, if the bank sells more risky tranches (i.e. sells equity and keeps the mezzanine tranche), then no premium can be realized with respect to the more risky tranche.

Assumption 1 *If the bank retains an equity tranche of thickness t which is not expected to be exhausted, then it is able to value upfront payments for selling a total of $(1-t)R$ mezzanine and senior tranches at $S_E(t) = (1 - t^2)R$.*

While the choice of the specific functional form is somehow ad-hoc, it allows us to capture the benefits of securitization and to also consider agency costs due to informational asymmetries in a reduced form approach.⁵ This effect can be seen in Figure [1].

The solid blue line plots the fixed upfront payment $R(1 - t)$ for different values of t where R is set to 2. The dashed green line displays values corresponding to the concave function $(1 - t^2)R$. It can be seen that starting with a fully retained loan portfolio, i.e. $t = 1$, the initial marginal benefit of securitizing is very high and it subsequently decreases the more of the loan portfolio is sold to outside investors. We can also see that if the entire portfolio is sold to outside investors, i.e. $t = 0$, the net benefits from securitization are zero such that the originator is only able to value the upfront payment at its notional value. The assumption thus captures the intuition that initially securitizing is beneficial to the bank but the less credit exposure is retained, the more agency costs relating to asymmetric information

⁵Besides, the intuition is similar to Jensen and Meckling (1976) who illustrate a trade-off between agency costs of equity and agency costs of debt in the capital structure choice of a single firm.

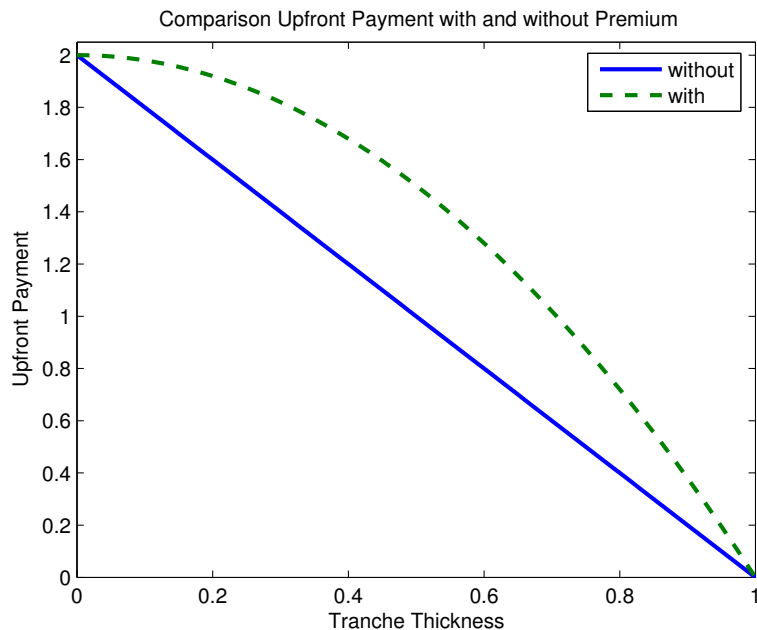


Figure 1: Visualizing the Intuition of Assumption [1]

dominate and eliminate the marginal gain from securitizing an additional unit. We follow a similar intuition for the upfront payment relating to the case when the bank retains the mezzanine tranche which is formalized in Assumption [2].

Assumption 2 *If the bank retains a mezzanine tranche of thickness t which is not expected to be exhausted, then it is able to value upfront payments for selling a $(1-2t)R$ senior tranche at $S_M(t) = (1 - 4t^2)R$.*

Although the functional forms implicitly capture the trade-off between accounting related benefits of securitization and costs due to adverse selection, it is important to note that the framework presented is not a signaling model a la Leland and Pyle (1977) and DeMarzo (2005).

From a practical perspective, banks face also costs of regulatory capital charges depending on how much credit exposure they retain. We therefore specifically introduce capital charges into the model and assume a linear cost function for capital requirements.

Assumption 3 *To capture the various capital charges associated with each of the retention mechanisms, we assume the following linear cost function*

$$k(t) = k_i \cdot t \tag{5}$$

where k_i captures capital charges, conditional on the specific retention mechanism. Specifically we assume that $k_i = CAR \times RW_i \times (R - 1)$ where CAR is the capital adequacy ratio, RW_i denotes the risk weight under equity or mezzanine retention and $(R - 1)$ captures the opportunity costs of the capital charges.⁶

Combining above, we are now able to write down the following general maximization problem.

$$\max_{e,t} \Pi(e, t) = S(t) + F(e, t) - c(e) - k(t) - 1 \tag{6}$$

where $F(e, t)$ denotes the cash flows relating to the retained credit exposure. The subsequent analysis investigates how optimal screening effort and tranche size differ depending on whether the bank retains the equity or the mezzanine tranche.

Retaining interest in the equity tranche is similar to holding a call option on the performance of the loan portfolio with a strike price equal to the promised payments to senior and

⁶The intuition for this assumption is as follows. As the bank is required to retain capital in its balance sheet it does not lose the entire amount but only the option to originate even more loans. Thus, the true costs of capital requirements are foregone profits or opportunity costs.

mezzanine tranche holders. Specifically, expected profits of the retained credit exposure are given by

$$F(e, t) = p_L \max \{P_L(e) - B_1(t), 0\} + p_H \max \{P_H(e) - B_1(t), 0\} \quad (7)$$

where $B_1(t) = (1 - t)R$ denotes the promised payments to mezzanine and senior tranche holders.

Proposition 1 *If the bank does not allow the equity tranche to be exhausted in both states of nature, then the maximization problem is given by*

$$\begin{aligned} \max_{e,t} \Pi_{E1}(e, t) &= (1 - t^2)R + p_L [P_L(e) - B_1(t)] + p_H [P_H(e) - B_1(t)] \\ &- \frac{\phi}{2}e^2 - k_E t - 1 \end{aligned} \quad (8)$$

$$s.t. B_1(t) \leq P_L(e) \quad (9)$$

$$e \leq 1 - \theta \quad (10)$$

$$e \geq 0 \quad (11)$$

where [9] is the positive payoff constraint of equity tranche holders in the low state of nature and the minimum and maximum effort constraints [11] and [10] consider the fact that the probability of making a good loan is bounded by zero and one.

We can see that under equity retention, the bank is able to benefit from market imperfections for the entire fraction of the loan portfolio sold to outside investors in case it does not make use of its limited liability option. However, once it allows the equity tranche

to get exhausted in the low state of nature, then it will only partly benefit from market imperfections as can be seen in Proposition [2].

Proposition 2 *If the bank makes use of its limited liability option in the low state of nature, the maximization problem is given by*

$$\begin{aligned} \max_{e,t} \Pi_{E2}(e,t) &= p_L P_L(e^*) + p_H(1-t^2)R + p_H [P_H(e) - B_1(t)] - \frac{\phi}{2}e^2 \\ &- k_E t - 1 \end{aligned} \tag{12}$$

$$s.t. B_1(t) \leq P_H(e) \tag{13}$$

$$e \leq 1 - \theta \tag{14}$$

$$e \geq 0 \tag{15}$$

Depending on whether expected profit is higher by enforcing a non-negative payoff in the low state of nature or by making use of its limited liability option, the bank will choose effort and tranche size accordingly.⁷ Note that the solution to Propositions [1] and [2] are given in the Appendix whereas the corresponding interpretation of the results is deferred to Section [3].

However, the ultimate interest lies in answering whether mezzanine retention induces higher screening effort than equity retention and whether this outcome is practically feasible. The payment structure when investing into the mezzanine tranche of a structured product is similar to holding subordinated or junior debt. Specifically, the claim is given by

⁷In principle, one would also need to check whether it is optimal for the bank to make use of the limited liability option in the high state of nature. For presentational simplicity and due to the fact that this scenario almost never becomes relevant in the numerical analysis, we abstract from this case here.

$$\begin{aligned}
F(e, t) &= \min [\max \{P_L(e) - B_2(t), 0\}, tR] p_L \\
&+ \min [\max \{P_H(e) - B_2(t), 0\}, tR] p_H
\end{aligned}
\tag{16}$$

where $B_2(t) = (1 - 2t)$ denotes promised payments to senior tranche holders. Because the maximum payment mezzanine tranche holders can receive is capped at tR , they will only exert so much screening effort as to guarantee this payoff in the low state of nature. At the same time, this implies that the equity tranche will be exhausted in this case. Combining above together with the fact that the payoff in the high state of nature is always larger than the payoff in the low state, i.e. $P_H(e) > P_L(e)$, the expected value of the equity tranche, denoted as $C(t)$, is given by

$$C(t) = 0 + p_H (P_H(e^*) - B_1(t)) \tag{17}$$

as long as it does not get exhausted in the high state of nature. Using this together with Assumptions [2] and [3], Proposition [3] is as follows.

Proposition 3 *Under mezzanine tranche retention, if the equity tranche is not expected to*

be exhausted in the high state of nature, the maximization problem of the bank is given by

$$\begin{aligned} \max_{e,t} \Pi_M(e,t) &= C(t) + (1 - 4t^2)R + p_L (P_L(e) - B_2(t)) + p_H t R \\ &\quad - \frac{\phi}{2} e^2 - k_M t - 1 \end{aligned} \tag{18}$$

$$s.t. B_2(t) \leq P_L(e) \tag{19}$$

$$P_L(e) \leq B_1(t) \tag{20}$$

$$e \leq 1 - \theta \tag{21}$$

$$e \geq 0 \tag{22}$$

where [19] is the positive payoff constraint of mezzanine tranche holders in the low state of nature, [20] is the maximum payoff constraint of mezzanine tranche holders in the low state of nature and the minimum and maximum effort constraints [22] and [21] consider the fact that the probability of making a good loan is bounded by zero and one.

Clearly, the different maximization problems provide different incentives to screen loans and although we obtain the optimal screening effort and tranche size as closed form solutions, it is practically impossible to judge which retention mechanism dominates the other due to the various kinks in the payoff functions. The next section will therefore present numerical examples using the solutions to Propositions [1] to [3] which are provided in the Appendix.

3 Numerical Analysis

This section uses extensive numerical analysis to judge whether equity or mezzanine tranche retention results in higher screening effort and which retention mechanism would maximize expected profits. We start our analysis by focusing on the stylized case of a market with high systematic and idiosyncratic risk which can be thought of as a proxy for the subprime market. Then, we perform a variety of robustness checks by varying the impact of screening costs, capital requirements and loan profitability as well as macroeconomic factors such as the systemic risk component and the fraction of good quality borrowers.

3.1 Baseline Scenario

We start our analysis by calculating implied screening effort for the case of equity and mezzanine tranche retention. All effort levels will be displayed relative to the amount of effort the bank would exert in case it retained the entire loan portfolio. Results are presented for all default probabilities for which securitization is profitable for at least one of the two retention mechanisms.

For the baseline scenario, it is assumed that three out of 10 borrowers in the economy are classified as good ($\theta = 0.3$) and that the probability of entering a downturn is equal to 80 percent. Furthermore, the gross return R is set to 1.1 and ϕ is equal to 1. Following the Basel II framework, the capital adequacy ratio is equal to 8 percent, risk weights for equity retention are set to 1250 percent while those of mezzanine tranche retention are assumed to be 100 percent.

The left panel in Figure [2] displays the amount of screening effort exerted relative to the case when the entire loan portfolio was retained.⁸ It can be seen that for default probabilities of up to 12 percent, equity tranche retention best incentivizes diligent loan screening. However, in order for equity tranche retention to be efficient, securitizers have to retain sufficient skin in the game such that the equity tranche is not expected to be exhausted and such that interests are aligned. The right panel in Figure [2] illustrates that substantially more credit exposure is retained in case the securitizer retains the equity tranche.

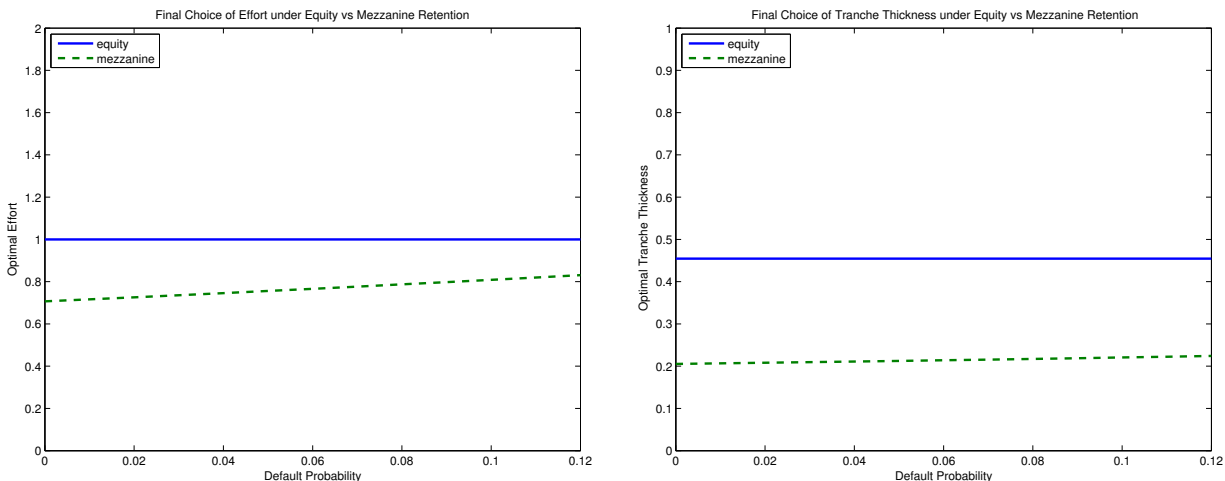


Figure 2: Optimal Screening Effort and Tranche Thickness

The main interest lies in analyzing whether a profit maximizing securitizer would actually choose equity or mezzanine tranche retention if left with the decision. Figure [3] therefore displays profit levels under both retention schemes. It can be seen that the securitizer would choose equity retention as long as the default probability is less than 6% and mezzanine tranche retention otherwise. Intuitively, this is because the equity tranche is the first to suffer any losses which is why expected profits decline if the default probability is increased.

⁸The case for which the entire portfolio is retained corresponds to the case in which there is no securitization activity.

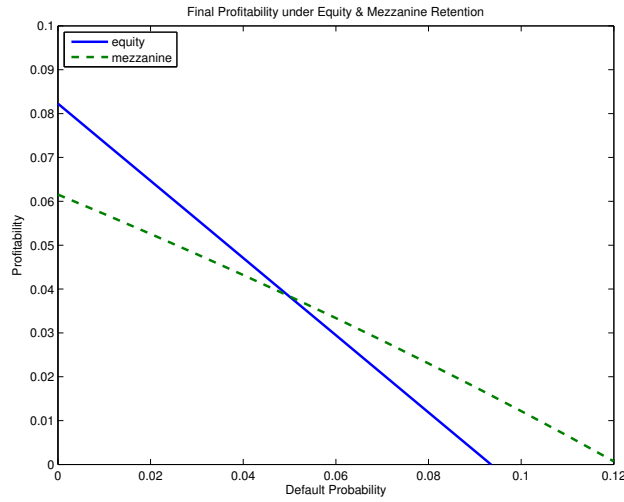


Figure 3: Profitability under Equity and Mezzanine Tranche Retention

The simple example shows that for the stylized case of a low quality market, i.e. high fraction of bad borrowers and high chances of economic downturn equity tranche retention would best incentivize loan screening. However, a profit maximizing securitizer would not necessarily choose to retain the equity tranche due to its high implied level of loan retention. Before discussing any potential policy implications, it is important to know how results change if different parameter values are assumed. We therefore start by varying the magnitude of capital costs, screening costs and the gross return of the individual loan and assess its implications for expected profits and screening level. Then, we investigate the influence of the macroeconomic environment, as measured by the fraction of good and low quality borrowers and the systemic risk component on retention policy.

3.2 The Profit Drivers

3.2.1 The impact of loan screening costs

As a first step, we analyze the impact of screening costs on the retention decision. Instead of setting ϕ equal to one, we assume a value of 5% which is common in the Corporate Finance literature relating to agency costs of free cash flow.⁹ It turns out that due to the low costs of screening, the bank will exert maximum screening effort under both equity and mezzanine tranche retention for default probabilities of 17% and higher which is visualized in the left panel of Figure [4]. For portfolios with lower risk, mezzanine tranche retention leads to less screening activity due to the lower amount of skin in the game. The right panel of Figure Figure [4] confirms that implied retention under equity retention is considerably higher than under mezzanine tranche retention.

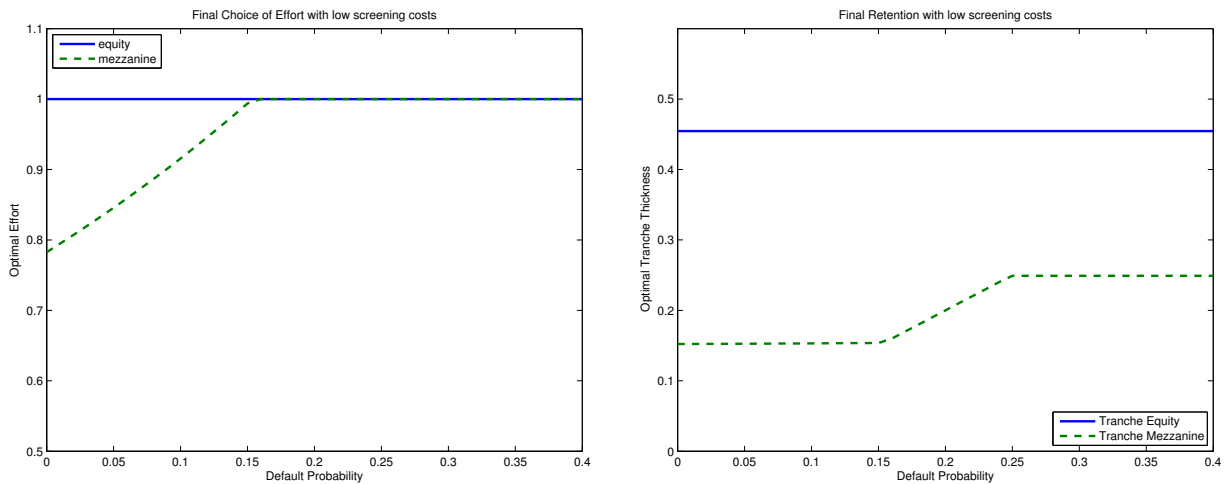


Figure 4: Optimal policies for low screening costs.

⁹For more details see for example Eisfeldt and Rampini (2009).

Finally, Figure [5] shows that securitization is more profitable than for the baseline scenario. Projects with default probabilities of up to 40% receive financing and equity retention generates higher expected profits than mezzanine tranche retention for default probabilities of up to approximately 17%. This example illustrates how crucial it is that policymakers have a good estimate of potential screening costs across different securitization markets before designing any active policy recommendation. If the costs of performing due diligence are prohibitively high, then a unanimous imposition of equity tranche retention might not lead to a higher level of screening activity but could just simply shut down certain credit markets.

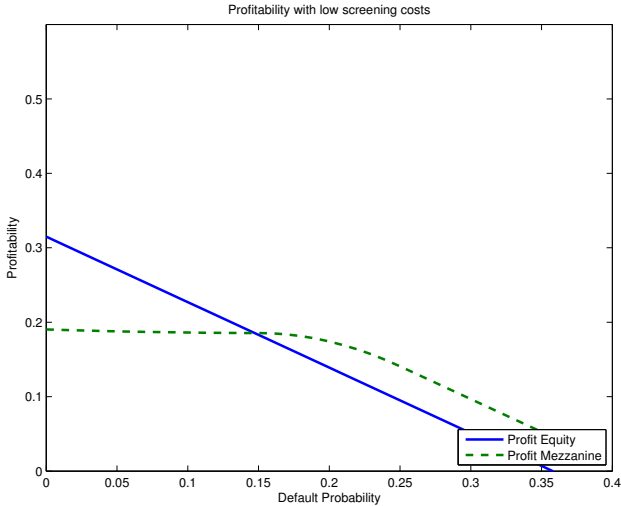


Figure 5: Profitability under Equity and Mezzanine Tranche Retention

3.2.2 The impact of capital requirements

Capital requirements have a direct impact on the profitability of securitization but they affect equity and mezzanine tranche retention in a different way. To analyze the sensitivity of the results with respect to capital charges while preserving their asymmetric influence,

we therefore reduce their monetary impact in the profit function. The left panel in Figure [6] displays the corresponding screening levels if capital charges are reduced to 10 percent of their actual value. It can be seen that equity tranche retention continues to best incentivize diligent loan screening whereas under mezzanine tranche retention screening effort is lower than for the baseline scenario. On the other hand - as visualized in the right panel - implied tranche thickness is considerably higher under equity tranche retention.

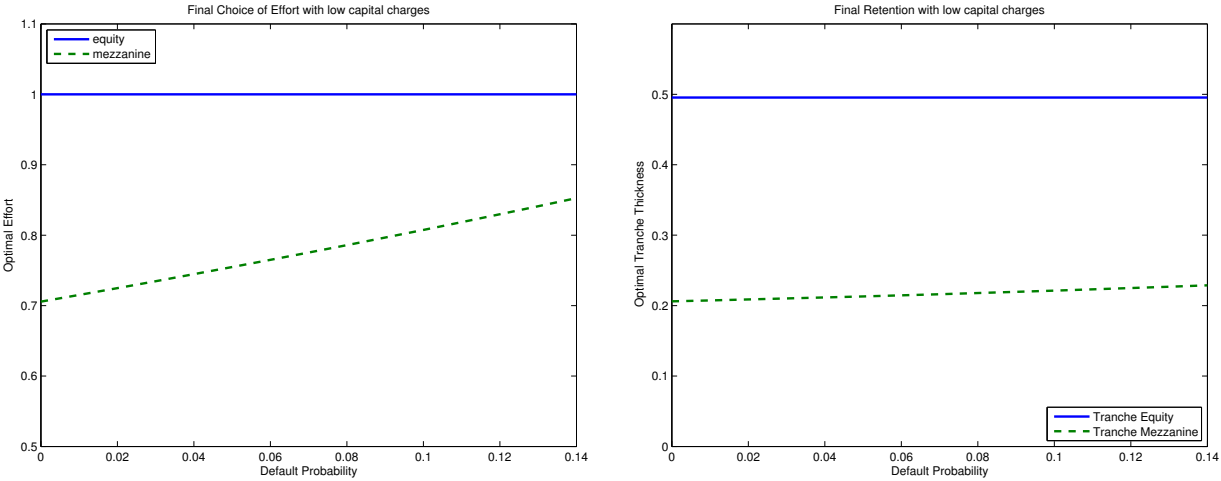


Figure 6: Optimal policies for low capital charges.

Looking at Figure [7], we can see that the region for which projects are financed using equity tranche retention more than doubles (with respect to the baseline scenario) to default probabilities of up to 14% whereas there is basically no impact on the profitability under mezzanine tranche retention. This is due to the fact that that the initial risk weight under mezzanine tranche retention is rather small which makes its impact negligible. Most importantly, equity retention delivers both the highest expected profit and the highest level of loan screening activity. While we do not argue that regulators should decrease the cost

of retaining the most risky asset, we want to emphasize the possible feedback effect on the incentives to retain credit exposure.

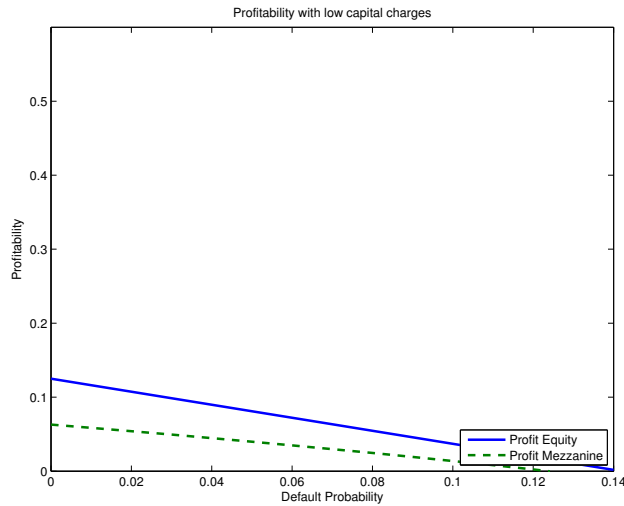


Figure 7: Profitability under Equity and Mezzanine Tranche Retention

3.2.3 The impact of loan profitability

Finally, we can analyze the effect of the gross return on relative profitability and screening levels. We therefore set R equal to 1.5 and analyze implied screening activity and retention. Figure [8] shows that for default probabilities of approximately 20%, mezzanine tranche retention leads to a lower amount of loan screening than retention of the equity tranche. This is because when investing into the mezzanine tranche of a structured product, maximum payoffs are capped such that for low levels of default probabilities there is little incentive to screen loans more diligently. In other words, because the expected return of investing into the mezzanine tranche is high and risk is low, the bank has little incentive to screen loans diligently. At the same time, retention is considerably lower under mezzanine tranche retention.

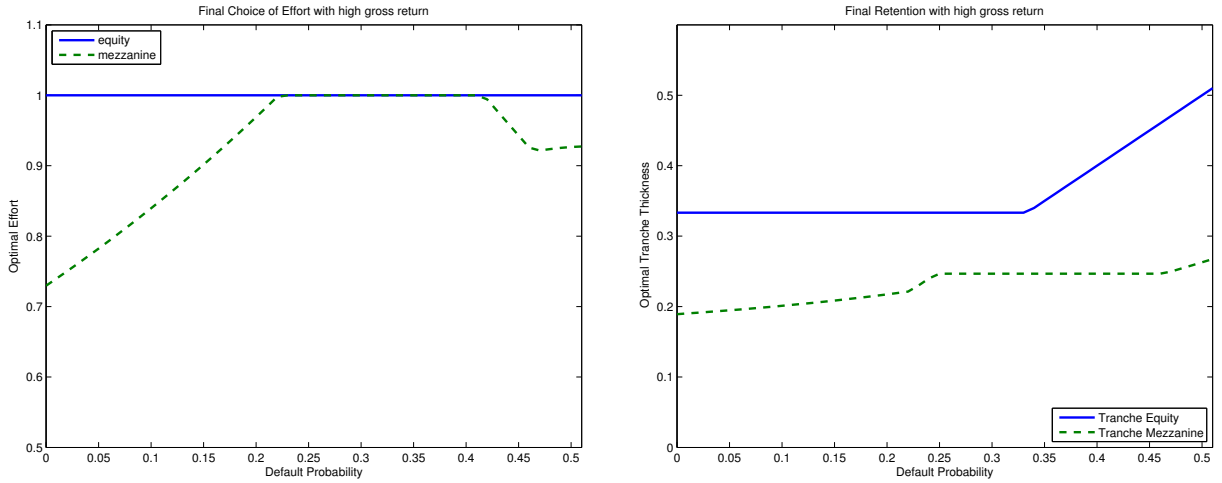


Figure 8: Optimal policies for high profitability.

At the same time, it turns out that mezzanine tranche retention always generates higher profits than retaining the equity tranche. The reason is that equity retention becomes increasingly costly as the opportunity cost of capital charges are positively related to the gross return R . Thus, because retention is more costly under equity tranche retention, the bank optimally chooses to retain the mezzanine tranche in case loans promise a high expected return. This is visualized in Figure [9].

3.2.4 Intermediate Summary

Summing up, we have seen that capital charges have a strong impact on the incentives to diligently screen loans and borrowers. This can be explained by the fact that in order for equity retention to be effective, a profit maximizing bank has to ensure that the next risky tranche is safe and this is achieved by increasing the thickness of the equity tranche. While this leads to the highest possible screening effort, it also reduces expected profits compared to the case of mezzanine retention due to the comparably much higher capital charges. This

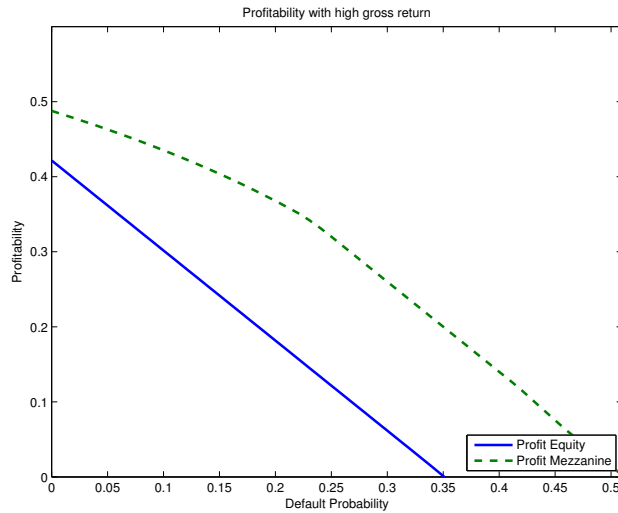


Figure 9: Profitability under Equity and Mezzanine Tranche Retention

feedback effect even gets more pronounced in case gross profit is high as the opportunity costs of retaining funds become increasingly expensive in this case. While we do not argue that capital costs should be reduced to restore banks' incentives to retain the equity tranche, it is important to consider this negative feedback effect when giving regulatory advice.

Another factor influencing the retention decision is the magnitude of loan screening costs. We have seen that once it becomes cheaper to screen, more projects receive financing. However, at the same time this makes high screening effort under mezzanine tranche retention also much more likely.

It is therefore crucial that regulators have a good estimate of loan screening costs and the relative profitability of the different credit markets in order to avoid any of the above mentioned undesired effects.

3.3 The Effect of the Macroeconomic Environment

The results presented so far have focused on one stylized credit market characterized by a large fraction of low quality borrowers and a high chance of an economic downturn. We now relax this assumption and present results for different levels of systematic risk and varying fractions of good and low quality borrowers.

3.3.1 The impact of the future state of the economy

Figure [10] displays optimal screening activity, tranche retention and profit levels for equity and mezzanine retention under different economic scenarios. Under the first one, we assume that the economy will enter a recession with 90% probability, under the second one we make no directional assumption regarding the future state of the economy and finally we set the probability of entering an upturn equal to 70 percent. It can be seen that if one expects an economic downturn, then only projects with default probabilities of up to 8% would receive financing and equity tranche retention would be the preferred choice both in terms of screening effort and profitability. On the other hand, if chances of an economic upturn are 50% or higher, then more projects are financed and a profit maximizing bank would always choose to retain the mezzanine tranche. The main reason is that the positive economic outlook allows the bank to save on screening costs in case the less risky mezzanine tranche is retained.

3.3.2 The impact of loan quality

We now assess how the quality of a given credit market influences loan screening activities and therefore change the fraction change the fraction of high quality borrowers in the economy. Figure [11] displays optimal screening effort, retention policy and profitability when the

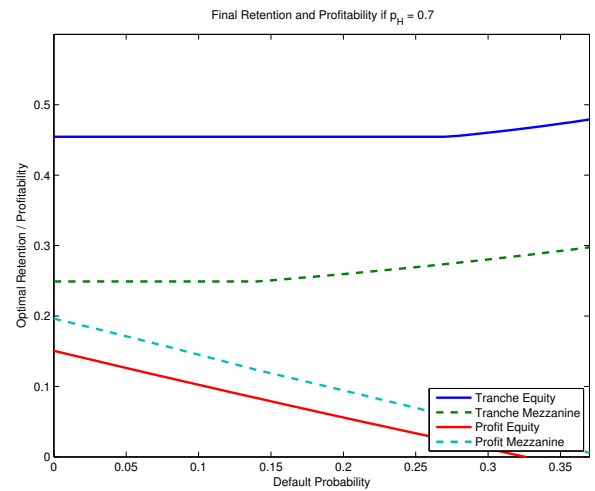
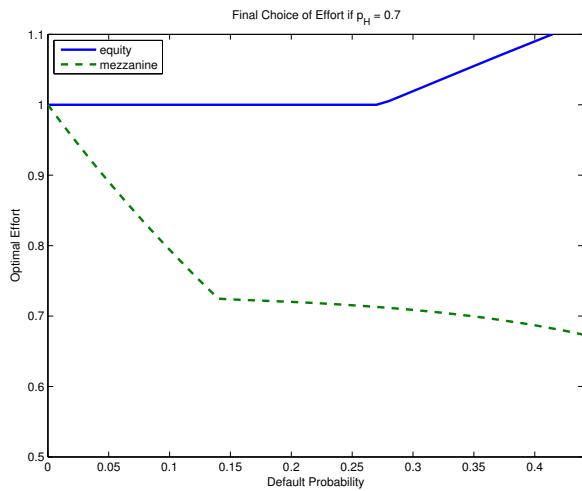
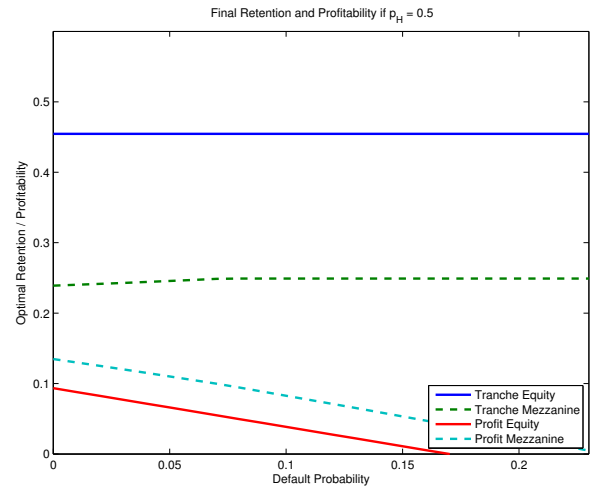
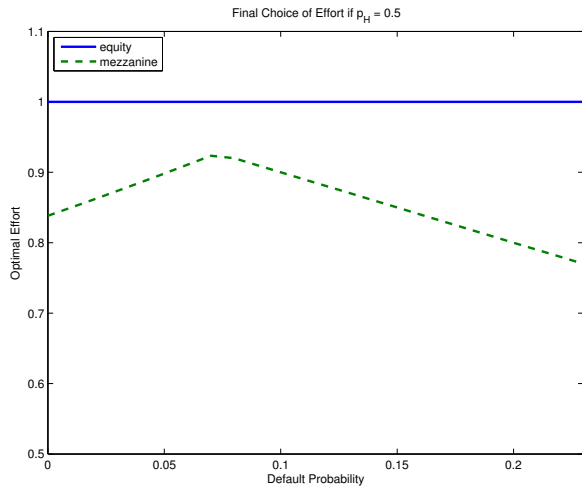
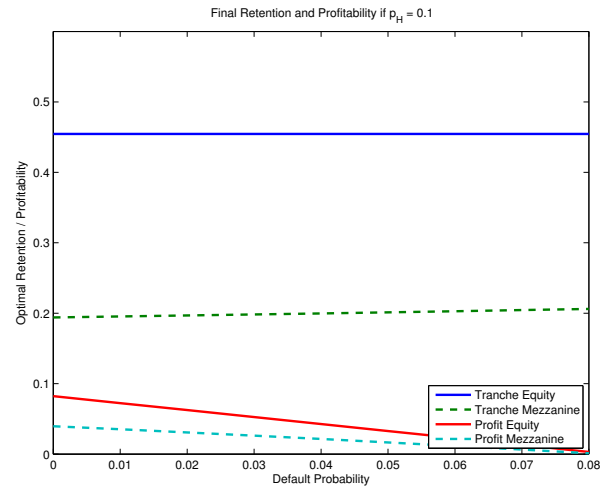
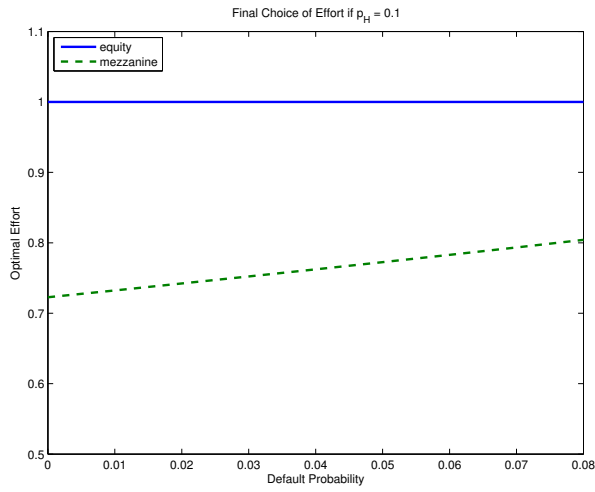


Figure 10: Optimal policies for different economic scenarios.

parameter θ is set to 50% or 80%. We can see that for both cases, equity tranche retention delivers the highest screening effort but that it would only be the preferred choice for default probabilities of less than approximately 15%. One can thus observe a similar pattern as for the benchmark case.

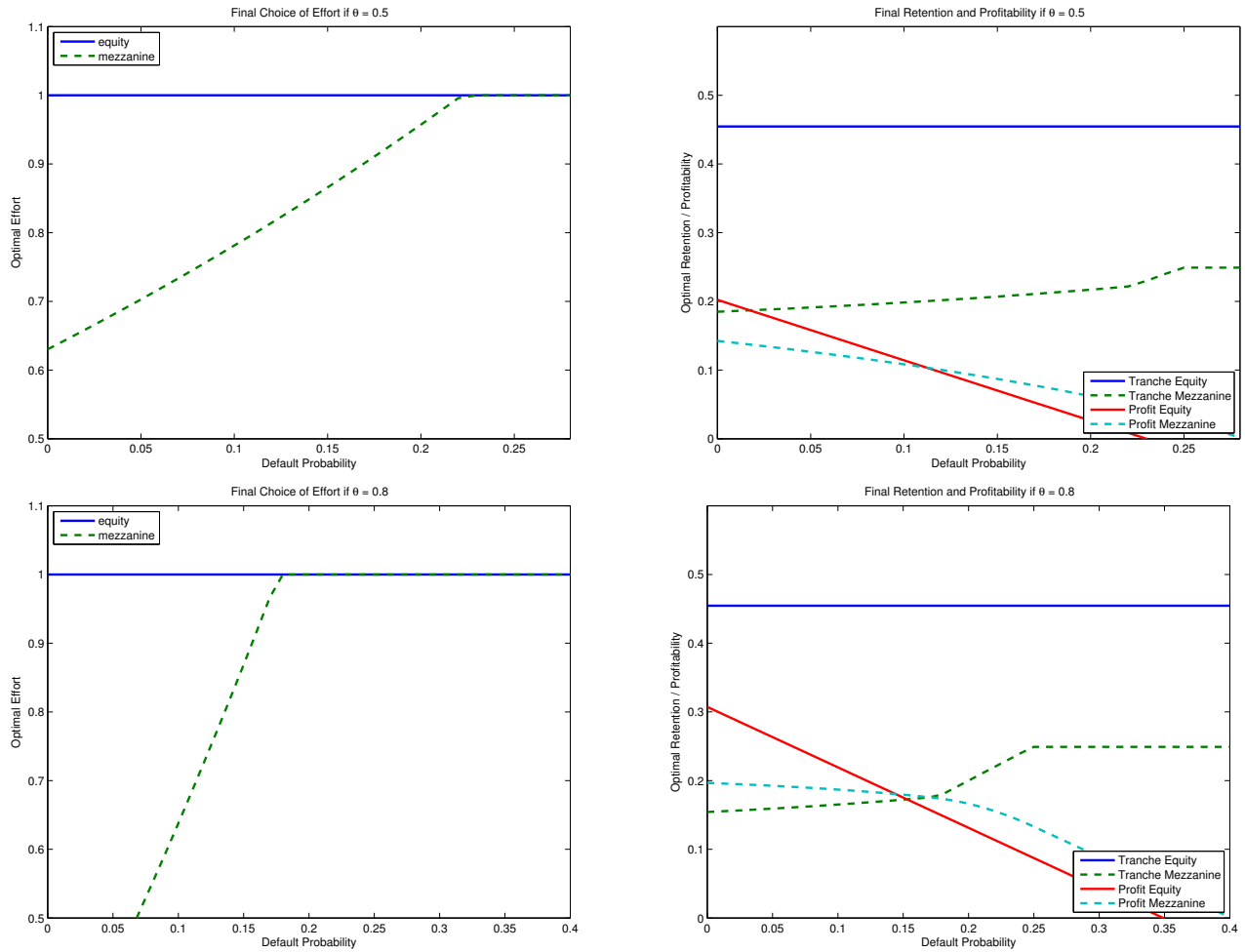


Figure 11: Optimal policies for different fractions of high and low quality borrowers.

3.3.3 A high quality market

So far, all the robustness checks we have presented displayed results by only changing one parameter whereas the others have been left unchanged at the level of the baseline scenario. As a last step, we therefore display optimal policies and profit levels for the case of a high quality market, i.e. we set the parameter θ equal to 60% and assume that the chances of entering an economic up- or downturn are equal.

Figure [12] displays corresponding results. It can be seen that for nearly all levels of default probability, a profit maximizing bank would choose to retain the mezzanine tranche. At the same time, the implied screening level is considerably below the one obtained if the equity tranche was retained. Besides, it can be seen that optimal retention size under mezzanine retention is considerably lower than under equity retention as visualized in the right panel of Figure [12]. Thus it seems again that once the expected outlook is of neutral to good quality, mezzanine retention would be the preferred choice due to lower screening costs.

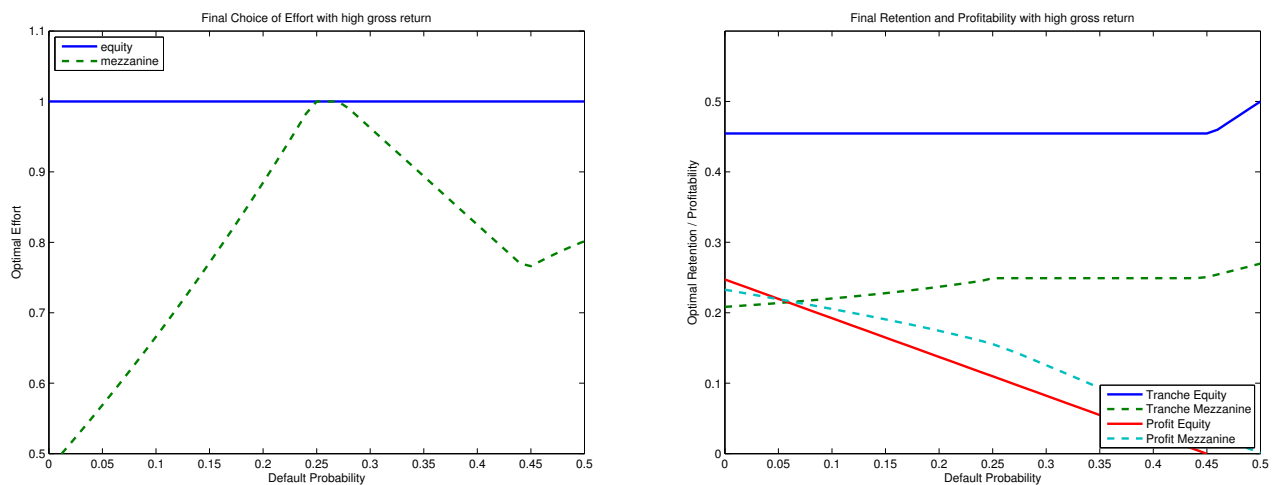


Figure 12: Optimal policies for high quality market.

4 Conclusion

This paper compares the effects of equity and mezzanine tranche retention by investigating the corresponding incentives of a loan securitizing bank to screen loans and retain skin in the game. The analysis accounts for systemic risk, accounting frictions, regulatory capital requirements, and reduced form informational asymmetries.

We find that equity tranche retention generates the highest possible screening effort but, most of the same time, a profit maximizing bank will choose to retain the mezzanine tranche and therefore exert less screening effort. The intuitive reason is given by the fact that both screening costs and capital charges are higher under equity retention than in case the mezzanine tranche was retained.

The paper also illustrates the importance of accurate estimates of loan screening costs for risk requirement regulations. In that light, an unanimous imposition of equity tranche retention in case of high loan screening costs might run the danger of shutting down certain areas of securitization markets. Regulators should also be aware that while higher profitability generally makes securitization more profitable, it also reduces banks' incentives to retain the equity tranche due to higher associated capital requirements.

Finally, it is also shown that a more positive economic outlook allows the bank to save on screening costs in case the less risky mezzanine tranche is retained. That is, a profit maximizing bank would choose to retain the mezzanine tranche even though the implied screening level is only suboptimal from a regulator's point of view. The analysis therefore suggests that a more dynamic and countercyclical risk retention requirement policy could vary with the business cycle by, for example, requiring equity retention during boom periods.

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A Appendix

A.1 Proof of Proposition [1]

Proof.

[Proof] The maximization problem is as follows

$$\begin{aligned}
 \max_{e,t} \Pi_{E1}(e,t) &= (1-t^2)R + p_L [P_L(e) - B_1(t)] + p_H [P_H(e) - B_1(t)] \\
 &\quad - \frac{\phi}{2}e^2 - k_E t - 1 - \lambda_1 [P_L(e) - B_1(t)] - \lambda_2 [e + \theta - 1] - \lambda_3(-e)
 \end{aligned} \tag{23}$$

If $\lambda_1 = \lambda_3 = 0$ and $\lambda_2 \geq 0$, the solution is given by

$$\begin{aligned}
 e^* &= \min \left[(p_L(1-PD) + p_H PD) \frac{R}{\phi}, 1 - \theta \right] \\
 t^* &= \frac{1}{2} - \frac{k_E}{2R}
 \end{aligned} \tag{24}$$

If $\lambda_1 > 0$, $\lambda_2 \geq 0$ and $\lambda_3 = 0$, the solution is given by

$$\begin{aligned}
 e^* &= \min \left[\frac{k_E(1-PD) + R [2(1-PD) - p_H(1-2PD) - 2(PD-1)^2\theta]}{\phi + 2(PD-1)^2R}, 1 - \theta \right] \\
 t^* &= \max \left[\frac{\phi - k_E(PD-1)^2 + (PD-1)(2PD-1)p_H R + (PD-1)\phi\theta}{\phi + 2(PD-1)^2R}, PD \right]
 \end{aligned} \tag{25}$$

Finally, if $\lambda_1 = \lambda_3 > 0$ and $\lambda_2 = 0$ then

$$\begin{aligned} e^* &= 0 \\ t^* &= 1 - (1 - PD)\theta \end{aligned} \tag{26}$$

Note that $\lambda_2 = \lambda_3 \geq 0$ is not possible.

■

A.2 Proof of Proposition [2]

Proof.

[Proof] The maximization problem is as follows

$$\begin{aligned} \max_{e,t} \Pi_{E2}(e,t) &= p_L P_L(e^*) + p_H(1 - t^2)R + p_H [P_H(e) - B_1(t)] - \frac{\phi}{2}e^2 \\ &\quad - k_E t - 1 - \lambda_1 [P_H(e) - B_1(t)] - \lambda_2 [e + \theta - 1] - \lambda_3(-e) \end{aligned} \tag{27}$$

If $\lambda_1 = \lambda_3 = 0$ and $\lambda_2 \geq 0$, the solution is given by

$$\begin{aligned} e^* &= \min \left[p_H PD \frac{R}{\phi}, 1 - \theta \right] \\ t^* &= \frac{1}{2} - \frac{k_E}{2R\rho h} \end{aligned} \tag{28}$$

If $\lambda_1 > 0$, $\lambda_2 \geq 0$ and $\lambda_3 = 0$, the solution is given by

$$\begin{aligned} e^* &= \min \left[\frac{PD [k_E + 2PDp_H R(1 - \theta)]}{\phi + 2PD^2 p_H R}, 1 - \theta \right] \\ t^* &= \max \left[\frac{PD(\phi(1 - \theta) - k_E PD)}{\phi + 2PD^2 p_H R}, 0 \right] \end{aligned} \quad (29)$$

Finally, if $\lambda_1 = \lambda_3 > 0$ and $\lambda_2 = 0$ then

$$\begin{aligned} e^* &= 0 \\ t^* &= 1 - \theta - (1 - PD)\theta \end{aligned} \quad (30)$$

Note that $\lambda_2 = \lambda_3 \geq 0$ is not possible.

■

A.3 Proof of Proposition [3]

Proof. The maximization problem is given as follows.

$$\begin{aligned} \max_{e,t} \pi_M(e, t) &= C(t) + (1 - 2t^2)R + p_L (P_L(e) - B_2(t)) + p_H t R - \frac{\phi}{2} e^2 - ct \\ &\quad - 1 - \lambda_1 [B_2(t) - P_L(e)] - \lambda_2 [P_L(e) - B_1(t)] - \lambda_3 [e + \theta - 1] - \lambda_4(-e) \end{aligned} \quad (31)$$

If $\lambda_1 = \lambda_2 = \lambda_4 = 0$ and $\lambda_3 \geq 0$, the solution is given by

$$e^* = \min \left[(1 - PD)p_L \frac{R}{\phi}, 1 - \theta \right] \quad (32)$$

$$t^* = \frac{1}{2} - \frac{k_M}{4R} \quad (33)$$

If $\lambda_1 > 0$, $\lambda_3 \geq 0$ and $\lambda_2 = \lambda_4 = 0$, the solution is given by

$$e^* = \min \left[\frac{k_M(1 - PD) + (1 - PD)R2(p_L - \theta(1 - PD))}{2(\phi + (PD - 1)^2R)}, 1 - \theta \right] \quad (34)$$

$$t^* = \max \left[\frac{2\phi - k_M(PD - 1)^2 + (PD - 1)^2 p_H R - 2\theta(1 - PD)}{4(\phi + (PD - 1)^2R)}, \frac{PD}{2} \right] \quad (35)$$

If $\lambda_1 = \lambda_4 > 0$ and $\lambda_2 = \lambda_3 = 0$, the solution is given by

$$e^* = 0 \quad (36)$$

$$t^* = \frac{1 - (1 - PD)\theta}{2} \quad (37)$$

If $\lambda_2 > 0$, $\lambda_3 \geq 0$ and $\lambda_1 = \lambda_4 = 0$, the solution is given by

$$e^* = \min \left[\frac{k_M(1 - PD) + (PD - 1)R[-4 + 2p_H + p_L + 4\theta(1 - PD)]}{1 + 4(PD - 1)^2R}, 1 - \theta \right] \quad (38)$$

$$t^* = \max \left[\frac{1 - k_M(PD - 1)^2 + (PD - 1)^2 [2p_H + p_L R] - \theta(1 - PD)}{1 + 4(PD - 1)^2R}, PD \right] \quad (39)$$

If $\lambda_2 = \lambda_4 > 0$ and $\lambda_1 = \lambda_3 = 0$, the solution is given by

$$e^* = 0 \tag{40}$$

$$t^* = 1 - (1 - PD)\theta \tag{41}$$

Note that it is not possible that both $\lambda_1 = \lambda_2 > 0$. Otherwise, it would immediately follow that as $\hat{t}(e) = 0$ as $B_2(t) = P_L(e)$ and $P_L(e) = B_1(t)$. This in turn implies that

$$e^* = \frac{1}{1 - PD} - \theta \tag{42}$$

Because $\lambda_2 = 0$, we need that $e^* < 1 - \theta$ which only holds true if $PD = 0$. Excluding the economically uninteresting case where $PD = 0$, the contradiction finishes the proof.

■