Governance and Design of Structured Securities: Theory and Evidence

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Abstract

This paper provides theory and evidence on structured security governance, and how governance structure affects security design. We focus on two types of frictions that exist in addressing situations of financial distress—costly effort provision and risk shifting incentives.The main insights of the model are: (1) In a second-best world in which control over loan modification decisions is vested with one particular class of securityholders, the junior securityholder who holds the first-loss position exerts an efficient level of effort and is in the best position to resolve financial distress; (2) That said, although effort provision is efficient, there are incentives for junior securityholders to shift risk by playing for time, where governance mechanisms that limit risk shifting can be value enhancing; (3) Security design as measured by subordination level at the time of issuance depends on the anticipation of security governance decision outcomes. Empirical analysis of two distinct samples of commercial mortgage-backed securitiesissuances supports many of the model predictions, including the relative efficiency of junior security control over the special servicer and the value enhancing properties of specific governance mechanisms.

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Governance and Design of Structured Securities: Theory and Evidence

1 Introduction

U.S.-style securitization requires setting up a bankruptcy remote special purpose vehicle (BR-SPV) to isolate assets backing the securitization from other assets of the issuer. Then, once the relevant assets have been deposited into a BR-SPV, it is typically the case that the asset pool (composed exclusively of mortgages or some other type of debt) is static in the sense that no additional assets are contributed to the BR-SPV after the securities issuance date.[2] The static nature of securitized asset pools has, as a consequence, created the impression that securitygovernance is a nonexistent or uninteresting issue in the structured securities market.

This impression is a false one, however, as recent experience in the private-label structured mortgage-backed securities has shown. Indeed, credit risk is central to investment in many mortgage-backed and other asset-backed securities. Governance structures are, as a consequence, implemented not only to comply with tax and regulatory rules, but also in anticipation of decisions that will be required to resolve loan default and financial distress.[3]

[2] But assets will exit the asset pool due to prepayment, default or simply going to term.

[3]Tax law in the U.S. calls for securitizations to conform as much as possible to *if-then/automon-style* rules that limit discretionary decision-making in a post security issuance setting. But the law also recognizes the practical realities of incomplete contracting, implying that some discretion will be required to deal with problems as they arise. As a consequence, the compromise has been to provide discretion to certain agents,

Using the commercial mortgage-backed securities (CMBS) market as a model, this paper considers the governance of structured securities. We recognize that two types of post-issuance activities occur with securitization,involving a master servicer whoconsiders the collective interests of all securityholders. The first activity, which we will not emphasize,involvesthe collectionof loan payments from borrowers and appropriate distribution of collected cash flows to securityholders.

The second activity is a centrol focus of the paper. This activity requires the master servicer to decide how to proceed when a payment default happens. Specifically, in response to a loan payment default, after making an assessment of the borrower's situation as well as broader market conditions, the master servicer decides whether or not to transfer the loan to a special servicer. The special servicer is an agentwhose job it is to maximize the continuation value of a loan in financial distress. The alternative of not transferring the loan to the special servicer isimmediate loan liquidation and sale of the security backing the loan. These decisions are important because they affect both the timing and distribution of cash flows to the various securityholders.

Although the master servicer considers the interests of all securityholders, for cost efficiency reasons the special servicer is assigned to follow the instructions of a particular class of securityholders. In our model with only two classes of security interests, the special servicer is controlled by either the junior securityholders or the senior securityholders. Given a particular control structure, two kinds of distortions can occur in resolving financial distress. First, depending on the controlling securityholder's payoff sensitivity to effort provision, the special servicer may underinvest or even possibly

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but to do so within a structure set up at the time of security issuance that governs *ex post facto*decision-making.

overinvest in effort during the loan continuation phase. Second, as a result of distorted effort provision or the possible influence of a controlling securityholder over the master servicer, risk shifting may occur. Risk shifting happens because loan modification (loan liquidation) adversely affects the timing and expected payoffs of the senior (junior) securityholders.

The model generates a number of results that are amenable to empirical testing. First, due to efficient effort provision, junior securityholder control of the special servicer is shown to weakly dominate non-junior control, implying that junior control should be frequently observed in the data. Junior securityholder control is also predicted to result in lower subordination levels than senior control, particularly when weak asset resale market conditions are expected.

Second, due to possible influence costs resulting in risk-shifting to senior securities, junior securityholder control of the special servicer is most problematic when resale asset market conditions are expected to be strong (default is borrower specific, or idiosyncratic, as opposed to being caused by poor market conditions). This implies that mechanisms to control risk shifing incentives should be most prevalent when stronger resale asset market conditions are expected. In these cases, lower subordination levels are realized.

Third, non-junior control of the special servicer, when it occurs, should be associated with expectations of stronger asset resale market conditions. Mechanisms to increase special servicer effort provision should be utilized, particularly when asset resale market conditions are not expected to be strong. Introduction of these mechanisms reduces subordination levels below those that result with non-junior control and no mechanisms in place.

To assess empirical implications of the model, we analyze two distinct sampleperiods over which CMBS where issued. The first sample period is from 1994 to 1996, coveringthe early development of the CMBS market to the point where the market began entering a more mature phase just prior to the onset of the Asian financial crisis. Empirical results support our theory of optimal security design and governance. Specifically, we find that junior securityholder control over special servicing decisions is typically observed in the data andresults in lower subordination levels than non-junior control. But, although junior control is viewed positively as measured by subordination level, offsetting effects are found to exist with respect to therisk-shifting problem, as also predicted by our model.

To further examine empirical implications of our model, we also analyze a sample of more recent CMBS issuances that occurred over the 2004 to 2007 time period. Empirical results based on this sample also support predictions of our theory, and are consistent with results generated by the older sample. One specific finding is that when there is non-junior securityholder control over the special servicer, and the special servicer is also the master servicer,effort underinvestment problems are limited to result in lower realized subordination levels.

As far as we know, the only other paper to study optimal security design in the context of security governance is Riddiough (1997). In that paper he considers servicer control rights associated with an asset information asymmetry problem. This paper instead focuses on a double moral hazard problem in which the anticipated actions of the special servicer feed back to affect *exante* security design. We also empirically test specific predictions of the model, whereas the earlier paper focuses only on theoretial model development.

Only a very few other papers discuss the importance of security governance and itslink to security design. Jacob and Fabozzi (2003) point out that in most cases the special servicer owns the most junior classes, and that this sometimes leads to conflicts of interest. Closely related empirical research by Chen and Deng (2003) and Gan and Mayer (2006) study the special servicer's role in managing troubled loans, but do not focus on implications for front-end security design. Ambrose, Sanders, and Yavas (2010) consider a different potential conflict that may exist between the master and special servicers in handling troubled loans, and how those conflicts might be diminished if the master and special servicing rights are held by the same firm. We develop a similar theme in the context of how alignment between the two servicers helps improve issuance proceeds realized by the issuer when control of the special servicer is vested with non-junior securityholders.

This paper also contributes to a rapidly expandingliterature on structured security design, including work ofDemarzo (2005), An and Deng (2006), Deng, Quigley and Sanders (2004), Fan, Ong, and Sing (2006). Other recent studies have focused more specifically on security design and loan quality associated with default. For example, Piskorski, Seru, and Vig (2009) examine the effects of securitization on *expost* loan modification outcomes. Further such work includes Adelino, Gerardi and Willen (2009), and Agarwal et al. (2010).

The paper is organized as follows. In section 2 we present a theoretical model of security governance and security design, preceding by a brief description of how thestructured securitiesmarket works. Section 3 presents the data and preliminary results, while section 4 provides formal empirical tests of model predictions. The paper ends with a summary of the main findings.

2 A Model of Security Design and Governance

2.1Brief Description of the Structured Securities Market and Servicer Roles

In a typical asset-backedsecuritization, a number of assets, such as commercial mortgages, are grouped together in a single pool. Our focus will be on pooled cash flows that are subject to credit risk. Security structuring is such that credit enhancement occurs through the subordination of security interests.

Figure 1 presents a simple visual depiction of senior-subordinated classes of securitization interests. A line indicating subordination level separates senior securityholders from junior securityholders. A waterfall repayment structure is specified in which the senior securityholders have a priority claim principal payments made into the pool, including any proceeds from the sale of securitythat happens subsequent to payment default. Junior securityholdersare residual claimants, being allocated any realized losses from default and receiving whatever principal is left over after the senior securities are paid in full.

Figure 1 Here

It is well known that, for fundamental as well as regulatory reasons, strong demand exists in the marketplace for investment-grade (particularly AAA-rated) securities. With this in mind, at the security design stage the issuer typically proposes a capital structure tocredit rating agencies, who then provide credit ratings to the various securities. From the issuer's perspective, the optimal capital structure is one in which the quantity of securities labeled senior is maximized. Or, stated differently,in order to satisfy excess demand for senior securities, the capital structure that maximizes issuance proceeds is one in which subordination levels are minimized (see, e.g., Partnoy (2009)for perspective on excess demand existing due to regulatory distortions). This implies that the subordination level that divides the senior from junior securities is right at the investment-grade "margin."

With securitization, third party specialists are involved in the loan production process. Servicing is particularly important to securitization. A master servicer oversees the collection of payments, monitors assets that collateralize issued securities, and works to ensure the timely payment of interest and principal to securityholders. When a loan experiences a payment default, the master servicer makes an initial determination as to the severity of the default and possible loss resulting from immediate liquidation and sale of the security. If the master servicer determines that losses realized from an immediate liquidation and sale are sufficiently severe, the loan is transferred to a special servicer that has expertise in loan renegotiation and modification.

The governance challenge with special servicing is aligning the interests of the special servicer with the interests of the securityholders as a whole. Finding a cost-effective "voting" mechanism that applies across all securityholders is difficult. As a result, the special servicer is typically assigned to follow instructions of a particular class of securityholders. Doing so inevitably results in conflicting interests across security classes. The effectiveness of a special servicer that is controlled by particular security classes is ultimately an empirical question. The aim of the rest of the paper is to examine whether issuers, at the initial security design stage, attempt to account for the potential distorting effects of security governance by modifying subordination levels and/or introducing other mechanisms that cancontrol distorting behavior at low cost.

2.2Model

In this section we develop a theory of optimal security governance and security design. Through the model we concisely summarize rights and responsibilities of those involved in the structured securities default resolution process, and analyze the balance of power that exists between master servicers (MS), special servicers (SS), junior securityholders, and senior securityholders in the context of identifying optimal governance mechanisms and security designs.

All agents are risk-neutral and the risk-free rate is normalized to zero. An issuer holds a standard debt claim with a promised payoff of$L$, which is due one period. The debt is secured by a single assetwhose value at time 0 is $P, P \geq L$. The future asset value is uncertain, either increasing or decreasing in value in one time period. In a good state, asset value is $\overline{P}$, and the debt is fully paid in the amount of$L$. In a bad state, asset value is $\underline{P} < L$, which causes the borrower to default on the promise to repay *L*.

For exogenous reasons, assume that at time 0 the debtholderis motivated to sell the loan to raise cash, and that partitioning the loan into a senior and a junior security is more valuable than selling the loan whole. The incremental value from partitioning the loan into securities is due to excess demand for the senior securities. This excess demand results in the issuer's objective of maximizing the size of the senior security subject to the restriction that payoffs to the senior security are invariant to state-contingent payoff outcomes.

Security governance structure is established by the issuer at the time of security issuance with the objective of maximizingtotal security value. For our purposes, security governance is specifically defined as follows. Given that a default state occurs at time 1, the MSis tasked with decidingwhether or not to transfer the loan to special servicing, where MS decisions are to be made in the collective interest of all securithholders.

Conditional on borrower default, a decision not to transfer the loan to special servicing implies immediate liquidation, meaning that the loan collateral is sold with sales proceeds distributed to securityholders. In this case the payoff is $\beta R(e^{L})$, with*R* denoting a baseline recovery value as a function of effort level,e^{L}, supplied to market the underlying asset that collateralized the loan. We restrict$\beta < 1$, where β is a recovery value parameter that is associated with immediate liquidation. One way to think of β is as a proxy for asset market conditions when liquidation is immediate (see, e.g., Shleifer and Vishny (1992), Brown, Ciochetti and Riddiough (2006)). The cost of supplying sales marketing effort is linear in effort level, where $R(e)$ increases in e at a decreasing rate, and where $R(0)$ is sufficiently large so as to satisfy regularity conditions. To be concrete, we will specifically assume that $R(e) = \underline{R} + \alpha\sqrt{e}$, $\alpha>0$, with $R(e)$ realized at a cost of e.In liquidation the cost of marketing effort is internalized, meaning that the MS controls the marketing of the asset in order to ensure an appropriate level of effort is exerted.

If the loan is transferred by the MS to the SS, it is extended one period with investors receiving the asset value at the end of the period. For simplicity, assume that the asset value is either $R(e^{E}) < L$ or 0 at the new maturity date, withassociated probabilities p and $1-p$, respectively. When external market conditions do not deteriorate over the extension period, occurring with probability p, the special servicer adds value by eliminating the sales discount of $1-\beta$ as well as provides effort to further increase the asset value. The risk of loan extension is exposure to a deterioration in market conditions, which causes the asset value to equal 0 with probability $1-p$. Depending on the structure of the SS function, the cost of effort provision may or may not be internalized. Figure 2 visually displays payoffs conditional on liquidation versus renegotiation outcomes.

Figure 2 Here

2.3 First-Best

To benchmark our main results, we first examine the first-best case in which the master servicer fully and efficiently fulfills the duties that are otherwise assigned to the special servicer. The problem is solved with backward induction.

Consider the effort decision conditional on loan default and liquidation. In this case the first-best effort level is determined by:

$$\max_{e} \; \beta R(e) - e \tag{1}$$

with optimal e^L such that $e^L = \frac{(\alpha\beta)^2}{4}$.

If the loan is transferred to special servicing, loan extension occurs with the first-best level of effort determined as follows:

$$\max_{e} \; pR(e) - e \tag{2}$$

with optimal e^Esuch that $e^E=\frac{(\alpha p)^2}{4}$.

Given these first-best levels of effort, the decision of whether or not to place the loan into special servicing can be made. This decision will hinge on the value of the asset from immediate liquidation as compared toits expected asset value from loan extension, inclusiveof the costs of effort provision. Straightforward analysis shows that liquidation is optimal when $\beta>p$(indicating a good resale market or a low probability of a successful outcome from loan extension) and that special servicing is optimal when $\beta<p$.

The first-best security design can now be stated.[4] When $\beta>p$ the master servicer will liquidate the loan conditional on borrower default, and the size of the senior security is $\beta R(e^L) - \beta\left[\underline{P}+\frac{\alpha^2\beta}{2}\right]$. This payoff is fixed regardless of whether the borrower defaults or not at time 1, thus satisfying the criteria of maximizing the size of the senior security subject to a fixed and constant payoff to senior securityholders independent of state-contingent realizations.

In contrast, when $\beta<p$, and conditional on borrower default,the special servicer is called in and the loan is extended. In this case, given the stated model structure with only one loan collateralizing the securities, the senior security is exposed to payoff risk given the possibility of realizing a zero payoff from loan extension. To eliminate state-contingent payoff risk, a senior security size of$pR(e^P) - p\left[\underline{P}+\frac{\alpha^2 p}{2}\right]$can be established and justified by appealing to two distinct rationales. One rationale is that an arbitrarily large pool of identical but imperfectly correlated assets would, by the law of large

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[4] Implicit in our approach is that any benefit that can be gained through increasing the size of the senior security by overinvesting in effort is outweighed by the marginal cost of that effort. Analyzing the security size-effort issue, although interesting, would not yield any additional insight into the analysis.

numbers, almost surely converge on fixed payoff in default with loan extension to the senior security of $pR(e^S)$. A second rationale takes the current model and relies on the ability to purchase default insurance from a risk-neutral third-party (an external credit enhancement). The insurance is structured so that it pays $pR(e^S)$to the senior securityholder given a bad loan extension state outcome, but requires payment ofan insurance premium to the insurer that equals the difference between the full payoff of $R(e^S)$ and $pR(e^S)$ given a good loan extension state outcome.[5] With this self-funded credit enhancement structure, a fixed payment of $pR(e^S)$to the senior security is assured.

Given these senior security sizes, it immediately follows that the subordination level is lowest with liquidation when $\beta > p$, which corresponds to a market with relatively high immediate asset resale value or a relatively low probability of a good loan extension outcome. In contrast, subordination level is lowest with special servicing when $\beta < p$, which corresponds to a market with low immediate asset resale value or a relatively high probability of a good loan extension outcome.

2.4Second-Best

We now consider alternative governance regimes in which the SS follows the instructions of either the senior securityholder or the junior securityholder.This means that the cost of effort provision is internalized by the agent that controls the SS, and not by the MS who looks out for the collective interests of all securityholders or the issuer who wants to maximize the aggregate value of security issuance. An additional issue is

[5]That is, the risk-neutral insurer's profit in expectation is $p[R(e^S) - pR(e^S)] + (1-p)[-pR(e^S)] = 0$.

that, given that the SS is independent of the MS, the SS may try to influence the decisions of the MS if it is in its interest to do so.Conditional on which class of securities controls SS decisions, the issuer's objective function is first to maximize aggregate security value, and second to maximize the value of the senior security subject to fixing its payoff.

2.4.1Senior Securityholder Control of the Special Servicer

Consider first placing the *senior securityholder* in control of the special servicer, in the sense that it makes the effort decision conditional on loan extension. Now, if liquidation is optimal given borrower default at time 1, the MS expends the first-best level of marketing effort and senior security size equals $\beta R(e^{*}) - \beta\left[\underline{P} + \frac{\alpha^{2}\beta}{2}\right]$. Subordination is therefore at the first-best levelwhen immediate liquidation is anticipated given borrower default.

However, in the case of loan extension, the SS has no incurs effort costs since senior securityholder payoffs are insensitive to effort provision. With no effort, the payoff to a successful loan extension outcome is $\underline{P}$. This in turnimplies that the size of the senior security is $p\underline{P}$, which is smaller by $\frac{(\alpha p)^{2}}{2}$ than the senior security size under first-best. Thus, conditional on the loan being transferred to special servicing, senior control over the SS means that the subordination level is higher than first-best.

Because of this underinvestment in effort, it will no longer be the case that liquidation is optimal whenever*β<p*. Specifically, with no effort provision by the SS when loan renegotiation occurs, and given the issuer's primary objective of maximizing total securities issuance proceeds, the MS will only transfer the loan to special servicing

when $\beta < p - \frac{(\alpha\beta)^2}{2P}$, which is less than p. The senior securityholder will have no incentive to try to influence the MS's liquidation-workout decision, since its payoff is fixed in advance. The following proposition thus summarizes the main results of placing the senior security in charge of SS.

<u>Proposition 1</u>: *With the senior securityholder in control of the special servicer, across different β regimes liquidation occurs more frequently than first-best. This happens because underinvestment in effort results when loan extension occurs. As a result, subordination levels are high relative to first-best except in the case of β>p.*

Thus, senior securityholder control over the SS causes a bias towards liquidation in all but the the worst of resale markets. There is a significant mark-up in subordination levels when asset resale markets are expected to be weak conditional on loan default. In other words, distortions associated with placing the senior securityholder in control of the SS are greatest when asset resale market conditions in default are expected to be weak.

2.4.2 Junior Securityholder Control of the Special Servicer

Now consider the case of junior securityholder control over the SS. Conditional on liquidation, first-best effort occurs because the MS ensures the asset is marketed properly. This in turn results in the first-best subordination level with no residual payoff to the junior security when borrower default occurs.

Conditional on borrower default and the loan being transferred to special servicing, with the payoff to the senior security being fixed in advance at some constant κ^E, the junior securityholder controlled SS solves the following problem:

$$\max_{e} \; pX(e) - e - \kappa^{E} \tag{3}$$

subject to participation by the junior securityholder.

Given that $\kappa^E$is constant it is clear that first-best effort level is optimal, implying that $e=e^E$. But participation on the part of the junior securityholder requires that κ^E cannot exceed $pR(e^E)-e^E$, implying that $\kappa^E \leq \frac{p}{2}+\frac{(\alpha p)^2}{4}$. In order to make the senior security as large as possible, it will be in the issuer's interest have this constraint bind. As a result, given control of the SS resides with the junior securityholder, senior security size is less than first best by $\frac{(\alpha p)^2}{4}$ given loan extension. This means that the junior securityholder will secure a positive payoff given a good state outcome with loan extension. Notice that, given loan extension, although senior security size is less than first-best it nonetheless exceeds senior security size when the senior securityholder controls the SS.

As noted earlier, the issuer's first priority is to maximize aggregate security value. This means that achieving first-best effort provision with junior control, which happens at the cost of reducing senior security size in order to secured participation,is superior toreducing effort in order to increase size of the senior security. As a result, equilibrium is such that when $\beta>p$, liquidation is optimal. In contrast, when $\beta<p$, loan extension is optimal. Thus, when the SS is under junior securityholder control, the liquidation-loan extension decision is efficient, as is effort provisions. However, when $\beta<p$, subordination level is higher than first-best by $\frac{(\alpha p)^2}{4}$. Nonetheless, conditional on loan extension, senior security size with junior control of the SS exceeds senior security size with senior control. And finally, total issuance proceeds given junior control equals or exceeds issuance proceeds given senior control.

It is useful to observe that by providing a positive expected payoff to the junior security when loan extension occurs, the SS that is controlled by the junior securityholder will always prefer loan extension over liquidation (since liquidation results in a zero payoff to the junior security). Because of this, to the extent that the junior securityholder-SS exerts any influence over the decision-making of the MS, loan extension could possibly occur when liquidation is optimal.

The following proposition summarizes the results.

Proposition 2: *The first-best effort provisionis always achieved when the special servicer is controlled by junior securityholder. Conditional on loan extension, subordination levels are higher than first-best, but are smaller than subordination levels given senior security control. However, to the extent that the junior securityholder controlled SS has influence over the liquidation-loan extension decision, loan extension may occur too often relative to first-best. In those cases, subordination levels will exceed first-best subordination levels. When there is no influence over the MS, junior securityholder control over the SS (weakly) dominates senior control in terms of maximizing total issuance proceeds.*

Differences in control are especially apparent in low β regimes, where the SS that is controlled by senior securityholders vastly underinvests in effort. A important potential distortion associated with junior securityholder control of the SS isdisproportionate influence over the MS in the liquidation-renegotiation decision whena good asset resale market exists at the time of borrower default. If mechanisms exist to control any potential influence, then junior control is such that first-best or nearly first-best outcomes can always be achieved.

3Empirical Implications and Data

3.1 Empirical Implications

Our model shows that security governance, which is established in anticipation of addressing financial distress and subsequent resale of collateral, will affect how securities are designedwhen an issuer seeks to maximize total security issuance proceeds. This model structure generates a number of empirically testable predictions. For example, in a second-best world, our model predicts that junior control of the SS will be favored over other control allocations. Junior control is particularly valuable when asset recovery rates conditional on default are expected to be low, since non-junior securityholder control is predicted to result in significant underinvestment in effort.

There is a potential cost to junior control, however, since payoffs are such that the junior-controlled SS will prefer loan extension (playing for time) in circumstances when immediate liquidation is optimal. There are two possible solutions to addressing this conflict. One solution is tomaintain junior securityholder control of the SS, but introduce mechanisms that restrict discretion or otherwise moderate conflicts. To the extent that low-cost mechanisms can be introduced to limit inefficient decision-making, subordination levels should decrease and approach first-best. A second solution is to remove the junior securityholder from direct control. This is problematic in the effort dimension, however, should loan modification be necessary *ex post*. Consequently, we would expect non-junior control of the SS to be most effective when mechanisms are introduced mitigate the effort underinvestment problem.

Thus, in summary, we generate the following testable model implications:

1. Due to efficient effort provision, junior securityholder control of the special servicer should be frequently observed. Junior control is predicted to result in lower subordination levels than senior control, particularly when weak asset resale market conditions are expected.
2. Due to possible influence costs, junior control is most problematic when resale asset market conditions are expected to be strong. This implies that

mechanisms to control incentives to play for time are most prevalent when stronger resale asset market conditions are expected. In these cases, lower subordination levels are realized.

3. Non-junior control of the SS, when it occurs, should be associated with stronger resale asset market conditions. Mechanisms to increase SS effort should be utilized, particularly when asset resale market conditions are not expected to be strong. Introduction of these mechanisms reduces subordination levels below those that result with non-junior control and no mechanisms in place.

3.2Data

We test our model predictions using commercial mortgage-backed securities (CMBS) data. Previous papers like Chen and Deng (2003), Gan and Mayer (2006) and Ambrose et al. (2010) examined outcomes of special servicer decisions associated with borrower default. Rather than examine *ex-post* outcomes from financial distress as they depend on governance structure, we insteadexamine*ex-ante* security design as it depends on security governance structure.

In order to better assess the performance of CMBS deals, we construct two datasets. One dataset includes CMBS issuances from 1994 to 1996, which coincides with early development of the market. The other datasetexamines security issuances during the 2004 to 2007 time period.

Both data sets include all issuances that occurred during the relevant sample period. For our purposes we examine only the AAA-rated senior security issuances, characterizing all other security issuance that are subordinate to the AAA-rated securities as junior securities. This characterization is clearly a simplification, but a valuable one as it allows us to avoid unnecessary messy detail associated with alternative characterizations.

In the earlier sample period, all AAA-rated securities issued from a particular asset pool had the same subordination level, suggesting that the subordination level was the lowest that could be achieved while still generating a AAA-rating for the senior securities. In the later sample period, AAA-rated securities issued from the same asset pool often had different subordination levels, indicating that there were junior AAA–rated securities and more senior AAA-rated securities. When this occurs in the data, we examine only the junior-most AAA-rated securities, since, consistent with the dataset corresponding to the earlier sample period, subordination levels associated with those securities are the lowest that could be achieved while still generating a AAA-rating for the relevant senior securities.

3.2.1 The 1994-1996 Data Set

The 1994-96 dataset a total number of 119 senior security (AAA-rated) issuances. The beginning of the sample period coincides with early-stage development of the private-label CMBS market, and terminates as the CMBS market began transitioning into a more mature phase just prior to the beginning stages of the Asian financial crisis. These data were obtained from Nomura Securities and Standard & Poor's Corporation. REIT market data were obtained from the National Association of Real Estate Investment Trusts.

For empirical model estimation purposes, we wish to explain security design as it depends on governance structure. As a result, the dependent variable of interest is subordination level, defined as the percentage of the total asset pool that is subordinated to the AAA-rated securities. In practice, the CMBS issuer determines the level of subordination through an iterative “negotiation”process with a credit rating agency. Subordination levels are known to vary with the credit risk of the underlying asset pool, suggesting that controlling for asset pool risk is important in terms of isolating our hypothesized security governance effects.

We require data that provide objective measures of security governance structure. In the datawe can identify whether the special servicer is controlled by junior securityholders or not. We consequently create an indicator variable called Junior that equals 1 if junior securityholders control the special servicer, and 0 otherwise. This data set also includes information about rules that may affect special servicer actions. The most relevant variable for our purposes identifies whether, at the time a loan is sent to special servicing, the loan balance is modified according to an appraisal that estimates the liquidation value of the asset. Appraisal reduction has the effect of conveying reliable information to the Master Servicer that can aid in deciding whether to transfer a loan to special servicing or not. For example, without a required appraisal on the collateral asset, a junior-controlled SS may try to argue for a low liquidation value of the asset (or a high value conditional on loan modification) when in fact the current liquidation value is high, thus meriting immediate sale.

Our model also suggests that expectations regarding future asset market resale conditions are relevant to determining governance structure and hence security design (subordination level). During our sample period from 1994 to 1996, commercial property markets entered into a period of sustained value increases after experiencing negative growth resulting from consequences of the Savings & Loan crisis of the middle to late

1980s. Because of this, year dummies are not likely to provide the fine-grained variation. We are looking for in characterizing forward-looking asset prices. Instead we compile an index of publicly traded commercial property firm prices that references the property types collateralizing loans in the underlying asset pool. From the model, good asset resale market conditions ($\beta \geq p$) imply a preference for liquidation over loan modification. As a result, if the property price index experiences a return that is above sample-period average in the month of issuance, suggesting relative optimism in forward-looking property prices, a dummy variable called *Econ* takes on a value of one. It is zero otherwise, corresponding to a below-average index return in the month of issuance.

Table 1 provides a summary of the three different key variables of interest. We see that out of 119 security issuances, 98 werestructured so that the special servicer was controlled by junior securityholders. This outcome, with over 80 percent of security issuances being controlledby the junior securityholder, is consistent with our model prediction that junior securityholder control of the special servicer is generallypreferred to alternative structures.

Table 1 Here

Appraisal reduction is required in 89 of the 119 security offerings. Most importantly, we see that in 83 of the 89 cases, or 93 percent of the time, appraisal reduction is associated with the junior securityholder being in control of the SS. This is consistent with the notion that certain distortions do potentially exist with junior control, suggesting that application of appropriate control mechanisms can aid in reducing distortions.

The *Econ* dummy variable indicates that in 53 of 119 security issuances, a “good” asset resale market is expected. Control of the special servicer is vested with the junior securityholder 83 percent of the time (44 out of 53) in a “good” resale market versus 82 percent of the time (54 out of 66) in a “bad” resale market. This would seem to be contrary to model predictions that junior control is most valuable in a “bad” resale market. But note that appraisal reduction is utilized much more often in a “good” asset resale market (46 out of 53, or 87 percent), where it is predicted to be most valuable, than in a “bad” resale market (43 out of 66, or 65 percent).

Critically, we see that there are 41 instances of junior control of the SS combined with appraisal reduction when a “good” resale market is expected. Thus, in 41 cases out of 44 (93 percent), appraisal reduction is required when junior control of the special servicer is vested in a “good” asset resale market. This compares 42 cases out of 54 (78 percent) in which junior control with appraisal reduction is paired with a “bad” asset resale market. A propensity to institute controls when special servicers follow the direction of junior securityholders in a “good” asset resale market is consistent with model predictions.

3.2.2 The 2004-2007 Data Set

The 1994-96 data set marks the early stages of CMBS market development. It should not be surprising that security designs during the early stage development of the CMBS market were relatively conservative. This was due to the product itself being new and untested, as well as the adverse effects of the S&L bust being fresh in the minds of market participants. The relatively conservative nature of the deal structure is evidenced in the fact that subordination levels to AAA-rated securities were in excess of 20 percent at the time, and the fact that 89 of 119 securities analyzed (as noted in Table 1) placed the junior securityholder in control of the special servicer (where we predict that junior control is more likely when investors are concerned about relatively poor future asset resale market conditions.

In an effort to thoroughlytest our theory, wealso analyze a more recent dataset of CMBS issuances. This dataset contains about 456 securities issued from 2004 to 2007ranging from boom in 2004 and 2005 to bust in 2007. This is in contrast to the other data set which was a transition from bust to robust market conditions. We can safely characterize 2004 as a boom year in commercial property and securitized loan markets, with increasing concerns about weakening foundations of the boom market beginning to emerge in 2005 and 2006. By 2007 weaknesses were clearly apparent to market participants, as evidenced by the beginnings of significant price declines and volatility in the sister sub-prime residential mortgage market.

We obtain the more recent CMBS data from CMA (Commercial Mortgage Alert) database, which provides detailed information on asset pool credit risk characteristics, time of issuance, etcetera.All CMBS data we analyze in this data set are U.S. issuances with fixed rate mortgage loans in the asset pool. All of the asset pools contain performing mortgage loans originated for the intent of securitization (so-called " conduit loans").

As noted earlier, there are typically several AAA-rated securities issued from any particular asset pool. These securities generally differ by their expected maturity (priority on return of paid-in principal) and sometimes, later in the sample period, in their subordination level. We analyze only those AAA-rated securities from a particular asset pool that have do not have any AAA-rated securities subordinate to them. That is, we only analyze AAA-rated securities that are at the boundary between AAA-rated and below AAA-rated.

Our data set of early CMBS issuances contained detailed information about the structure of the special servicing function. This information allowed us to, for example, identify the appraisal reduction variable as a mechanism to control junior-controlled special servicer incentives to extend loan terms when asset resale market conditions weregood enough to support immediate liquidation. Unfortunately, this kind of detailed information are not available in the more recent CMA data base.

The CMA data base do, however, provide the identity of both the special servicer and the master servicer. This is usefulfor tworeasons. First, our model suggests that the junior controlled SS should also function as the MS, since the MS might be compromised by the SS in making appropriate liquidation-loan modification decisions. This precisely what we see in the data, as there is never a case where the MS and SS are the same entity when the SS is controlled by the junior securityholders.

Second, it may be appropriate for the MS and SS to be the same entity when there is non-junior control of the SS. The basic argument is the following: the non-junior controlled SS has reduced incentives to exert effort in a poor resale market due to the fixed payoff, which in turn causes liquidation to occur too often relative to first-best. Because the MS is charged with considering the interests of all securityholders, having the SS also play the role of the MS may moderate underinvestment and excess liquidation problems that exist when placing control of the SS with more senior securityholders.

To begin to develop a sense of the more recent data, Table 2 reports frequencies of observations for the three primary variables of interest: junior v. non-junior control of the special servicer, year of issuance, and cases in which the SM and the SS are the same entity. Relevant interaction terms are also reported.

Table 2 Here

Interestingly, junior control of the special servicer is less frequent in this data set than the earlier data, where now 266 of 456 security issuances (58 percent) vest control of the SS with the junior securityholders. Variation in junior control across issuance year is most revealing. In 2004, a year of great optimism in property markets throughout the U.S., only 96 out of 244 issuances (39 percent) had SS control vested with the junior securityholders. This is consistent with model predictions of security governance when strong asset resale market conditions are expected. The relationship flips in 2005-06, however, where junior control is realized in over 60 percent of issuances in each year. This period coincides with increasing concerns by market participants as to the sustainability of robust market conditions. In 2007, when the resale market are weakest, the percentage of issuances of SS junior control increases to51 out of 81 issuances (63 percent).

Now consider the MS variable. As noted earlier, it is never the case that the junior controlled SS is also the MS. But there are a number of cases when then non-junior controlled SS is also the MS. In particular, after conditionalon non-junior control of the SS, 34 out of 190 possible cases (18 percent) are such that the SS and MS are identical. Our model suggests an alignment between the non-junior controlled SS and the MS is most valuable when asset resale market conditions are weak. As seen in the table, in 2004 there are only 15 out of 148 cases, or 10 percent,where the SS is also the MS. The percentage increases to 31 percent (15 out of 49) in 2005-06 and 13 percent (4 out of 30) in 2007. The latter time periods again coincide with increasing concern of the robustness of commercial property market fundamentals.

4 Summary Statistics, Model Specification and Estimation Results

Our most important empirical predictions are that, given issuer objectives of maximizing total security issuance proceeds when senior securities are highly valued in the structured securities markets, security governance structure affects security design choice as measured by the security subordination level. In this section we estimate appropriately specified empirical models in an effort to identify relations predicted by our theoretical model. Our plan is to first present summary statistics, model specification and estimation results realized from the 1994-96 sample, and then do the same for the 2004-07 sample.

4.1 1994-96 Sample

Table 3 displays summary statistics for the dependent variable of interest, subordination level, and for control variables. It is well know that subordination levels adjust across securitizations depending on the risk characteristics of the underlying asset pool. The control variables provide the necessary measures of the risk characteristics of the asset pool.

Table 3 Here

Subordination levels averaged 37 percent during the sample period. The average size of the asset pools is approximately $445 million, with an average total number of loans of about 113 in each deal. The largest loan in the asset pool is about 9 percent of the total asset pool on average. Properties are identified by their types, and measured by their composition as a percentage of the pool. Office, retail and multi-family are seen to be the most prominent property types. The mean weighted average loan-to-value ratio of the asset pools is 69% , while the mean debt service coverage ratio (defined as net operating income divided by debt service) is 1.3. These two variables tend to correlate closely in the data, where more highly leveraged loan pools generally result in lower debt service coverage ratios. The securities have an expected security life of about 6 years on average. We also include geographic variables. California is a variable indicating the percentage of loans in California. On average, approximately 16% of all loans in each deal were collateralized by property located in California.Geographic Concentration measures the regional concentration. The average concentration is about 25%.

It is possible that rating agencies exert idiosyncratic effects on subordination levels, particularly in these early years of market development. We include dummy variables that indicate whether three different rating agencies are used to rate securities issued from an asset pool, and whether one rating agency is used. 14% of the securities use three rating agencies while 8% securities use only one rating agency. The majority of securities thus use two rating agencies.

We also include variables that reflect current market conditions. The variable REIT measures the weighted average return to REITs in the month of issuance, with an average REIT return of 0.01. The Treasury variable indicates the 10 yeartreasury rate in the month of issuance.The average treasury rate is about 0.06.

The empirical model specification is as follows. The most important testable implications of our model are those addressing the question of how security governance affects security design. Based on previously articulated model implications, we write down the following model specification:

$$s_i = x_i\beta^x + m_i\beta^m + k_i\beta^k + n_i\beta^n + (k_i * n_i)\beta^{kn} + (m_i * k_i)\beta^{mk} + (m_i * k_i * n_i)\beta^{mkn} + \xi_i^s \tag{4}$$

where s_i is the subordination level of security i, x_i is a vector of control variables, m_i is a junior control dummy variable, n_i denotes variables used to control SS incentives to to play for time when controlled by junior securityholders (appraisal reduction in this case), and k_i is the proxy for asset resale market conditions (the REIT return variable in the month of issuance, which takes on a value of 1 if REIT returns exceed the average return). ξ_i^s is an error term and $\beta^x, \beta^m, \beta^k, \beta^n$, β^{kn} and β^{mkn} are coefficients to be empirically estimated.

In the context of our model predictions, we expecta negative and significant β^m (junior control results in lower subordination levels across the entire sample), a positive and significant β^{kn} (junior control is less effective when a strong resale market is expected, as incentives will exist for the junior-controlled SS to extend the loan rather than efficiently liquidate), and a negative and significant β^{mkn} (conditional on junior securityholder control of the special servicer and expectations of a strong asset resale market, control mechanisms are more effective at mitigating distorted incentives of the special servicer to engage in value-destroying behavior associated with loan extension).

We examine the robustness of our specification by recognizing that special servicer control might may be determined simultaneously with subordination level. To address this potential endogeneity problem, we re-estimate the model using a three-stage regression. This regression endogenizes the use of junior control and subordination level.

The simultaneous equations are:

$$s_i = x_i\gamma^x + m_i\gamma^m + k_i\gamma^k + n_i\gamma^n + (k_i \cdot n_i)\gamma^{kn} + (m_i \cdot k_i)\gamma^{mk}$$

$$+ (m_i \cdot k_i \cdot n_i)\gamma^{mkn} + \eta_i^s \tag{5}$$

$$m_i = y_i\gamma^y + s_i\gamma^s + \eta_i^m \tag{6}$$

where y_i is a vector of control variables, η_i^m and η_i^s are error terms and γ^x , γ^m , γ^k ,γ^n ,γ^{kn} ,γ^{mkn} ,γ^y, and γ^scoefficients to be empirically estimated. Other variables are as previously defined. If subordination level and special servicer control are determined simultaneously, we would expect γ^s and γ^m to be statistically significant.

Table 4 displays our estimation results obtained from three different model specifications. The first two specifications are simple OLS regressions, where, for comparison purposes, key security governance variables of interest are omitted in the first specification. The third set of results are generated from a 3SLS estimation that is meant to addressjoint causation between security design and security governance choices.

Overall, these estimation results reveal a high R^2 and show that many of the observable asset pool credit characteristic variables are statistically significant. For example, an increase in the weighted average loan-to-value ratio increases the subordination level, and a higher DSCR (which closelynegatively correlates with loan-to-value ratio) results in a lower subordination level. Larger (better diversified)asset pools are rewarded with a lower subordination level. As pointed out by analysts, loans made on property located in California are riskier, and our results are consistent with this argument. Issuers also seem to differentiate between property types that collateralize the loans.

Now, focus on the variables that are related to security governance structure. Estimation results indicate that, consistent with predictions of our model, subordination levels are lower when there is junior securityholder control over special servicing decisions. In particular, estimation results indicate that issuances with junior securityholdercontrol result in 4.5 to 5.0 percent lower subordination levels than issuances without junior securityholder control. This result is also consistent with the prediction of Riddiough (1997), who argues that junior securityholders have both incentives and information to make efficient decisions to address financial distress problems.

We see that in strong resale markets, in which liquidation is preferred to loan modification, junior control leads to a higher subordination level as predicted by the model. In this case, we would expect the issuer to introduce mechanismsto moderate incentives for junior-controlled special servicers to play for time.To this end, note that the triple interaction term of Econ, App and Junior is negative and statistically significant at the 10 percent level. The interpretation of this variable is that,given strong property market conditions at the time of security issuance, applying (appraisal reduction) rules that could prevent a special servicer from over-extending leads to lower subordination levels. Results from the 3SLS estimation indicate that our basic results are robust to endogenous choice possibilities.

Table 4 Here

4.2 2004-07 Sample

Table 5 displays summary statisticsassociated with the 2004-2007 sample. For regression model specification, we include the asset pool and security-related variables as controls. The average size of the asset pool is approximately $1.6 billion. Each pool contains 134 loans on average that are collateralized by an average of 330 properties. The fact that there are fewer loans than properties implies that some of the loans are collateralized by more than one property. Properties are identified by their type, and measured by their composition as a percentage of the pool. The weighted average maturity of pooled mortgage loans is about 8 years on average. The mean weighted average loan-to-value ratio of the asset pools is 68%, while the mean debt service coverage ratio is 1.61. Expected security life is about 8.1 years on average. Most of the securities have two ratings.

Table 5 Here

The empirical model specification for this sample is as follows. Based on previously articulated model implications, we write down the following model specification to test for the effects of security governance on security design outcomes:

$$s_i = x_i\varphi^x + m_i\varphi^m + y_i\varphi^y + (m_i * y_i)\varphi^{my} + \epsilon_i^s \tag{7}$$

where s_i is the subordination level of security i, x_i is a vector of control variables, m_i is a junior control dummy variable, y_i denotes a vector of year indicators. We choose year 2007 as the comparison group. ϵ_i^s is an error term.

In the context of our model predictions, we expect a negative and significant φ^m (junior control results in lower subordination levels across the entire sample),positive and significant cofficients (φ^{my}) associated with junior control of the special servicer during the years 2004-06 relative to 2007. The reason for the prediction of a positive coefficient is that, compared with the resale market in 2007, resale markets in 2004-06 are stronger and therefore junior control of the special servicer is less effective.

We again examine the robustness of our specification via a three-stage regression that addresses potential simultaneity between security governance and security design choices. The simultaneous equations are:

$$s_i = x_i\mu^x + m_i\mu^m + y_i\mu^y + (m_i * y_i)\mu^{my} + \varepsilon_i^s \quad (8)$$

$$m_i = y_i\nu^y + s_i\nu^s + \varepsilon_i^m \quad (9)$$

Finally, to measure the effects of aligning the MS with the SS, and write the following empirical equation:

$$s_i = x_i\delta^x + m_i\delta^m + y_i\delta^y + (m_i * y_i)\delta^{my} + w_i\,\delta^w + (w_i * y_i)\delta^{wy} + \varepsilon_i^s \quad (10)$$

where w_i is a dummy variable indicating MS=SS. The other variables are defined the same as before. Consider the mechanism designed for MS, we expect a negative and significant δ^w, in the sense that MS=SS resolve at least a part of underinvestment problem and should result in lower subordination levels. As discussed, the alignment of MS and SS is more useful when a weak resale market is predicted. Compared to that in 2007, market conditions are better in 2004-06. Hence, we expect to positive coefficients forw_i associated with 2004-06.

The regression results associated with SS effects for the subordination model areshown in Table 6. The first two columns report the empirical result with only junior control dummy variable. The next two columns report the result with junior control dummy variable interacted with year indicators.The last two columns report estimation results from the 3SLS regression.

First consider estimation results in the context of loan characteristics of the asset pool. As with the first data set of early CMBS issuances, most variables have the expected sign. For example, a higher DSCR results in a lower subordination level.

Now, focus on the variables which are related to security governance and the special servicer. Results are similar to those from the earlier sample. For example, across the entire sample, estimation results indicate that subordination levels are lower (and therefore proceeds are higher) when the junior securityholder controls the special servicer. As related to incentives for the special servicer to inefficiently modify loans when liquidation is a better outcome, estimation results indicate that issuers set higher subordination levels when asset market conditions are good and there is junior securityholder control. 3SLS results are consistent with OLS estimation results.

Table 6 Here

Table 7 shows the results of MS effects. The first two columns report the basic result with only MS=SS. The next two columns report with MS=SS interacted with year indicators.

The estimation results are consistent with model predictions related to asset substitution problems and possible mechanism associated with SS with junior control. Next, we test the mechanisms used to control the special servicer's hypothesized tendency to underinvest in effort when there is senior control. Table 7 shows the result, with a significantly negative coefficient on the MS=SS variable across the entire sample. Regarding to the coefficients on MS=SS interacted with year indicators, we find positive sign associated these variables, but not all of them are significant. One possible reason is that issuers view the underinvestment problem as a severe and general issue and the mechanism effect is just picked by the MS=SS variable cross the entire sample.

To sum up, 2004-07 sample estimation results are generally consistent with our model predictions. Junior control of special servicers is broadly viewed as efficient.

Empirical results also indicate that, in a second-best world, issuers pay close attention to underinvestment distortions associated with senior-control of SS and asset substitution problems associated with junior control of SS.

Table 7 Here

5Conclusion

This paper offers theory and evidence related to security design and security governance of structured securities. We model the relative efficiency of alternative control rights designs in the security governance process, and its impact on security design. After modelling the special servicer actions in equilibrium, we show that junior securityholders---who possess strong incentives to maximize bargaining payoffs---will optimally control the special servicer when control rights must be vested with particular security classes. Special servicer's under junior securityholder control will exert appropriate levels of effort that increases the asset recovery value in distress. But, junior control introduces a different moral hazard problem, with a preference for loan modification over liquidation when liquidation is optimal. This asset substitution problem is therefore most glaring when the asset resale market at the time of borrower default is strong as opposed to weak.

We use two different and unique data sets to test the model. Empirical results support our theory of optimal security design and governance. Specifically, estimation results indicate that, in general, issuers favor junior securityholder control over special servicing decisions. Estimation results also indicate that optimal security design addresses asset substitution problem.

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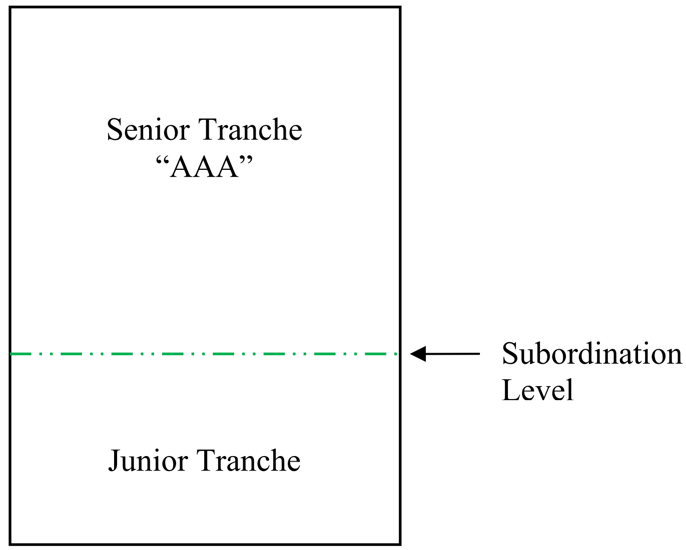

Figure 1 Capital Structure for Structured Securities

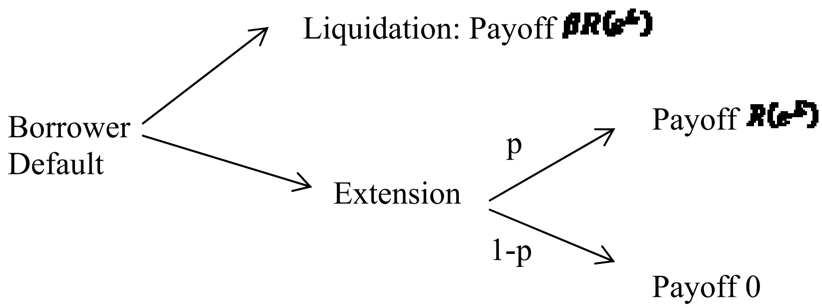

Figure 2 The Default Process

Table 1 Summary of Different Events in Sample (1994-1996)

	Total	Percentage
Econ	53	0.45
Junior	98	0.82
Junior*Econ	44	0.37
Econ*App	46	0.39
Junior*Econ*App	41	0.34
Junior*App	83	0.70
App	89	0.75

This table shows a summary of different events in the sample (1994-1996). Junior is a dummy variable and equals 1 if junior control and 0 if senior control. Econ is a dummy variable and equals 1 if REIT return is above average and 0 otherwise. App is a dummy variable and equals 1 if appraisal could be used and 0 otherwise.

Table 2 Summary of Different Events in Sample (2004-2007)

	Total	Percentage
Junior	266	0.58
Junior*year04	96	0.39
Junior*year05	42	0.65
Junior*year06	40	0.61
Junior*year07	51	0.63
MS	34	0.07
MS*year04	15	0.03
MS*year05	11	0.02
MS*year06	4	0.01
MS*year07	4	0.01
Year04	244	0.54
Year05	65	0.14
Year06	66	0.14
Year07	81	0.18
Non-Junior	190	0.42
Non-Junior*year04	148	0.61
Non-Junior*year05	23	0.35
Non-Junior*year06	26	0.39
Non-Junior*year07	30	0.37

This table shows a summary of different events in the sample (2004-2007). Junior is a dummy variable and equals 1 if junior control and 0 if senior control. MS indicates master servicer is also the special servicer. The percentages of year indicators, Junior and MS variables are calculated as the total number of securities in different category divided by the total number of securities in the sample. The percentage of Junior*year, MS*year and Non-Junior* year variables are calculated as the total number of securities in different category divided by the total number of securities in certain year.

Table 3Summary Statistics (1994-1996)

Variable	Mean	Std. Dev.	Min	Max
Sub	37.01	7.59	26.60	60.00
DSCR	1.30	0.20	0.89	1.85
Deal-Size	444.96	364.86	78.00	1926.50
LTV	0.69	0.10	0.51	0.95
Life	6.00	2.50	1.30	12.60
Hotel	0.11	0.19	0.00	1.00
Industry	0.07	0.08	0.00	0.34
Multi-Family	0.33	0.28	0.00	1.00
Office	0.13	0.15	0.00	1.00
Retail	0.29	0.22	0.00	1.00
California	0.16	0.17	0.00	0.77
Num_Loan	112.65	119.78	1.00	583.00
Loan	0.09	0.11	0.02	1.00
REIT	0.01	0.03	-0.06	0.06
Three Ratings	0.14	0.35	0.00	1.00
Treasury	0.06	0.01	0.05	0.08
One Rating	0.08	0.28	0.00	1.00
Geographic Concentration	0.25	0.17	0.09	1.00

This table shows the summary statistics of data used in regression (1994-1996). Sub is the subordination level of AAA-rated securities. Deal-Size is the total deal size in millions. LTV is the weighted average loan-to-value ratio. DSCR is the weighted average debt service coverage ratio. Life is the weighted average loan age. Office is the percentage of office property in the asset pool. Industry is the percentage of industrial property in the asset pool. Multi-Family is the percentage of multi-family property in the asset pool. Retail is the percentage of retail property in the asset pool. Hotel is the percentage of hotel property in the asset pool. Num_Loan is the average number of loans in the deal. California is the percentage of loans in CA. Loan is the percentage of the size of the largest loan in the pool. REIT is the weighted average return to REITs in month of issuance. Treasury is the treasury rate in the month of issuance. Three ratings indicates that three rating agencies give ratings. One rating indicates only one rating agency gives rating. Geographic Concentration demonstrates the regional concentration.

Table 4 Empirical Result: Determinants of Subordination Level (1994-1996)

	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
Junior	-4.64	-3.72	-4.91	-3.38	-8.76	-1.99
App	-2.53	-2.05	-1.20	-0.97	-1.62	-0.32
Econ			0.39	0.11	-0.06	-0.01
Junior*Econ			5.69	1.72	6.17	1.68
Econ*App			5.57	0.92	5.00	0.72
Junior*App			2.14	0.48	1.48	0.25
Junior*Econ*App			-11.00	-1.82	-10.55	-1.74
DSCR	-21.57	-5.95	-23.92	-6.07	-23.65	-6.17
Deal-Size	-0.01	-2.89	-0.01	-2.88	-0.01	-2.55
LTV	20.47	3.99	21.50	4.30	22.81	4.79
Life	-0.42	-2.80	-0.39	-2.56	-0.37	-2.60
Hotel	16.35	4.04	18.69	3.78	17.46	3.34
Industry	1.97	0.28	-3.42	-0.45	-3.82	-0.54
Multi-Family	-6.35	-1.78	-6.20	-1.70	-5.55	-1.63
Office	2.63	0.64	3.03	0.72	2.49	0.70
Retail	-5.37	-1.51	-5.72	-1.59	-5.08	-1.68
California	3.34	1.20	3.16	1.11	3.30	1.34
Num_Loan	0.01	1.26	0.01	1.42	0.01	0.41
Loan	19.30	5.32	21.56	6.34	16.70	5.25
REIT	-24.17	-3.05	-27.17	-1.29	-32.89	-2.66
Three Ratings	2.41	2.20	2.80	2.52	2.57	2.42
Treasury	-83.99	-1.29	-66.59	-0.98	-54.26	-0.65
One Rating	0.88	0.50	-0.13	-0.07	-0.15	-0.06
Geographic Concentration	4.58	1.48	6.25	1.95	8.59	7.67
Constant	61.95	6.72	64.33	6.81	47.39	6.72
R-Square	0.85		0.86		0.84	

This table shows the regression result for subordination level. First four columns show the basic OLS regression results and the last two columns show the 3SLS regression results. Junior is a dummy variable and equals 1 if junior control and 0 if senior control. Econ is a dummy variable and equals 1 if REIT return is above average and 0 otherwise. App is a dummy variable and equals 1 if appraisal could be used and 0 otherwise.

Table 5Summary Statistics (2004-2007)

Variable	Mean	Std Dev	Minimum	Maximum
Sub	13.07	2.08	4.95	44.00
LTV	68.05	3.52	55.20	75.60
DSC	1.61	0.24	1.19	2.82
LIFE	8.10	2.51	0.52	10.03
WAM	8.99	1.10	5.25	28.17
ln_Amount_Deal	7.43	0.51	5.47	8.98
Ln_Loan	4.90	0.41	3.22	6.05
ln_Prop	5.18	0.48	3.33	6.83
ln_Amount	5.32	0.87	3.29	7.87
Office	31.17	10.31	8.80	59.60
Hotel	5.85	4.93	0.00	29.90
Multi_Family	15.94	8.08	0.50	46.50
Nursing	0.08	0.56	0.00	8.20
Park	3.17	4.20	0.00	19.80
Retail	33.77	9.13	9.50	51.00
Warehouse	7.15	3.95	0.00	19.90
Moody	0.69	0.46	0.00	1.00
S&P	0.82	0.38	0.00	1.00
Fitch	0.56	0.50	0.00	1.00
three Ratings	0.08	0.27	0.00	1.00
One Rating	0.02	0.15	0.00	1.00

This table shows the summary statistics of data used in regression (2004-2007). Sub is the subordination level of AAA-rated securities. LTV is the weighted average loan-to-value ratio. DSCR is the weighted average debt service coverage ratio. ln_Amount_Deal is the log of total amount of the deal. Ln_Loan is the log of total number of loans in the pool. Ln_Prop is the log of total number of properties in the pool. Ln_Amount is the log of total amount of the security. Life is the average life of the security. WAM is the weighted average maturity of loans by year. Office, Hotel, Multi_family, Nursing, Park, Retail and Warehouse are the percentage of property types used in the pool.

Table 6 Empirical Result of Special Servicer Effect: Determinants of Subordination Level (2004-2007)

	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
Junior	-0.44	-4.34	-1.18	-7.41	-1.50	-4.15
Junior*year04			1.11	6.03	0.84	2.58
Junior*year05			0.74	2.68	0.44	2.13
Junior*year06			0.83	3.30	0.53	1.79
Year04	1.28	5.71	0.46	1.83	-14.84	-17.35
Year05	0.55	3.11	-0.06	-0.23	-7.91	-10.27
Year06	0.02	0.10	-0.53	-2.47	-4.55	-6.85
LTV	0.11	5.42	0.12	6.09	0.12	6.05
DSC	-0.61	-1.77	-0.42	-1.25	-0.28	-0.86
LIFE	0.02	0.86	0.01	0.48	0.02	0.78
WAM	-0.01	-0.34	-0.02	-0.42	-0.04	-1.03
ln_Amount_Deal	-0.27	-1.48	-0.25	-1.41	-0.32	-1.91
Ln_Loan	-1.45	-6.93	-1.41	-7.02	-1.42	-7.33
ln_Prop	0.72	4.48	0.68	4.35	0.80	5.30
ln_Amount	0.05	0.97	0.03	0.58	0.05	0.85
Office	-0.04	-2.96	-0.04	-2.85	-0.04	-2.84
Hotel	-0.03	-1.34	-0.04	-1.84	-0.03	-1.79
Multi_Family	-0.01	-0.77	-0.01	-0.82	-0.02	-1.29
Nursing	-0.10	-1.27	-0.06	-0.81	-0.08	-1.22
Park	0.00	0.23	0.01	0.44	0.00	0.09
Retail	-0.03	-1.86	-0.03	-2.04	-0.03	-2.02
Warehouse	-0.06	-3.34	-0.06	-3.40	-0.06	-3.36
Moody	0.94	4.72	0.90	4.74	0.87	4.75
S&P	0.74	3.40	0.79	3.77	0.76	3.91
Fitch	0.37	1.97	0.40	2.24	0.41	2.50
three Ratings	-0.15	-0.66	-0.37	-1.65	-0.49	-2.39
One Rating	-0.05	-0.27	-0.16	-0.93	-0.31	-1.96
Constant	12.50	4.95	12.36	5.08	12.77	5.56
R-Square	0.65		0.67		0.63	

This table shows the regression results for subordination level in sample period 2004-2007. First four columns show the basic OLS regression results and the last two columns show the 3SLS regression results. Junior is a dummy variable and equals 1 if junior control and 0 if non-junior control.

Table 7 Master Servicer Effect Result: Subordination Level Equation (2004-2007)

	Coef.	T-stat.	Coef.	T-stat.
MS	-0.29	-1.69	-0.90	-2.03
Junior	-0.48	-4.65	-1.27	-7.89
MS*Year04			0.75	1.45
MS*Year05			0.24	0.44
MS*Year06			1.56	2.51
Junior*year04			1.14	6.21
Junior*year05			0.61	2.16
Junior*year06			0.94	3.70
Year04	1.28	5.75	0.39	1.53
Year05	0.58	3.27	0.07	0.27
Year06	0.01	0.07	-0.69	-3.10
LTV	0.11	5.30	0.12	6.16
DSC	-0.61	-1.77	-0.38	-1.15
LIFE	0.02	0.91	0.01	0.50
WAM	-0.02	-0.42	-0.03	-0.70
ln_Amount_Deal	-0.27	-1.48	-0.24	-1.38
Ln_Loan	-1.44	-6.89	-1.41	-6.92
ln_Prop	0.72	4.51	0.68	4.41
ln_Amount	0.05	0.98	0.03	0.53
Office	-0.04	-2.87	-0.04	-3.01
Hotel	-0.02	-1.16	-0.04	-1.98
Multi_Family	-0.01	-0.63	-0.02	-0.99
Nursing	-0.10	-1.28	-0.07	-0.90
Park	0.00	0.23	0.00	0.22
Retail	-0.03	-1.73	-0.03	-2.14
Warehouse	-0.06	-3.27	-0.06	-3.49
Moody	0.91	4.61	0.89	4.68
S&P	0.71	3.26	0.76	3.70
Fitch	0.36	1.94	0.40	2.21
three Ratings	-0.16	-0.70	-0.24	-1.48
One Rating	-0.04	-0.24	0.24	0.81
Constant	12.52	4.97	12.51	5.18
R-Square	0.65		0.68	

This table shows the regression result for subordination level in sample period 2004-2007. MS is a dummy variable and equals 1 if the master servicer is also the special servicer. Junior is a dummy variable and equals 1 if junior control and 0 if non-junior control.