A Direct Test of Agency Theories of Debt: Evidence from RMBS

Yilin Huang
Federal Reserve Bank of Philadelphia

Taylor D. Nadauld*
Brigham Young University

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Abstract

When a firm is facing default, equity holders have incentives to engage in asset substitution, underinvest, or directly transfer wealth. Few papers document investment distortions on account of debt-equity agency conflicts, only that the threat of distortions influence ex ante financing costs. A non-agency RMBS deal represents an entity that is highly leveraged where, ex ante, equity holders know they will face default. This provides an ideal laboratory for testing whether the threat of default creates any of the distortions predicted in theory. We estimate a lower bound on agency costs associated with direct wealth transfers to be in the range of $.018 per dollar.

Agency theories of debt maintain that excessive leverage in a firm creates conflicts of interest between debt and equity holders. Conflicts of interest arise because a firm's investment decisions can generate payoffs that have disproportionate effects on the value of debt and equity claims (Jensen and Meckling (1976)). Agency conflicts are exacerbated in the presence of financial distress and can result in underinvestment, asset substitution, or even direct wealth transfers (Myers 1977). Measuring the welfare effects of debt-equity agency conflicts in practice is difficult. In this paper we exploit the structure of residential mortgage-backed security (RMBS) deals to provide a direct test of agency theories of debt.

Empirical tests of agency theories of debt are inherently difficult to construct because an adequate test would require the following essential elements: a large sample of firms that are all highly levered and facing imminent financial distress, but that exhibit meaningful variation in how closely aligned managers are with shareholders. A sample that met these criteria would essentially allow for the econometrician to hold leverage and the threat of financial distress constant while varying the incentives and ability of the equity holders of the firm to expropriate bondholders. Theory predicts that firms with highly concentrated ownership whose interests are closely aligned with management are more likely to engage in activities that transfer wealth from debt holders to equity holders in the face of financial distress. We provide empirical tests of this prediction. That is, we evaluate whether the cash flows of RMBS deals are managed in a way that benefit equity investors at the expense of senior debt investors as a result of an affiliation between the management of an RMBS deal and equity investors. While the existing empirical literature is able to construct tests to show that the threat of wealth transfers increases ex ante financing costs, the literature is yet to quantify welfare costs associated with actual wealth transfers.[1] As such, our work represents a novel attempt to quantify agency costs of debt in the form of direct wealth transfers.

The design of non-agency RMBS represents an ideal setting to measure distortions arising from debt-equity agency conflicts for at least two reasons. First, non-agency RMBS represent a senior-subordinated structure of securities in the presence of extreme leverage where equity holders face imminent

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[1] Parrino and Weisbach (1999) quantify the agency costs of debt by focusing on leverage-induced underinvestment.

financial distress. Second, RMBS deals feature meaningful variation in the degree of alignment between managers and equity holders. Mortgage servicers in an RMBS play a role similar to managers in a firm in that their decisions regarding servicing actions ultimately determine the performance of the securities in the trust, particularly the performance of the equity tranche. It is also the case in RMBS that mortgage servicers can be affiliated with the ultimate investor in the equity tranche. Thus, a mortgage servicer that also owns the equity tranche of an RMBS can service mortgages in a manner that benefits the equity tranche at the expense, ultimately, of senior bondholders in the RMBS. As evidence of this possibility, consider the following language contained in the prospectus of a representative RMBS deal: "*the master servicer or an affiliate of the master servicer may initially own all or a portion of certain classes of the securities. The timing of mortgage loan foreclosures and sales of the related mortgage properties, which will be under the control of the master servicer, may affect the weighted average lives and yields of the securities."*[2] In Section 4 of the paper we discuss the institutional features of RMBS that allow servicing actions to impact the value of securities.

The institutional relationship between the key entities involved in RMBS– the mortgage servicer, equity tranche investors, and senior tranche investors– closely parallel the nature of the relationships between managers, shareholders, and debt holders in a firm. Our sample allows for an evaluation of the equity tranche performance of RMBS in the presence of two distinct, implicit types of management contracts: those where mortgage servicers (akin to managers) are closely affiliated with equity tranche investors (akin to shareholders) and those where an affiliation does not exist.

Debt, equity agency conflicts create incentives that give rise to at least three potential investment distortions: underinvestment, risk-shifting through asset substitution, or direct wealth transfers. Direct wealth transfers represent the most extreme form of investment distortion, and are most likely when a firm

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[2] The prospectus further explains, "*Although the servicing standard in the related servicing agreement will obligate the master servicer to service the mortgage loans without regard to the ownership or non-ownership of any securities by the master servicer or any of its affiliates, you should consider the possibility that the timing of such foreclosures or sales may not be in the best interests of all security holders. You should also consider that, other than the general servicing standard described above, no specific guidelines will be set forth in the related servicing agreement to resolve or minimize potential conflicts of interest of this sort.*"

is close to bankruptcy. Equity holders, facing total loss in the event of bankruptcy, have incentives to extract as much value as possible from the firm in the form of special dividends or other direct payment methods, leaving debt holders with little value to salvage in bankruptcy. The evidence provided in this paper is more consistent with direct wealth transfers than underinvestment or asset substitution.

Despite the virtues of RMBS as a laboratory for quantifying the cost of agency conflicts, we face two noteworthy empirical challenges. The first challenge is that, in most circumstances, it is impossible to determine with certainty the identity of owners of the equity tranche.[3] Thus, we are unable to determine with certainty circumstances when the mortgage servicer is directly affiliated with the equity tranche investor(s). In addressing this issue we make a critical assumption, which is that arrangers of RMBS securitizations (referred to as "deal sponsors") are more likely, all else equal, to themselves own the equity tranche, or at the very least have incentives to influence the performance of the equity tranche. That is, deal sponsors are more likely to retain 'skin in the game.' We discuss the sensibility of this assumption in more detail in Section 5.2. Though it is clearly not the case that every equity tranche is owned by the deal sponsor, it is not clear why making such an assumption should result in any systematic estimation bias in favor of identifying cash-flow shifting, especially when mortgage servicer fixed effects are taken into account. Stated differently, in testing the hypothesis that conflicted deals generate higher cash flows to the equity tranche, measurement error in the assignment of the conflicted status of a deal should bias estimates on the conflicted variable towards zero.

The second empirical challenge is that omitted variables could jointly influence deal performance and collateral selection. For example, deal sponsors would have an incentive to select higher quality collateral for deals where they plan to retain both the equity tranche and mortgage servicing rights (Benmelech, Ivashina, and Dlugosz (2012)). We address the bias this could introduce in two ways. First, we match deals originated within the same vintage based on observable hard information and test whether affiliated equity tranches live longer than their matched counterparts. While matching on observables is a

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[3] We can determine with certainty the owner of the equity tranche for a small sample of deals.

useful exercise, it does not solve selection bias on account of unobservable, soft information. To address this concern we consider a subsample of affiliated deals in our sample that should be immune to an ex-ante collateral selection critique. Some deals became affiliated through deal sponsors' acquisition of mortgage servicing companies after the origination of RMBS deals.[4] Thus, at the time of deal origination, affiliation between mortgage servicers and deal sponsors did not exist, and therefore should not have impacted the collateral selection process. After deal origination, however, the deals became conflicted through the subsequent acquisition of a mortgage servicing company. One limitation of this approach is that it applies to a relatively small sample of deals.

Our study benefits from the use of a novel sample. Intex, a leading provider of RMBS analytics, provides data on the real-time collateral balance and cash flows to the equity-tranche of RMBS deals. Intex also provides information on the performance of the mortgage collateral, including delinquency rates and cumulative loss rates as well as modification data for a sub-sample of deals, including a time-series of loan modifications. We bolster our sample of loan modification data using data from CoreLogic. We rely on publicly available deal prospectuses and on Bloomberg in supplementing our sample with information regarding deal sponsors and mortgage servicers.[5] Our final sample that measures equity tranche longevity consists of 1,003 unique RMBS deals, as well as information on the 79 unique sponsors and 48 unique mortgage servicers of the deals.

Our primary empirical result is that the performance of the equity tranche is substantially better when the mortgage servicer is affiliated with the assumed holder of the equity tranche.[6] Better equity tranche performance does not appear to be the result of higher-quality collateral, as would be suggested under a 'skin-in-the-game' collateral selection hypothesis. Rather, the performance is influenced by the time series of servicing activity. The equity tranche in deals with a close affiliation between mortgage servicers (managers) and equity tranche investors (shareholders) remain eligible to receive interest

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[4] We provide an example of these types of acquisitions in Section 5.3.
[5] The term deal sponsor is used interchangeably with deal arranger. We will use the term deal sponsor henceforth.
[6] From this point forward, we refer to deals with an assumed affiliation between the deal sponsor (i.e. the entity that arranges the securitization) and mortgage servicer as "affiliated" deals.

payments for 6.5 months longer than deals with no such affiliation, on average. This translates into higher total payments to equity tranche investors. Estimates of the 'abnormal' cash flows accruing to equity tranche investors as a result of cash flow shifting translate into roughly $.018 cents on the dollar for an average RMBS deal. However, we view these estimates as a conservative lower bound given that our effects are estimated as an average over a large sample of deals, some of which likely did not have any cash flow shifting. Conditional on cash flow shifting occurring in a given deal, the effects are likely to be larger.

What is the cash-flow shifting mechanism? Longer-lived equity tranches are made possible by mortgage servicing actions that essentially transfer wealth to equity tranche investors, at the expense, ultimately, of investors in senior debt claims. At least two possible cash-flow shifting mechanisms exist. The first is the delaying of liquidation of delinquent mortgages and the second is through strategic use of loan modifications.[7] Delaying the liquidation of delinquent mortgages and engaging in aggressive loan modifications allow equity tranches to receive principal and interest payments that they would not receive otherwise. We provide empirical evidence consistent with the delaying of liquidations and aggressive loan modifications. We also find that affiliated deals ramp up modification activity in the months preceding the death of the equity tranche. Further, the loans of affiliated deals that are modified prior to the equity tranche death have substantially higher re-default rates, evidence that the modifications were more aggressive to begin with.

The most poignant empirical evidence in this paper stems from a set of deals where we can confirm the organizational entity that owned a given set of equity tranches.[8] Subsequent to the origination of the equity tranches, the entity purchased the mortgage servicing company that owned the servicing rights on the equity tranches they owned. The equity tranche owners' acquisition of a mortgage servicing company provides an ideal setting to test our hypothesis because the equity tranche owner did not own the equity tranche of all the deals serviced by the mortgage servicer they acquired. Thus, we can compare the

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[7] Both mechanisms rely on payment advances from mortgage servicers to the RMBS trust. We discuss the institutional details associated with the practice of payment advances in Section 2.

[8] It is also the case that the entity was the deal sponsor in the RMBS that created the equity tranches.

performance of the equity tranches they owned against the performance of the equity tranches they did not own, where the full set of equity tranches had the exact same mortgage servicer. The equity tranche of the deals that became conflicted through the acquisition lived an average of 17 months longer than the non-conflicted deals (Figure 2 provides plots of the longevity of the conflicted deals compared to the non-conflicted deals).

In a final section of the paper, we address whether the existence of agency conflicts are priced at the time of deal origination. The fact that potential agency conflicts exist in securitizations where mortgage servicers are affiliated with equity tranche investors could influence the price of senior RMBS securities at the time of origination. We find that the at-origination yields of senior tranches with servicer-investor affiliations were not statistically different than those without an affiliation.

Aside from informing agency theories of debt in Corporate Finance, we believe these results have important policy implications. The practice of securitizing financial assets has come under considerable scrutiny given securitizations role in the recent Financial Crisis. At issue is the moral hazard that arises when the originators of loans and securitization deals have private information regarding the quality of the securitized collateral. In response to the potential moral hazard inherent in securitization, policy makers have proposed that originators of securitization deals retain some "skin in the game" (see Section 15G of the Securities Exchange Act (Dodd Frank)).[9] This paper identifies a potential dark side to securitization arrangers' retention of skin in the game. In the case of RMBS, deal arrangers that retain skin in the game - in the form of ownership of the equity tranche – also frequently own the servicing rights of the mortgages comprising the collateral in the RMBS. Deal arrangers that retain ownership of both the equity tranche and mortgage servicing rights are conflicted. Future policy decisions should consider the practice of requiring an arm's length relationship between mortgage servicers, deal sponsors, and equity tranche investors. Alternatively, policy makers could require adequate transparency in the RMBS market that would allow market participants to appropriately allocate the risk of cash-flow shifting.

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[9] Democratic representative Barney Frank, co-author of Dodd-Frank, said the skin in the game requirement was, "the single most important part of this bill." (Center for Public Integrity, July 11, 2011)

Section 2. Contribution to the Literature.

This paper is relevant to two distinct streams of literature. The first is the literature on the agency costs of debt. Jensen and Meckling (1976) first proposed the asset substitution problem followed by Myers' (1977) model of underinvestment and liquidating dividends. These papers spurred theoretical work further exploring the nature of contracts that can mitigate agency costs of debt, highlighted by Berkovitch and Kim (1990). Shleifer and Vishny (1997) argue importantly that the severity of agency costs of debt depend on the concentration of equity ownership. Concentrated equity ownership creates stronger incentives to expropriate bondholders as compared to diffuse equity ownership. Based on this theoretical prediction, the existing empirical literature is focused primarily on estimating whether debt financing costs are higher in circumstances of concentrated equity ownership. Examples include Bagnani, et al. (1994), Anderson, Mansi, and Reeb (2003), Aslan and Kumar (2012). The equity tranche of an RMBS represents a highly concentrated ownership position. While the existing literature tests agency theories of debt by evaluating ex ante financing costs, our setting is ideal to test how debt, equity agency conflicts in the presence of concentrated equity ownership can lead to direct wealth transfers, the threat of which is the source of the higher ex ante financing costs identified in the literature.

This paper also contributes to a growing literature on agency conflicts created by securitization. James and Demiroglu (2012) study the performance of RMBS deals when the mortgage originators are affiliated with RMBS deal sponsors and mortgage servicers. They find that an affiliation between mortgage originators and deal sponsors results in lower ex-post default rates – evidence that expected exposure to the equity tranche leads mortgage originators to more carefully screen loans at the time of origination. They also find that originator, servicer affiliation also results in lower ex-post default. Multiple papers have also documented that agency conflicts at the time of origination impact originators' incentives to screen borrowers (Keys et al (2010) and Jian, Nelson, and Vytlacil (2013)).

The primary differences between the empirical evidence presented in this paper and the evidence in James and Demiroglu (2012) are two-fold. First, James and Demiroglu (2012) are primarily focused on

how *originator-servicer* affiliations impact ex-ante screening incentives. In contrast, we focus on how *servicer-sponsor* affiliations impact ex-post servicing decisions, particularly the time series of servicing decisions. The second key difference is that while ex-ante screening incentives are important, and can result in higher quality collateral in deals at the beginning of a deals life, what ultimately matters for deal performance is the practice of mortgage servicing. Our evidence indicates that the time series of servicing decisions has a meaningful impact on the ultimate performance of a deal, regardless of ex-ante collateral quality. Another related paper is Begley and Purnanandam (2013), who study whether the thickness of the equity tranche predicts subsequent equity tranche performance and find that larger equity tranches are associated with better ex-post performance. This result is also consistent with the idea that sponsor's exposure to the equity tranche increases tranche performance.

Our focus on servicing incentives is not new to the literature. Recent literature has also investigated how securitization and servicing incentives have impacted modification and foreclosure decisions. Piskorski, Seru, and Vig (2010), Agarwal, et al. (2011), and Kruger (2015) argue that securitization increases foreclosure likelihood. Further still, Piskorski et al (2010) and Agarwal et al (2011) argue that servicing incentives impact the ex-post performance of mortgages by documenting that servicers with no equity stake in originated mortgages are more likely to foreclose and less likely to modify. Adelino, Girardi, and Willen (2014) also provide evidence that securitized loans are less likely to be modified and have higher foreclosure rates. In summary, this large and growing literature has shown that securitization influences ex post mortgage performance, and that servicing incentives are an important mechanism in determining mortgage outcomes. In addition to securitization's impact on loan performance, recent work by Agarwal, et al. (2016) shows that the organizational ability of servicers to handle distressed loans is another quantitatively important factor affecting mortgage loan performance.

We contribute to the literature in two ways. First, though the literature has documented the impact of securitization and servicing on ex post outcomes, the literature has not yet documented how servicing incentives create agency conflicts between junior and senior bondholders in an RMBS. Our setting speaks to the fact that the cash-flow waterfall structure of RMBS creates interesting servicing incentives in the

time series of a deal. The cash flow rules of RMBS create incentives for deals to be propped up particularly when a deal is young, but incentives to prop up a deal through modifications decline as a deal seasons. Understanding the incentive structure of all the participants in an RMBS, particularly between servicers and investors, is critical in making sound policy decisions. Our second contribution is to provide corroborative evidence on the importance of servicing incentives in a novel sample by documenting how the ownership structure of servicing rights impacts RMBS deal performance, not just mortgage performance.

Section 3. Hypothesis Development.

Incentives for shareholders to expropriate debt holders depend on many critical factors: how closely aligned manager's interests are with those of the shareholders, concentration of equity ownership, leverage, and the likelihood of bankruptcy. The structure of a non-agency RMBS deal features each of these conditions. First, RMBS deals are highly levered. On average, the size of the equity tranche in RMBS deals originated between 2003 and 2007 represented only about 2.35% of the total deal balance.[10] In other words, the typical non-agency RMBS structure is extremely leveraged. Second, by construction, the equity tranche faces the threat of total loss at some point during the life of the deal. In fact, the very technology that forms the foundation of non-agency RMBS relies on the assumption that some expected fraction of the non-agency loans serving as collateral will default during the life of the deal. The only real uncertainty is when the timing of defaults sufficient to wipe out the equity tranche will actually occur. In fact, it is the timing of the recognition of the defaults that is crucial to a cash-flow shifting hypothesis.

The last feature of RMBS that lends itself to the possibility of wealth transfers is the nature of the relationship between investors in the equity tranche and mortgage servicers. In some deals, the interests of the mortgage servicer and equity tranche investor are very closely aligned. As such, servicing decisions made by mortgage servicers can directly influence cash flows to equity tranche investors, similar to

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[10] Summary statistics on deal attributes, including the size of the equity tranche, are reported in Table 1.

management decisions in a firm directly benefiting shareholders at the expense of debt holders. Of the factors that increase the threat of wealth transfers, leverage, the threat of bankruptcy, and the alignment of management/shareholder interests, we exploit cross-sectional variation in the degree of manager/shareholder alignment. That is, we control for leverage and other collateral attributes that impact the threat of equity tranche default, but almost by design, leverage and default risk are not substantially different for deals within the same origination vintage given that we also control for vintage-of-origination fixed effects. In this way, our empirical approach more carefully identifies variation in manager, shareholder alignment as the channel that varies the likelihood of wealth transfers.

Agency theories of debt predict two testable hypotheses relevant to our setting. First, agency theories of debt would predict the likelihood of wealth transfers to be higher among affiliated deals, all else equal. We employ a series of tests designed to detect possible wealth transfers, and wealth transfer mechanisms, among affiliated deals. Second, anticipated agency conflicts should impact the ex-ante cost of senior RMBS debt. We test whether senior tranches with an affiliation between mortgage servicers and assumed equity tranche investors have differential spreads at issuance compared to deals without an affiliation.

Section 4. The Mechanics of RMBS Cash Flows.

In this section we review the mechanics of equity tranche cash flows in preparation for a description of our empirical tests. The equity tranche of a non-agency RMBS deal has the potential to generate principal and interest payments if a deal meets pre-specified performance criteria. Our empirical tests rely on an objective assessment of servicing practices that could influence the performance metrics upon which cash flows to the equity tranche are based.

Section 4.1. Performance triggers and principal payments to the equity tranche.

The equity tranche will receive principal payments if the deal meets a set of performance criteria known as performance triggers. Performance triggers are an important type of credit enhancement for a deal because they ensure that the overcollateralization protection provided by the equity tranche remains in

place long enough to serve its intended purpose. However, in order to provide incentive for investors to purchase the equity tranche, deals do provide for the release of a percentage of the principal of the equity tranche, usually after 36 months, if the deal is deemed to be performing adequately. Deal-level performance triggers are generally defined as a function of the performance of the underlying mortgage collateral. If, after 36 months, rolling three-month average delinquency rates are low enough and realized losses have not crossed a specified threshold, the deal "steps down" and releases principal payments to the equity tranche. Given the high default rates on non-agency mortgage collateral during our sample period, deals in our sample rarely stepped down. In our sample of 1,003 deals, only 110 ever released principal to the equity tranche. However, conditional on meeting performance triggers and stepping down, the principal payments can prove to be a substantial fraction of the original principal in the equity tranche. Of the 110 deals that did pay principal, the average deal received $8.9M, representing 49.2% of the target balance of the equity tranche.

Section 4.2. Interest payments to the equity tranche.

In addition to the possibility of equity tranche investors receiving principal payments via performance triggers, investors in the equity tranche can also receive interest payments. However, unlike senior tranches in an RMBS, investors in the equity tranche are not promised interest payments. In short, the equity tranche receives interest payments as long as it is fully funded and the underlying mortgage collateral is generating interest payments in excess of the payments promised to investors in the RMBS bonds. The equity tranche is considered fully funded when the principal balance of the tranche is equal to the target balance of the tranche.[11] The ratio of the current tranche balance to the tranche balance at origination is called the "equity tranche factor." Through the life of the deal, when the equity tranche factor (also referred to as the "OC factor") is equal to one, and the mortgage collateral is generating excess interest, interest payments will flow to equity tranche investors. When the equity tranche factor falls below one,

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[11] In most cases, the target balance of the equity tranche is fixed at deal origination, but can change through time as a function of the performance of the collateral. The target balance of the equity tranche will "step down" if a deal passes its performance triggers.

which occurs when collateral losses are sufficiently large, the equity tranche is no longer eligible to receive interest payments.

While a deal is seasoning, the equity tranche factor will remain at one and interest payments will flow when realized credit losses in the underlying mortgage collateral are at a minimum. A deal can absorb minimal credit losses without reducing the equity tranche factor below one because a deal's first line of defense against defaults is the excess spread account. Excess spread represents the difference between the total interest generated by the mortgage collateral and the weighted-average interest payments promised to investors and administrative fees. Once realized credit losses exceed the amount in the excess spread account, losses begin eating into the principal balance of the equity tranche, the equity tranche factor will drop below one, and interest payments will shut down. In our full sample of deals, the equity tranche factor remained at one for about 33 months, on average (Table 1). Deals originated in 2003 maintained an equity tranche factor equal to one considerably longer than deals originated in 2007; 67 months for the '03 vintage as compared to 16 months for the '07 vintage.

Section 4.3. Mortgage servicing mechanisms that "prop up" the equity tranche factor.

The performance triggers discussed above can be influenced by servicing practices that serve to "prop up" the equity tranche. We discuss two such propping mechanisms in this section.

When a borrower becomes seriously delinquent (90+ days), mortgage servicers have three options. The first option is to foreclosure on the borrower, sell the collateral, and advance the proceeds of the liquidation to the RMBS trust. A decision to liquidate will result in credit losses to the deal, ultimately pushing the equity tranche factor below one. The critical technicality in a liquidation decision is that the credit loss is not realized until the liquidation has occurred. Thus, the foreclosure decision itself does not constitute a credit loss. Because of this, a mortgage servicer could foreclose on a property but not liquidate the property, the equity tranche factor would remain at one, and the equity tranche would be eligible for interest. Thus, the first mechanism that could keep the equity tranche factor propped up is a mortgage servicer's failure to liquidate.

Recall that the equity tranche will only receive interest payments if the excess interest is sufficient and the equity tranche factor is equal to one. In the scenario described above, where a number of mortgages are delinquent but the mortgage servicer has failed to liquidate the delinquent loans, it is unlikely that the deal will be generating any excess interest, and the equity tranche will not receive interest. This prompts the question, how can delaying the liquidation of delinquent mortgages support interest payments to the equity tranche? The answer lies in the practice of payment advances. When a borrower becomes seriously delinquent, the RMBS trust will not have the funds necessary to make scheduled principal and interest payments to bondholders. Mortgage servicers can "advance" the missing funds to the trust at their own expense, keeping a deal fully funded. The cost of advancing for a servicer is roughly equal to its cost of capital (assuming the value of liquidity is appropriately incorporated into any cost of capital calculation). The critical technicality in an advancing decision is the recognition that any cash advancements made by a servicer receive absolute refunding priority over any other trust liability. Thus, when the trust liquidates properties or receives unscheduled principal payments in the future, the cash flows first to the mortgage servicer which has advanced cash payments to the trust. Advancing cash to the trust so that the equity tranche factor remains equal to one works because the mortgage servicer becomes the senior claimant on subsequent cash flows advanced to the trust, senior even to interest payments made to the most senior bondholders. An aggressive advancing strategy would be positive NPV if the returns to the equity tranche exceed a mortgage servicers cost of capital. Our estimates indicate that the returns to the equity tranche are likely to be substantially higher than any plausible cost of capital.

A second propping mechanism is through aggressive loan modification. When a borrower becomes seriously delinquent, mortgage servicers have the option of modifying borrowers' loans. The most frequent type of modification brings the borrowers principal balance current, and the equity tranche factor remains equal to one. In the context of propping up an equity tranche factor, aggressive loan modifications are unambiguously beneficial to an equity tranche investor but more ambiguous in their impact on senior tranches. Loan modifications on loans which have little probability of performing are beneficial to equity tranche investors because modifications, even on fundamentally bad loans, delay recognition of credit

losses and keep the equity tranche factor high. With respect to senior tranches, modifications on fundamentally poor loans delay inevitable losses. If collateral values are expected to increase in the future, delay of loss could be beneficial. If collateral values are flat in expectation, aggressive modification is harmful to senior tranches because interest payments will flow to the equity tranche as though the deal is healthy, when in reality, the health of the deal is simply being masked by aggressive modification. Interest that flows to equity tranches in the interim essentially come at the expense of proceeds from liquidation (absent a modification) that would ultimately flow to the senior tranches.

Section 5. Data

Section 5.1. Sample Construction

The primary variable of interest in our empirical analysis is the ratio of the current (i.e. real-time) equity tranche balance divided by the original equity tranche balance, known in the RMBS industry as the 'equity tranche factor'. Construction of a time-series of the equity tranche factor for each deal in our sample requires data on the collateral balance of the equity tranche at origination and the real-time collateral balance through the life of the deal. Real-time collateral balance data is available from Intex, a leading provider of RMBS analytics. We begin the construction of our sample by downloading every non-agency RMBS deal with available cash flows on Intex that was originated between the years 2003 and 2007, which totals 1,602 deals. Intex reports data on the status of the mortgage collateral, including the cumulative percentage of loans that are 90+ days delinquent, bankrupt, foreclosed, and real-estate owned. Intex also reports the cumulative loss rate of a given deal in real time. Data on the cumulative loss rate of a deal is particularly important because it reflects the actual outcome of servicing decisions on delinquent loans that ultimately impacts cash flows to the RMBS trust. We also rely on Intex for data on the principal and interest payments that flow to the equity tranche over the life of a deal.

Tests of the performance of the equity tranche necessarily require data on the attributes of the underlying mortgage collateral. Real-time collateral attribute data on non-agency RMBS are provided by CoreLogic. Loan-level collateral attributes are rolled up to the deal level using loan sizes as weights. We

do not have a perfect matching of collateral attribute data from Corelogic to deal cash flow data from Intex. A merge of the two datasets results in available collateral data for 1,306 deals. We also require data on deal sponsors and mortgage servicers. Because data on deal sponsors is not systematically reported by any RMBS analytics source, we hand collect data on sponsors and mortgage servicers from each deal prospectus.[12] We are able to identify the deal sponsor and mortgage servicer for 1,056 deals which also have real-time collateral attribute data and real-time data required for construction of the equity tranche factor. A final sample screen is the requirement that a deal generates a non-zero amount of interest to the equity tranche at any point during its life, limiting our maximum sample size to 1,003 deals.[13]

Some of our tests rely on a smaller sample than 1,003 deals. Data on loan modifications are particularly sparse, for two reasons. First, the equity tranche of many deals, mostly those originated in 2003, were essentially dead by the time the practice of loan modifications began in earnest. Second, loan modifications are not systematically reported by any loan analytics data source. We rely on two sources for modification data. The first is Intex, which contains modification data for 120 deals in our final sample. The second source of modification data is CoreLogic, where we use algorithmic methods to gather modification data for another 292 deals in our final sample. Missing observations are cause for concern if they are not random in the sample. We take care to ensure that our sample of available data, though plagued by some missing observations, is not systematically biased in any direction.

Finally, our bond pricing tests rely on bond-level transaction data compiled and provided by Thomson Reuters EMaxx services. The transactions represent the open market transactions primarily of insurance funds, but include a very small amount of transactions of government state pension funds and mutual funds. We match the bond-level transaction data with deal-level securitization data by CUSIP. The

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[12] Most deal prospectuses are available in pdf form on Bloomberg. Those not available in Bloomberg can be found at secinfo.gov.

[13] Deals that fail to generate any amount of interest for the equity tranche are deals where the equity tranche is essentially dead at origination. While these these deals are interesting, and occur primarily in the second half of 2007, they are less relevant to our empirical tests because they do not provide any potential for servicing activity that could serve to keep the equity tranche alive.

matching of bond transactions to its associated mortgage collateral data results in a bond pricing sample of 504 total RMBS.

Section 5.2. Assignment of Deals as Conflicted

Our hypothesis relies on an objective assessment of an affiliation between deal sponsors and mortgage servicers. In this section we describe how we identify deals as being affiliated. In some instances the mortgage servicer and deal sponsor are the same entity; Countrywide being the most prominent example. Affiliations also existed through subsidiaries. Deal sponsors, typically large investment banks or commercial banks with investment banking arms, frequently owned mortgage servicers prior to and during our sample period. For example, Bank of America, among the top-10 originators of non-agency RMBS, owned a mortgage servicer named Wilshire Credit. In assigning deals as having an affiliated sponsor and servicer, we begin with a list of each unique mortgage servicer in our sample, 48 in total. We then use a business intelligence service named Mint Global to identify the ultimate parent of each servicer. If the mortgage servicer has as its ultimate parent the sponsor of the securitization deal, we classify the deal as affiliated.

Our assignment of the affiliated indicator is complicated by the fact that ownership changes and consolidation occurred in the mortgage servicing industry during our sample period. An example of ownership changes involves Bear Stearns, which was acquired by JPMorgan in 2008. Bear Stearns owned a mortgage servicer named EMC mortgage. Thus, after the acquisition, EMC technically could be considered affiliated with deals sponsored by JPMorgan, as well as all the deals sponsored by Bear Stearns prior to the ownership change. An example of servicer consolidation involves Litton Loan Servicing LP, which was acquired by Goldman Sachs in December 2007, and later sold to Ocwen Financial, itself a mortgage servicer, in September 2011. Deals serviced by Litton and sponsored by Goldman Sachs are considered affiliated during the period of their ownership affiliation. Our assignment of affiliated/not-affiliated status attempts to match with the periods of time in which an ownership affiliation existed during the life of the deal. Our classification results in 508 affiliated deals and 495 unaffiliated deals. We note, with emphasis, that bank acquisitions of other banks and servicer consolidations are *not* the types of

transactions we exploit for identification. We discuss the affiliated-through-acquisition sample in the next section.

A different issue in the assignment of affiliated status involves the selling of mortgage servicing rights during a deal's lifetime. Deals originated with one mortgage servicer may have had the servicing rights sold to a different servicer. When servicing rights are sold, they are most frequently sold early in a deals life. We check remittance reports in the months after deal origination to check if the original servicer has changed. Another issue is that some deals have more than one mortgage servicer for the underlying collateral. If any of the reported mortgage servicers are affiliated with the deal sponsor, we classify the deal as being affiliated. We also note, with emphasis, that the selling of servicing rights for *one individual* RMBS deal is also not the type of transaction we exploit for identification (i.e. these are not the affiliated-through-acquisition deals discussed in the introduction).[14]

The economics of the affiliated servicer-sponsor classification relies on one critical assumption. We assume that deal sponsors are most likely to retain ownership of the equity tranche. We believe this is a reasonable assumption for two reasons. First, the equity tranche is more complicated to sell to investors because of its role in absorbing first losses.[15] This increases the likelihood that sponsors, in many instances, retained the equity tranche.[16] Second, evidence from the 10-K of one of the largest sponsors of non-agency RMBS, Bear Stearns, provides indirect evidence of the quantity of equity-tranche holdings. As of November 30, 2006 Bear Stearns had retained interests on AAA-rated securitizations of $1.5 Billion and retained interests in $2.6 Billion of non-AAA rated securitizations. Given that, on average, close to 80%

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[14] Servicing rights to individual deals can be sold. This is a different concept than an entire mortgage servicing company being sold to another entity.

[15] This conclusion is based on discussions with industry professionals. Note the use of the term "complicated" in describing the sale of an equity tranche, as opposed to the possibility that the equity tranche is highly unlikely to ever sell because it absorbs the first loss.

[16] The most natural external clientele for the equity tranche is correlation traders at hedge funds. Highly correlated mortgage collateral provides the equity tranche with the best chance for survival, absent the servicing practices described in this paper (see Nadauld, Sherlund, and Vorkink (2011)).

of the principal balance of a non-agency RMBS was AAA-rated, holding 73% larger amounts of non-AAA rated securities than AAA-rated would only be possible by frequently retaining the equity tranche.[17]

We believe our assumption regarding a sponsor's retention of the equity tranche is likely to introduce noise into our estimates given that it cannot be the case that every sponsor in every deal retained ownership in the equity tranche. While the assumption does introduce noise in our estimates, it is not clear why it introduces bias. Deals in which sponsors systemically sell equity ownership will falsely be identified as affiliated and likely bias our estimates towards zero. Likewise, classifying truly conflicted deals as being not conflicted will also create noise in our estimates. In other words, mis-measurement of conflicted status should introduce classic measurement error with its resultant downward bias.

Section 5.3. Affiliation-through-acquisition sample

An important sub-sample of our data involves deals that became affiliated through a deal sponsor's acquisition of an entire mortgage servicing company. This sample includes deals originated by a sponsor which at the time of origination had an unaffiliated mortgage servicer. These deals became affiliated when the deal sponsor subsequent to deal origination acquired the mortgage servicing rights to some of the deals which they had originally sponsored through the acquisition of a mortgage servicing company. An example includes Morgan Stanley's acquisition of Saxon Mortgage Servicing, a deal which formally closed in December, 2006. Morgan Stanley had previously sponsored a few deals which were serviced by Saxon. Another example includes Carrington Financials' acquisition of both New Century and Fremont mortgage servicers in 2007 and 2008, respectively. Some of the deals with collateral being serviced by New Century and Fremont were originated and sponsored by Carrington Financial. Thus, while the deals were not originally affiliated because Carrington was not formally affiliated with New Century and Fremont at the time of deal origination, they became affiliated through the acquisition. One additional virtue of the affiliation-through-acquisition sample is that for most of the equity tranches in this sample, we can confirm

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[17] The 10-ks of other RMBS deal sponsors do not report granular enough data on the ratings and amounts of their securitization holdings to perform a similar clinical analysis.

with certainty using available reports that the equity tranche was owned by the entity(s) that purchased mortgage servicers.

Affiliation-through-acquisition represents an interesting subsample because it provides for an ideal experiment in which we can test whether deals with the exact same mortgage servicer perform differently when some of the deals are affiliated and some deals are not affiliated. The affiliation-through-acquisition subsample also has the virtue of being immune to an ex-ante collateral selection critique because the affiliation did not exist at the time of deal origination. Figures 2a, 2b, and 2c document differences in the performance of equity tranches based on their affiliated-through-acquisition status. The dotted lines in each of the three figures represent deals originated by a specific deal sponsor that purchased the servicing rights in 2007 to all of the deals in the plots. Thus, the dotted lines represent deals that were originated by a sponsor that only became affiliated *after* the sponsor's acquisition of the mortgage servicer. The solid lines represent deals that were not affiliated with a servicer at origination and remain unaffiliated after an acquisition.

In Figure 2a we plot the OC factor, our measure for the longevity of the equity tranche, through time for six deals originated in 2004. All of the six deals in Figure 2a had the exact same servicer, and that servicer was not affiliated with the deal sponsor during the first 3 years of the deals life – the years when performance triggers are so critical for generating potential returns for equity tranche holders. The plot in Figure 2a indicates that the deal's demonstrated very similar performance.

Figure 2b plots the performance of a set of nine deals originated in 2005, all with the same servicer, where six of the nine deals became affiliated through the sponsor's acquisition of mortgage servicing rights (represented by the dotted lines). Importantly, the 2005 deals were acquired early enough in their life that performance triggers could still be met. When compared against deals with the same servicer, the deals that became affiliated through the acquisition had equity tranches that "lived" substantially longer than deals that were not affiliated as a result of the acquisition.

Figure 2c repeats the exercise for a different set of nine deals originated in 2006, seven of which became affiliated through the sponsor's acquisition of servicing rights in 2007. Again, importantly, the

acquisition took place very early in the deal's lives. The affiliated deals plotted in Figure 2c, all originated in 2006, remained alive over twice as long as their counterparts, despite being serviced by the same servicer. Formal tests presented later in the paper confirm that the affiliated-through-acquisition equity tranches presented in each of the figures generated substantially higher cash flows. Taken together, the evidence in Figures 2a, 2b, and 2c indicate that for a set of deals with the same servicer, when the servicer became affiliated with the owners of the equity tranche (and where ownership of the equity tranche by the sponsor can be confirmed in the case of the deals plotted in these figures), the equity tranche substantially outperformed the equity tranche from comparable deals.

Section 5.4 Summary Statistics

Table 1 reports summary statistics. Our variable of interest is the number of months the equity tranche factor remained alive, tabulated separately for the affiliated, unaffiliated and affiliated-through-acquisition samples. On average, over the total sample, the equity tranche factor is equal to one for 33 months. Unconditionally, over the full sample, the life of the equity tranche is not statistically different for affiliated deals as compared to unaffiliated deals. As we will show momentarily, this is not the case when we control for collateral quality as well as quarter-of-origination and servicer fixed effects. Some individual vintages show substantial differences between affiliated and unaffiliated deals. Figure 1 plots the average number of months the equity tranche remained alive for affiliated and unaffiliated deals. The plot shows that, on average, the equity tranche of affiliated deals lived longer than their unaffiliated counterparts in all but three vintages of the 24 vintages in our sample.

The affiliated-through-acquisition sample, though small, reveals large differences in equity tranche life. These deals lived an average of 45 months, compared to 33 months for their unaffiliated counterparts. One striking comparison reveals that three deals originated in the third quarter of 2006 that became affiliated through acquisition lived for 50 months on average, while the average equity tranche life for unaffiliated deals in the same vintage was only 15.6 months.

As expected, the equity tranche from deals originated earlier in the sample period lived substantially longer than the equity tranche from deals originated later in the sample. This result highlights the

importance of including quarter-of-origination fixed effects in our more formal estimates. Table 1 also demonstrates that the bulk of the deals in our sample were originated in the years 2005 and 2006. The right panel of Table 1 includes summary data on the average size of the equity tranche, for both affiliated and unaffiliated deals. The size of the equity tranche in affiliated deals was larger on average than those of unaffiliated deals.

Table 2 reports attributes on collateral characteristics at the time of deal origination for affiliated and un-affiliated deals. Taken together, the evidence indicates that affiliated deals had mortgage collateral of a worse quality than un-affiliated deals, at least on the basis of observable, hard information. Affiliated deals had statistically lower average FICO scores. No/low documentation loans were more prominent in un-affiliated deals. Rates of house price appreciation in the year prior to deal origination were substantially lower in the affiliated sample. Affiliated deals had a higher fraction of loans with adjustable rate features. Cumulative loan-to-value ratios are not statistically different. The evidence in Table 2 is not consistent with the argument that affiliated deals performed better because of higher quality collateral, at least on the basis of observables.

Section 6. Empirical Design and Results

Section 6.1. The empirical specification.

In this section we turn our attention to more formal estimates of longevity in the equity tranche. As a starting point, consider the estimation of a simple, linear model of the following form:

$$Equity\ Tranche\ Longevity_{i,t} = \alpha_0 + \beta_1 \cdot Affiliated\ Indicator_i + \gamma_j + \lambda_t + \delta \cdot X_{i,t} + \varepsilon_{i,t},$$

where subscripts *i* and *t* represent RMBS deal *i* originated in year *t*. Coefficient γ_j captures time-invariant fixed effects for mortgage servicer *j* and λ captures vintage fixed effects originated in quarter *t*. Servicer fixed effects are important given that unobservable servicing practices will create variation in deal performance. Quarter-of-origination fixed effects are vital given variation in the macroeconomic environment that deals originated across different time periods would have been exposed to throughout

their existence. Matrix $X_{i,t}$ includes a set of mortgage collateral controls that should influence the cumulative loss rate, and ultimately the longevity of the equity tranche. Relevant collateral characteristics include deal-level FICO scores, CLTV ratios, the percentage of loans with no or low documentation in support of stated incomes, ZIP-code level house price appreciation in the year prior to deal origination, and the percent of loans with adjustable-rate features.[18] In expectation, deals with higher average FICO scores should produce equity tranche factors that live longer. Deals with higher CLTV ratios, higher fractions of no/low documentation loans, and higher percentages of adjustable-rate loans should be associated with shorter equity tranche lives. Mortgages originated in areas with higher rates of contemporaneous house price appreciation are expected to have a positive association with the longevity of the equity tranche. Finally, we control for the size of the equity tranche with a variable called *O.C. thickness* (over-collateralization), defined as the principal balance of the equity tranche scaled by the total principal balance of the deal.

The proposed specification suffers from some limitations. Estimates on the affiliated indicator could be biased if soft information about collateral quality is correlated with the affiliated indicator. This bias could exist in deals where, at the time of deal origination, a deal sponsor knows they are going to retain the equity tranche *and* where they also are affiliated with the mortgage servicer at the time of deal origination. In an attempt to provide estimates that should not suffer from this bias, we construct the *affiliated-through-acquisition* indicator. It is also very important, from an identification standpoint, to note that all deals in our sample could suffer from a collateral selection bias if a deal sponsor thought it likely they would retain the equity tranche, whether they were affiliated with the mortgage servicer or not. This is because any sponsor expecting to hold the equity tranche would have an incentive to select higher quality collateral. Thus, the affiliated and affiliated-through-acquisition indicator variables estimate the *differential* effects of affiliated status, essentially holding constant any collateral selection bias. Put differently, all deals could suffer from a collateral selection bias. The bias could be a problem for our estimates for deals

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[18] In areas where ZIP-code level house price data are not available we rely on MSA and state-level house price indexes.

where the bias is also correlated with the affiliated indicator. However, while a collateral bias could be present for all deals, the bias should not be systematically correlated with the affiliated-through-acquisition indicator.[19] We also note the unfortunate fact that we can only identify 17 deals that became affiliated through acquisition. While this sample is small, we believe our estimates for these deals are very tightly estimated because they should not suffer from an omitted variable bias and we know with a higher degree of confidence that the equity tranche was owned by the deal sponsor.[20]

Section 6.2 Do affiliated equity tranches live longer?

In Table 3 we report a broad set of results from specifications designed to test differences in equity tranche performance. The dependent variable in each specification is the number of months the equity tranche factor (current collateral balance/original collateral balance) remained equal to one. Columns (1) and (2) report estimates when the longevity of the equity tranche factor is specified as a raw number (in months) while Columns (3) and (4) report results with the dependent variable in log form. We include servicer fixed effects, which should capture important yet unobservable differences in mortgage servicing patterns across different servicers. We also include vintage fixed effects, where vintages are defined as deals originated in the same quarter. Standard errors are clustered by servicer and by vintage-of-origination.

Results in Column (1) indicate that affiliated deals are associated with an equity tranche factor that remained alive 6.5 months longer than the equity tranche of unaffiliated deals. The control variables have the expected sign, though they are not all significant at traditional levels. Column (3) of Table 3 presents estimates with the dependent variable in log form. Affiliated deals remain alive an estimated 12.3% longer than their unaffiliated counterparts. The statistically significant point estimates on the affiliated indicator reported in Columns (1) and (3) indicate that affiliation status has explanatory power outside of the servicer fixed effects and collateral quality controls.

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[19] One remaining concern would be whether a deal sponsor knew it was likely in the future to purchase the mortgage servicing company on an equity tranche they were likely to retain. It is possible that this could impact the collateral selection process. We are unable to rule out this valid critique entirely.

[20] We are able to identify the specific equity tranche cusips that are owned by one of the companies that acquired a mortgage servicing company.

While the results indicate a positive association between the affiliation indicator and longevity of the equity tranche, the results are potentially consistent with multiple explanations. The results are consistent with the cash-flow shifting hypothesis we propose, but they are also consistent with an equally viable collateral selection hypothesis. Columns (2) and (4) of Table 3 estimate the model using the affiliated-through-acquisition variable. The sample is smaller because it includes only unaffiliated deals and the small sample of affiliated-through-acquisition deals. The large positive and significant estimates on the affiliated-through-acquisition indicator variable are compelling. The equity tranche in deals affiliated-through-acquisition remained alive for an estimated 17 months longer than unaffiliated deals, as reported in Column (3). Results in log form, reported in Column 4 indicate a 77.9% longer life for the equity tranche.

Section 6.3 Balancing on observables

In this section we explore the robustness of the results presented in Table 3 using a statistical approach that compares the longevity of the equity tranche in affiliated and unaffiliated deals after matching affiliated and unaffiliated deals on observable characteristics. We employ a nearest neighbor matching algorithm that allows for the estimation of average treatment effects. Relevant exact matching characteristics include deals originated within the same vintage as a means of controlling for important vintage effects in equity tranche performance. Other matching characteristics include equity tranche thickness, deal-level FICO scores, CLTV ratios, documentation status, adjustable-rate loan features, and rates of house price appreciation.

Table 4 reports results of the estimates of average treatment effects on equity tranche longevity after having matched the treated and control samples exactly within vintage and then on multiple dimensions of observable mortgage attributes. Column (1) reports sample average treatment effects with the baseline sample of deals, excluding deals affiliated through acquisition. The estimated treatment effects indicate that the treatment sample of affiliated deals have equity tranches that live an average of 3.4 months longer than the control sample of unaffiliated deals. When estimated in log form, the equity tranche of affiliated deals lived 8.4% longer than control sample deals. Column (2) presents results on the average treatment effect for the affiliated-through-acquisition deals. Consistent with results presented in Table 3,

the equity tranche of deals that are affiliated through acquisition live 18 months longer than unaffiliated

deals and 53% longer when estimated in log form.

Section 6.4 Do longer-living equity tranches receive higher cash flows?

The results presented in Tables 3 and 4 indicate that the equity tranche of affiliated deals lives

longer, on average, than the equity tranche of unaffiliated deals. In the context of testing a cash-flow

shifting hypothesis, this result is more salient if longer equity tranche lives are also associated with a higher

rate of interest and principal payments flowing to the equity tranche of affiliated deals. We test whether this

is indeed the case and present results in Table 5.

We calculate two separate measures of equity tranche payment. The first measure sums the total

interest payments received by the equity tranche, scaled by the size of the equity tranche at origination. The

second measure sums the total principal and interest payments received by the equity tranche over its

lifetime, scaled by equity tranche size. The explanatory variables of interest in Table 5 are the affiliated

indicator and the affiliated-through-acquisition indicator. We control for the standard set of collateral

characteristics.

In column (1) we first test whether affiliated deals are associated with higher interest payments

over the life of a deal. The coefficient on the affiliated indicator is economically small and not significant,

suggesting that, on average, owners of the equity tranche in affiliated deals do not earn meaningfully

different returns. The no-result for affiliated deals could be biased for at least two important reasons. The

first issue that deserves careful consideration is the thickness of the equity tranche. The variable measuring

the size of the equity tranche, named "OC thickness" and calculated as the size of the equity tranche scaled

by deal size, is negatively related to equity tranche returns. As previously described, Table 1 reports that

the thickness of the equity tranche is systematically different for affiliated deals. Systematic differences in

the size of the equity tranche between affiliated and non-affiliated deals could explain the no result in

column (1). As a means of evaluating differences in equity tranche returns for affiliated vs non-affiliated

deals at the same equity tranche size, we construct a variable that interacts OC thickness with the affiliated

indicator. We report these estimates of the interaction term in Column (2) of Table 5. These results indicate

that, when evaluated at the average equity tranche size in our sample, affiliated deals earn 38% larger returns over the life of the deal as compared to non-affiliated deals. Taken together, the results in Columns (1) and (2) indicate that when estimated using our affiliated proxy, affiliated deals do not produce higher returns to equity investors, on average, but that part of the result could be due to differences in equity tranche sizes for affiliated vs unaffiliated deals. When we adjust for these differences by evaluating the effect at the average equity tranche size in our sample via the interaction term, we find that affiliated deals are associated with higher returns.

The second reason for potential bias in the estimates on the affiliated indicator in Column (1) is that every aspect of the deal, observed and unobserved, could be correlated with a deal's affiliated status at the onset of the deal. Collateral selection is a concern, though bias through collateral selection would predict better collateral that generates higher returns. However, affiliated deals could also be structured differently along unobserved dimensions at the deal's outset and in ways that could bias our estimates. We address this potential bias by estimating the returns-to-equity-tranche regression with the affiliated-through-acquisition indicator. Estimates in Column (3) indicate that, on average, deals that became affiliated through acquisition are associated with 71.9% larger returns to equity investors over the full life of the deal. We also evaluate returns at the average equity tranche size by interacting the affiliated-through-acquisition variable with OC thickness. Consistent with results in Column (2), we find positive and significant returns to equity tranche investors in deals that became affiliated through acquisition as compared to deals that were not affiliated through acquisition, at a given equity tranche size.

Columns (5) - (8) of Table 5 repeat the exercise of Columns (1) - (4) when the dependent variable includes total principal *and* interest payments to equity tranche investors. The results are consistent with those reported when returns are measured using only interest payments. Overall, the evidence in Table 5 is consistent with the prediction that affiliated deals produce larger returns to equity investors, particularly after addressing potential sources of bias in the estimates.

Section 6.5 Quantifying the Agency Costs of Debt.

The results presented in Tables 3 and 4 indicate that the equity tranche from affiliated deals lived longer, on average, than the equity tranche of unaffiliated deals. The estimates provided in Table 5 indicate that longer-lived equity tranches of affiliated deals generated larger cash flows. These estimates can be used to calculate dollar magnitudes of the agency costs of debt. The dependent variable in the cash flow estimates provided in Table 5 is the dollar amount of interest and principal payments to the equity tranche, scaled by the size of the equity tranche. Given that the average size of the equity tranche is 2.35% of a deal's collateral balance, an estimate of 71.9% higher cash flows, as reported in Column (3) of Table 5, translates into 1.68% of the principal balance of the deal, on average. Put differently, affiliated-through-acquisition deals result in an extra $.018 cents on the dollar per deal accruing to equity tranche investors that would otherwise have eventually accrued to senior bondholders. We view these estimates as a lower bound however because they represent the cost of cash flow shifting averaged across all deals. In practice, cash flow shifting does not occur in every deal. Conditional on the occurrence of cash flow shifting, costs to senior debt holders are much larger.

Section 7. Discussion of the Mechanism

For the sake of brevity, we relegate to the Internet Appendix (IA) a lengthy discussion on the mechanism(s) that can be employed to shift cash flows in RMBS deals. The IA presents empirical tests that generate three key results. First, for a given level of collateral delinquency, affiliated deals have lower loss rates, suggesting affiliated deals delay liquidation. Second, affiliated deals modify loans more aggressively prior to the death of the equity tranche. Finally, we find no evidence that the most senior RMBS in affiliated deals were priced differently than their un-affiliated counterparts at the time of deal origination. We refer the interested reader to the IA for a more careful treatment of each of these results.

Section 8. Conclusion

The separation of ownership claims between senior and junior claimants creates incentives for managers whose interests are closely aligned with shareholders to make investment decisions where the payoffs disproportionately accrue to equity holders. In this paper, we take advantage of a unique setting in order to test whether managers, in the presence of leverage and expected distress, actually make investment decisions which benefit equity holders at the expense of debt holders.

We find that mortgage servicers (akin to managers) that have an affiliation with RMBS deal sponsors (frequent investors in the RMBS equity tranche) appear to service mortgages in patterns that are more beneficial to investors in the equity tranche. Specifically, we document that the equity tranche from deals with affiliated mortgage servicers and deal sponsors live longer than equity tranches from deals where no affiliation exists. The internet appendix provides detailed evidence on the mechanism(s) by which cash flow shifting occurs. These include delayed liquidations and aggressive loan modifications prior to the death of the equity tranche.

Recent policy decisions have highlighted the importance of the deal originators retention of ownership in deals they originate. The paper identifies a potential dark side to owners maintaining skin in the game. Future policy decisions could consider the practice of requiring an arm's length relationship between mortgage servicers, deal sponsors, and equity tranche investors. Alternatively, requiring more transparency regarding ownership claims at deal origination and throughout the life of the deal would allow investors to allocate expropriation risk via the pricing of securities.

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Figure 1. Plot of Longevity of Equity Tranche by Affiliated Status

Each vertical bar represents the number of months the equity tranche originated in a given quarter remained eligible to receive principal and interest payments. Affiliated equity tranches come from deals where the deal sponsor has some affiliation with the mortgage servicer. The plot is created from a sample of 1,003 equity tranches. Of the 1,003 deals, 508 are considered affiliated. The plot corresponds directly to statistics reported in Table 1.
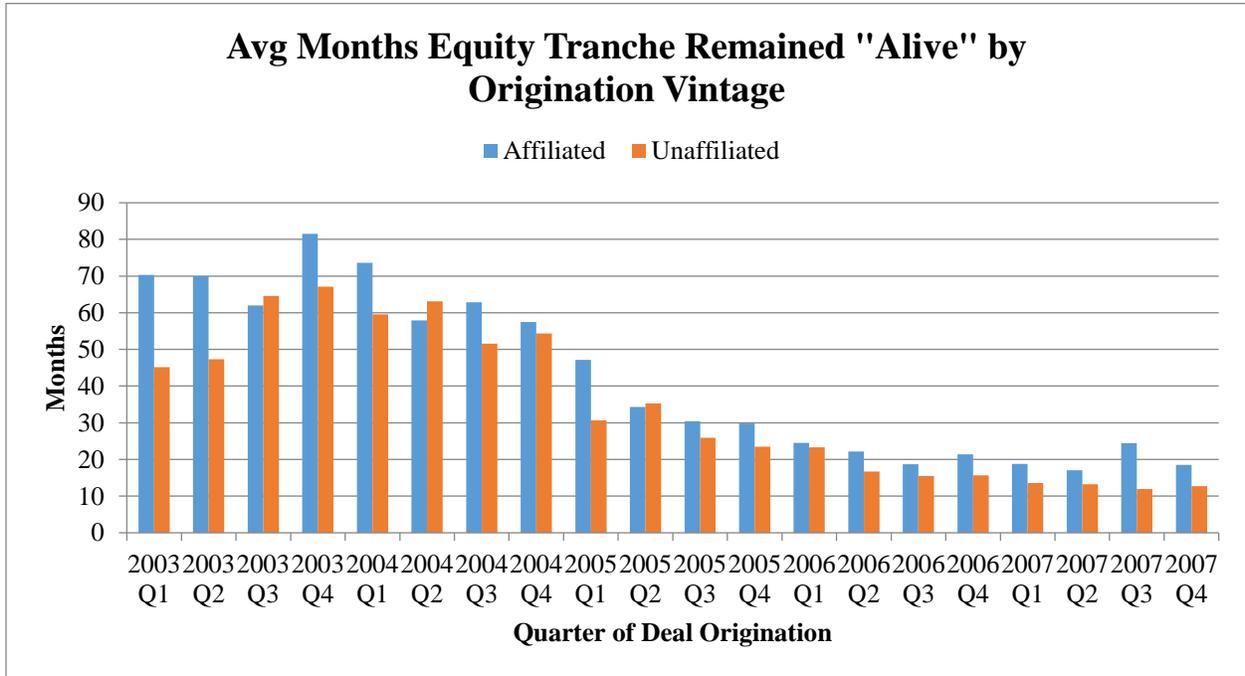
Figure 2. Plots of Equity Tranche Longevity: Same Servicer

These figures plot the path of the OC factor through time. The OC factor is equal to the current equity tranche balance divided by the original equity tranche balance. When the OC factor is equal to one, the equity tranche is eligible to receive interest payments. Figures 2a, 2b, and 2c feature deals that all had the same mortgage servicer, but two separate deal sponsors (dotted lines represent sponsor #1 and solid lines represent sponsor #2). The dotted lines represent deals originated by sponsor #1 that subsequently purchased the servicing rights in 2007 to all of the deals in the plots. Thus, the dotted lines represent deals that were originated by sponsor #1 that became affiliated after sponsor #1's acquisition of the mortgage servicer. The solid lines represent deals that were originated by sponsor #2 that were not affiliated with the original mortgage servicer, nor were they affiliated with the servicer after the servicer's acquisition.

Figure 2a

2005 Vintages (Same Servicer)

Legend:
- - - - - Affiliated
- - - - - Affiliated
- - - - - Affiliated
- - - - - Affiliated
- - - - - Affiliated
- - - - - Affiliated
——— Not Affiliated
——— Not Affiliated
——— Not Affiliated

OC Factor

# of Months from Origination

Figure 2c

2006 Vintages (Same Servicer)
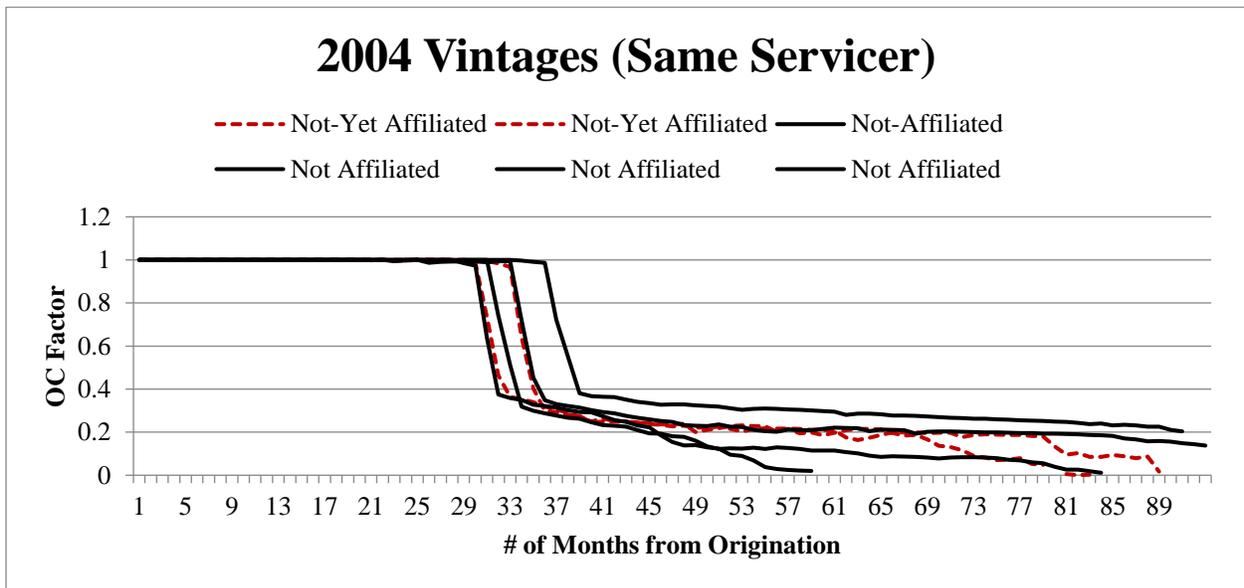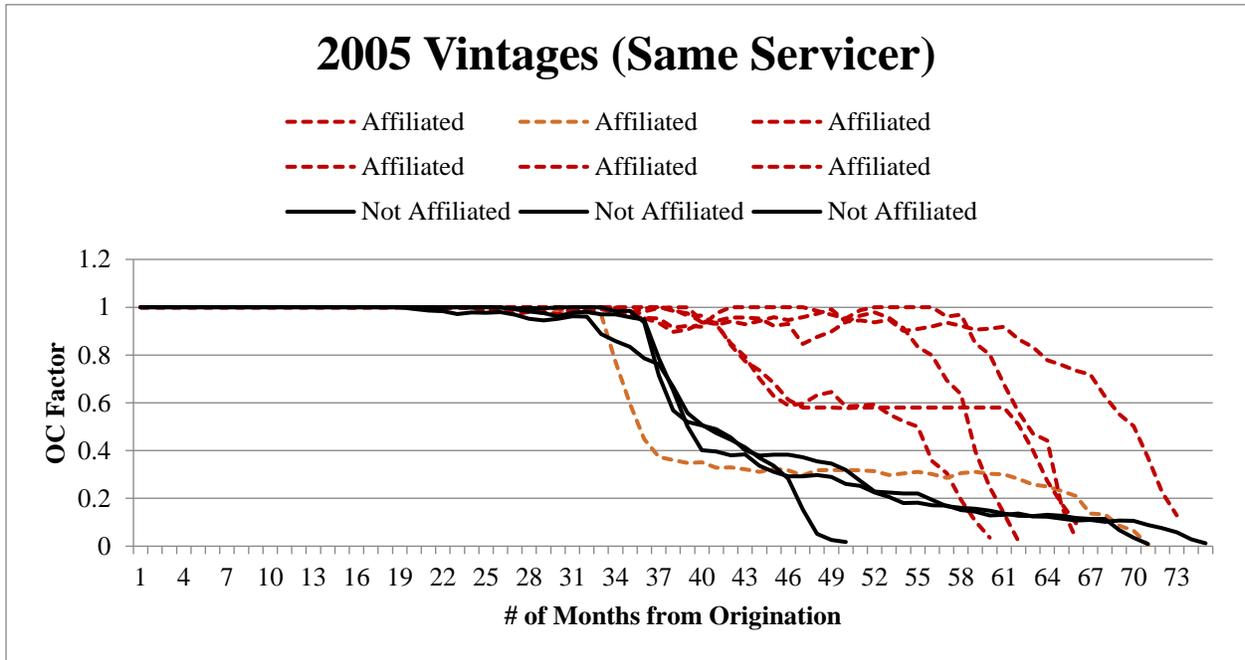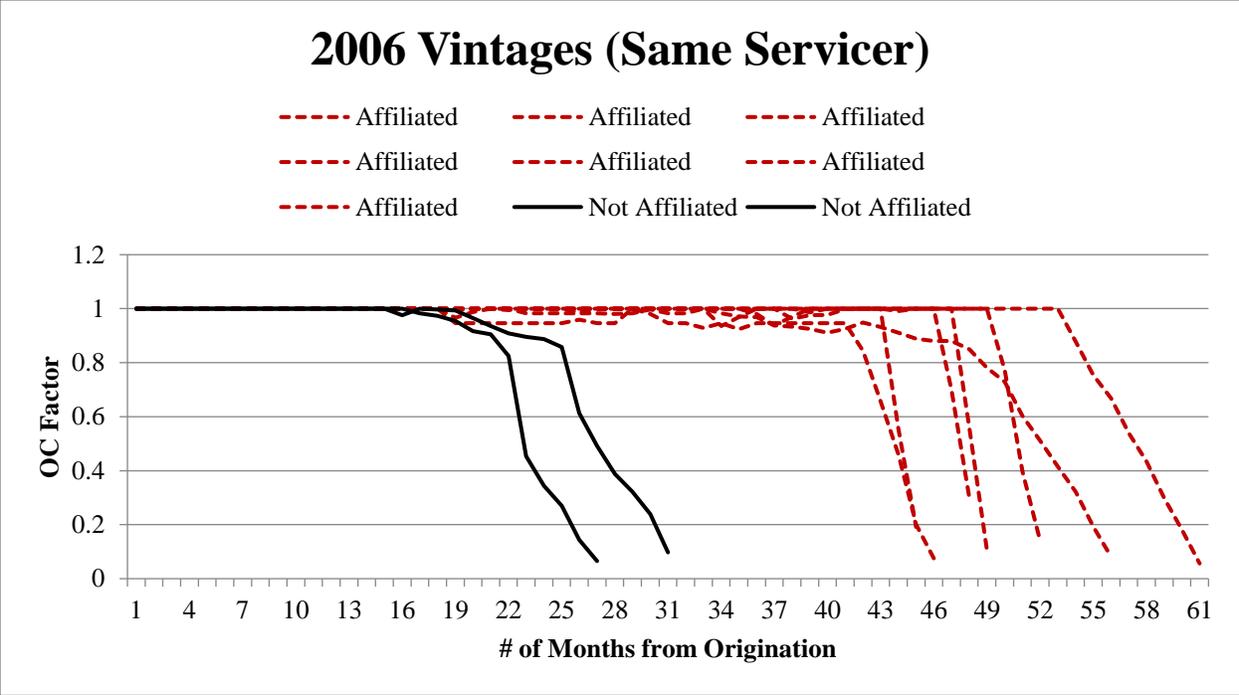
Figure 3. Modification and Re-Default Patterns

Figure 3a plots the fraction of loans outstanding that were modified through time. Months until death refer to the time when the OC factor dropped below one for the final time in the life of the deal. Figure 3b plots the number of loans in a given month that were modified that had subsequent re-defaults. The re-defaults could occur at any point after the original modification.

Figure 3a

Modifications Before and After Equity Tranche Death

Fraction of Modified Loans that Redefault
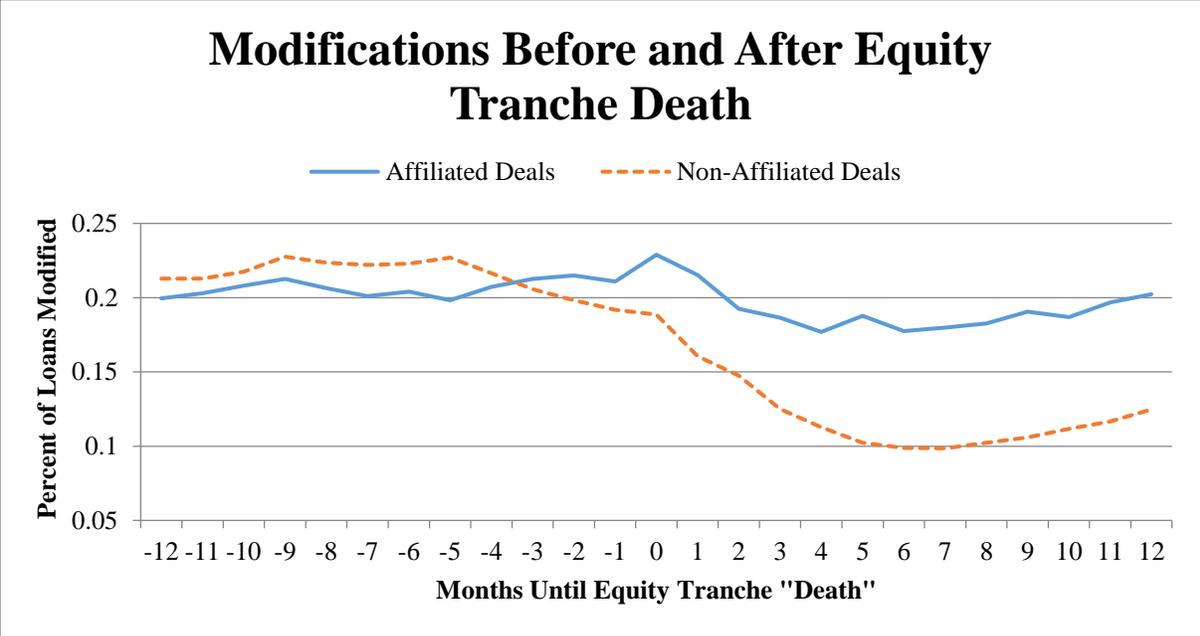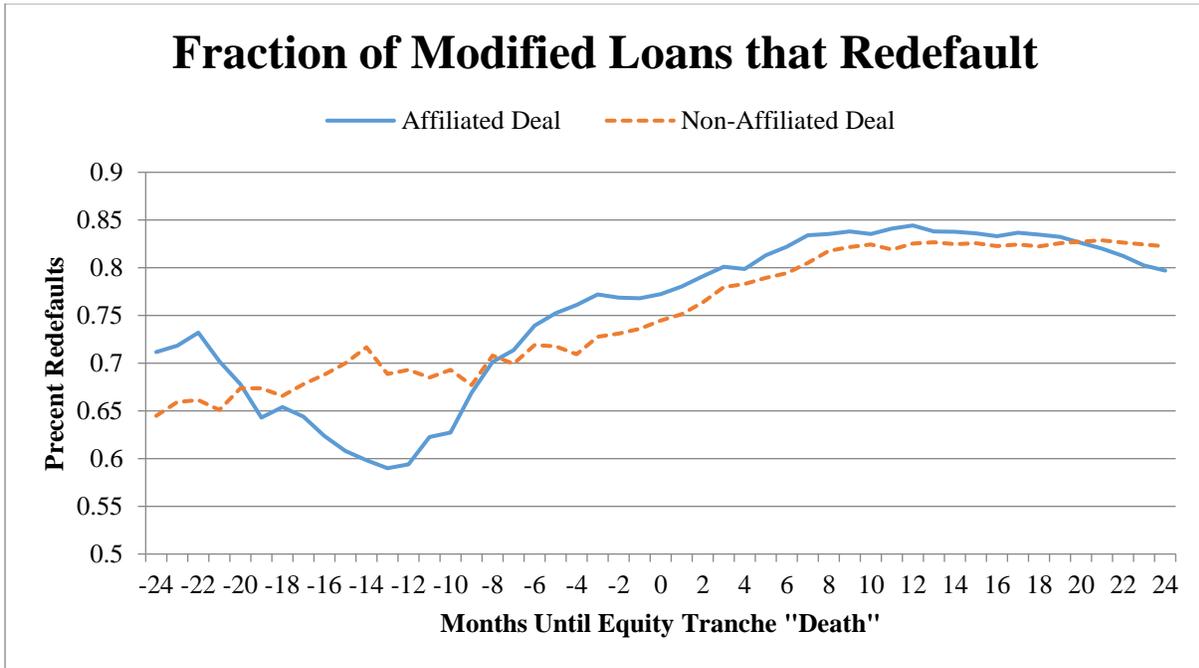
Table 1. Documenting Variation in Longevity of the Equity Tranche

This table documents the longevity of the equity tranche through time for a sample equity tranches of non-agency RMBS deals originated between 2003 and 2007. An equity tranche is defined as "alive" as long as the principal balance of the equity tranche is equal to the target balance of the equity tranche (the ratio of the current equity tranche principal to the target is called the O.C. factor). The principal balance of the equity tranche will fall below the target balance of the equity tranche when credit losses are sufficiently large. Affiliated status refers to RMBS deals that have mortgage servicers that are affiliated in some way with the deal sponsor. We make the assumption that deal sponsors retain interest in the equity tranche, an assumption that we discuss in more detail in Section 5.2. Affiliated-through-acquisition status refers to deals where the mortgage servicer and deal sponsor became affiliated through the acquisition of mortgage servicing rights after the RMBS deal had been originated. The size of the equity tranche is calculated as the original principal balance of the equity tranche divided by the total deal balance at origination.

| Year, Qtr	N	Affiliated	N	Non-Affiliated	Affiliated Minus Non-Affiliated	T-Stat.	N	Affiliated through Acquisition	Affiliated	Non-Affiliated	Affiliated Minus Non-Affiliated	T-Stat.	Affiliated through Acquisition
					Number of Months Equity Tranche Remained "Alive"						Size of Equity Tranche as Percent of Deal Balance		
2003 Q1	7	70.3	5	45.2	25.09	1.47	0	--	1.20%	1.68%	-0.48%	-1.70	--
2003 Q2	12	70.0	12	47.3	22.67	2.05	0	--	1.39%	1.60%	-0.21%	-0.56	--
2003 Q3	14	62.0	19	64.6	-2.58	-0.28	0	--	1.26%	1.53%	-0.27%	-1.23	--
2003 Q4	13	81.5	24	67.1	14.41	1.64	0	--	2.02%	2.28%	-0.26%	-0.68	--
2004 Q1	14	73.6	17	59.6	14.05	1.73	0	--	2.08%	1.43%	0.65%	1.80	--
2004 Q2	18	57.9	23	63.1	-5.14	-0.68	1	77.0	1.72%	1.44%	0.28%	1.14	3.1
2004 Q3	14	62.9	30	51.6	11.26	1.50	0	--	1.99%	1.97%	0.01%	0.04	--
2004 Q4	21	57.5	32	54.3	3.18	0.50	1	64.0	1.89%	1.85%	0.04%	0.13	3.3
2005 Q1	15	47.1	24	30.7	16.47	2.18	1	59.0	1.87%	1.89%	-0.02%	-0.08	3.0
2005 Q2	26	34.3	35	35.2	-0.92	-0.30	1	37.0	1.56%	1.72%	-0.16%	-0.56	3.1
2005 Q3	29	30.4	31	25.9	4.44	1.52	2	58.5	1.81%	1.95%	-0.14%	-0.44	3.0
2005 Q4	41	29.8	40	23.5	6.28	2.35	2	29.0	2.43%	1.81%	0.62%	2.41	2.5
2006 Q1	47	24.5	33	23.3	1.21	0.62	1	53.0	2.90%	2.88%	0.02%	0.08	4.8
2006 Q2	47	22.2	34	16.7	5.46	2.65	0	--	2.19%	2.04%	0.15%	0.75	--
2006 Q3	41	18.7	32	15.5	3.23	1.96	3	50.3	2.47%	2.03%	0.44%	1.94	3.8
2006 Q4	45	21.4	42	15.6	5.80	2.32	4	29.5	2.56%	2.09%	0.47%	2.29	2.9
2007 Q1	43	18.8	30	13.5	5.23	2.44	1	43.0	3.31%	2.46%	0.85%	3.42	3.1
2007 Q2	43	17.1	19	13.3	3.81	2.04	0	--	4.67%	3.81%	0.86%	2.51	--
2007 Q3	12	24.4	10	11.9	12.52	2.26	0	--	4.57%	4.21%	0.37%	0.44	--
2007 Q4	6	18.5	3	12.7	5.83	1.57	0	--	6.96%	7.72%	-0.76%	-0.65	--
Aggregate	508	33.5	495	33.1	0.32	0.20	17	45.7	2.59%	2.14%	0.45%	-5.36	3.17

Table 2. Collateral Attributes of Affiliated and Unaffiliated Deals

This table documents the collateral attributes of non-agency RMBS deals originated between 2003 and 2007. Each of the collateral attributes are aggregated to the deal-level using individual loan sizes as weights. All deal attributes are measured at the time of deal creation. Affiliated status refers to RMBS deals that have mortgage servicers that are affiliated in some way with the deal sponsor. We make the assumption that deal sponsors retain interest in the equity tranche, an assumption which we discuss in more detail in Section 5.2.

	Average Collateral FICO				Average Cumlative Loan-to-Value				Percent Collateral Low/No Documentation				Avg. Deal-Level House Price App. t-1				Percent Adjustable Rate Mortgages			
Year, Qtr	Affiliated	Non-Affiliated	Diff.	T-Stat.	Affiliated	Non-Affiliated	Diff.	T-Stat.	Affiliated	Non-Affiliated	Diff.	T-Stat.	Affiliated	Non-Affiliated	Diff.	T-Stat.	Affiliated	Non-Affiliated	Diff.	T-Stat.
2003 Q1	614.4	616.2	-1.9	-0.22	80.8%	83.1%	-2.3%	-0.85	30.4%	34.7%	-4.3%	-0.47	11.2%	10.9%	0.2%	0.34	64.9%	57.6%	7.3%	0.68
2003 Q2	619.4	618.0	1.4	0.21	81.3%	81.8%	-0.5%	-0.27	36.0%	30.6%	5.4%	1.21	10.7%	11.0%	-0.3%	-0.73	56.8%	64.8%	-8.0%	-1.01
2003 Q3	616.8	615.4	1.4	0.25	81.3%	82.5%	-1.1%	-0.97	33.6%	36.6%	-3.0%	-0.96	11.3%	11.7%	-0.5%	-1.52	67.4%	67.8%	-0.3%	-0.07
2003 Q4	637.1	626.2	10.9	1.17	80.4%	84.3%	-3.9%	-2.52	29.6%	38.5%	-8.8%	-2.52	13.2%	13.6%	-0.4%	-0.84	49.3%	59.4%	-10.1%	-1.74
2004 Q1	625.2	625.5	-0.3	-0.03	81.3%	83.4%	-2.1%	-1.27	35.6%	33.9%	1.6%	0.33	15.6%	15.2%	0.3%	0.31	61.0%	58.5%	2.5%	0.41
2004 Q2	620.4	627.6	-7.2	-1.59	82.4%	84.5%	-2.1%	-1.65	38.0%	37.9%	0.1%	0.02	17.8%	18.2%	-0.4%	-0.53	63.7%	67.8%	-4.2%	-0.80
2004 Q3	621.8	635.1	-13.4	-3.81	82.5%	86.3%	-3.9%	-3.00	35.8%	40.3%	-4.5%	-1.20	18.7%	18.1%	0.6%	0.70	73.4%	64.9%	8.5%	1.93
2004 Q4	623.4	628.4	-5.0	-0.91	84.7%	85.0%	-0.2%	-0.16	36.0%	42.2%	-6.2%	-1.46	17.6%	17.9%	-0.3%	-0.51	74.3%	69.4%	4.9%	1.13
2005 Q1	622.1	636.2	-14.1	-2.41	84.7%	87.8%	-3.1%	-1.85	34.7%	43.7%	-9.0%	-2.06	17.1%	18.1%	-1.1%	-1.87	77.5%	70.0%	7.6%	1.71
2005 Q2	629.5	617.1	12.4	0.82	86.2%	86.1%	0.1%	0.06	39.0%	43.7%	-4.7%	-1.52	15.8%	16.6%	-0.8%	-1.03	80.3%	74.0%	6.3%	2.29
2005 Q3	628.4	634.9	-6.5	-1.59	86.9%	86.8%	0.2%	0.13	36.2%	41.5%	-5.3%	-1.64	16.0%	16.7%	-0.7%	-1.55	75.2%	71.0%	4.2%	1.10
2005 Q4	632.2	637.9	-5.8	-1.57	88.1%	87.8%	0.3%	0.30	39.9%	45.0%	-5.1%	-1.44	14.0%	13.9%	0.2%	0.39	77.9%	72.6%	5.3%	1.70
2006 Q1	626.5	636.2	-9.6	-2.87	88.0%	87.0%	1.0%	0.96	42.2%	47.1%	-4.9%	-1.37	10.6%	10.2%	0.4%	1.35	73.6%	69.1%	4.5%	1.24
2006 Q2	624.3	628.4	-4.2	-1.55	87.3%	86.9%	0.5%	0.48	44.4%	41.8%	2.6%	0.92	6.8%	6.8%	0.0%	-0.08	73.6%	73.4%	0.3%	0.13
2006 Q3	625.1	629.7	-4.6	-1.43	89.0%	88.9%	0.1%	0.07	44.2%	43.1%	1.1%	0.31	3.8%	3.7%	0.0%	0.21	71.2%	71.3%	-0.1%	-0.04
2006 Q4	621.6	632.6	-11.1	-3.16	88.4%	89.1%	-0.7%	-0.72	42.7%	43.5%	-0.8%	-0.25	0.0%	-0.1%	0.1%	0.52	68.7%	65.0%	3.8%	1.14
2007 Q1	625.7	634.0	-8.4	-1.83	87.6%	89.1%	-1.5%	-1.58	42.6%	41.6%	1.0%	0.31	-2.6%	-2.8%	0.1%	0.77	66.9%	62.9%	4.0%	1.03
2007 Q2	624.8	634.3	-9.5	-1.79	86.4%	87.8%	-1.4%	-1.28	40.2%	49.5%	-9.3%	-2.29	-4.1%	-4.8%	0.6%	2.50	67.5%	66.3%	1.2%	0.28
2007 Q3	610.8	625.0	-14.2	-2.41	81.6%	84.6%	-3.0%	-1.74	36.3%	37.3%	-0.9%	-0.24	-6.5%	-6.5%	0.0%	-0.02	66.6%	68.5%	-1.9%	-0.57
2007 Q4	622.4	628.5	-6.1	-0.42	84.5%	85.0%	-0.5%	-0.11	37.3%	42.9%	-5.6%	-0.41	-10.5%	-11.2%	0.6%	0.53	57.1%	79.0%	-21.9%	-1.40
Aggregate	624.8	629.9	-5.1	3.37	86.1%	86.5%	-0.40%	1.22	39.7%	41.8%	-2.1%	2.43	7.8%	10.2%	-2.4%	4.63	70.4%	68.1%	2.3%	2.36

Table 3. Does the Equity Tranche Live Longer in Affiliated Deals than Unaffiliated Deals?

This table documents the results of regressions of equity tranche longevity on the affiliated indicator variable and collateral control variables. The sample includes non-agency RMBS deals originated between 2003 and 2007 for which we have the required data. The dependent variable in Columns 1-2 is the number of months that the equity tranche remained "alive." The dependent variable in Columns 3-4 is the natural log of the number of months that the equity tranche lived. An equity tranche is defined as "alive" as long as the principal balance of the equity tranche is equal to the target balance of the equity tranche. Affiliated status refers to RMBS deals that have mortgage servicers that are affiliated in some way with the deal sponsor. Affiliated-through-acquisition status refers to RMBS deals that became affiliated through an acquisition of mortgage servicing rights after a deal was originated. The size of the equity tranche is calculated as the original principal balance of the equity tranche divided by the total deal balance at origination. Each of the collateral attributes (FICO, LTV, percent low/no documentation, average house price appreciation, and percent loans with adjustable rates) are aggregated to the deal-level using individual loan sizes as weights. *O.C. thickness* is defined as the principal balance of the equity tranche scaled by the total principal balance of the deal. All deal attributes are measured at the time of deal creation. We include servicer and vintage fixed effects and cluster standard errors by the mortgage servicer and vintage of origination.

	Dependent Variable: Number of Months the Equity Tranche Remained "Alive"		Dependent Variable: Natural Log of Number of Months the Equity Tranche Remained "Alive"	
	(1)	(2)	(3)	(4)
Affiliated Indicator	6.582**		0.123**	
	(2.33)		(2.05)	
Affiliated through Acquisition Indicator		17.632***		0.779***
		(2.67)		(3.03)
O.C. Thickness	0.831	0.820	0.014	0.014
	(1.23)	(0.73)	(0.74)	(0.43)
Deal-Level Collateral Controls:				
FICO Score	0.021	0.019	0.000	0.001
	(0.61)	(0.49)	(0.21)	(0.62)
Combined Loan-to-Value Ratio	-1.650***	-1.594***	-0.044***	-0.044***
	(5.57)	(4.14)	(11.59)	(7.43)
Percent of Loans No Doc./Low Doc.	-3.406	-2.989	-0.392***	-0.433**
	(0.70)	(0.50)	(2.74)	(2.30)
Average. House Price Appreciation t-1	0.415	-0.237	0.026**	0.012
	(0.71)	(0.38)	(2.05)	(0.98)
Percent of Loans with Adjustable Rate	-12.382**	-12.469**	-0.150	-0.163
	(2.13)	(2.40)	(1.36)	(1.23)
Constant	154.117***	158.448***	7.323***	6.943***
	(5.22)	(4.43)	(12.55)	(9.81)
Fixed Effects				
Servicer Fixed Effects	Yes	Yes	Yes	Yes
Year-Quarter Origination Date Fixed Effect	Yes	Yes	Yes	Yes
Clustering of Standard Errors				
Year-Quarter of Origination	Yes	Yes	Yes	Yes
Servicer	Yes	Yes	Yes	Yes
Observations	1,003	512	1,003	512
Adj. R2	0.625	0.615	0.695	0.686

Table 4. Balancing on the Observables: Does the Equity Tranche Live Longer in Affiliated Deals than Unaffiliated Deals?

This table reports the results of a nearest neighbor matching algorithm that allows for the estimation of average treatment effects. The treatment sample is comprised of affiliated deals and the control sample is comprised of unaffiliated deals. The matching algorithm pairs deals in the treatment sample with deals in the control sample based on a multi-dimensional set of observable characteristics, including exact matching characteristics. The exact matching characteristic is deals originated within the same vintage. Other matching characteristics include deal-level FICO scores, L.T.V. ratios, documentation status, adjustable-rate loan features, and rates of house price appreciation. Affiliated status refers to RMBS deals that have mortgage servicers that are affiliated in some way with the deal sponsor. Affiliated-through-acquisition status refers to RMBS deals that became affiliated through an acquisition of mortgage servicing rights after a deal was originated. An equity tranche is defined as "alive" as long as the principal balance of the equity tranche is equal to the target balance of the equity tranche. The sample includes non-agency RMBS deals originated between 2003 and 2007 for which we have the required data.

Sample Average Treatment Effect

	(1)	(2)
	Treatment Sample: Affiliated Indicator	Treatment Sample: Affiliated through Acquisition
# of Months Equity Tranche Remained "Alive"	3.41**	18.12***
	(2.67)	(5.16)
N	1003	512
Log(# of Months Equity Tranche Remained "Alive")	0.084***	0.53***
	(2.89)	(7.03)
N	1003	512

Exact Matching Variable:
    Deals Originated in the Same Quarterly Vintage

Bias-Adjusted Matching Variables:
    OC Thickness, Original FICO, C.L.T.V., % No/Low Documentation, House Price Appreciation$_{t-1}$, % A.R.M.

Table 5. Do Longer Lives Translate into Higher Cash Flows?

This table documents the results of regressions of equity tranche cash flows on the affiliated indicator variable and collateral control variables. The sample includes non-agency RMBS deals originated between 2003 and 2007 for which we have the required data. The dependent variable in Columns (1) and (2) is the total interest payments made to the equity tranche over the life of the equity tranche, scaled by the original equity tranche balance. The dependent variable in Columns (3) and (4) is the total principal and interest payments made to the equity tranche over the life of the equity tranche, scaled by the original equity tranche balance. Affiliated status refers to RMBS deals that have mortgage servicers that are affiliated in some way with the deal sponsor. Affiliated-through-acquisition status refers to RMBS deals that became affiliated through an acquisition of mortgage servicing rights after a deal was originated. The size of the equity tranche is calculated as the original principal balance of the equity tranche divided by the total deal balance at origination. Each of the collateral attributes (FICO, LTV, percent low/no documentation, average house price appreciation, and percent loans with adjustable rates) are aggregated to the deal-level using individual loan sizes as weights. *O.C. thickness* is defined as the principal balance of the equity tranche scaled by the total principal balance of the deal. All deal attributes are measured at the time of deal creation. We include servicer and vintage fixed effects and cluster standard errors by the mortgage servicer and vintage of origination.

	Dependent Variable: Total Interest Payments as Fraction of Equity Tranche Balance				Dependent Variable: Total Interest and Principal Payments as Fraction of Equity Tranche Balance			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Affiliated Indicator * OC Thickness		0.383***						
		(3.16)						
Affiliated Indicator	-0.018	-0.913**			-0.036	-0.946**		
	(0.10)	(2.36)			(0.19)	(2.41)		
Affilated through Acquisition Indicator * OC Thickness				0.838***				0.839***
				(4.59)				(4.37)
Affiliated through Acquisition Indicator			0.719*	-1.928***			0.712*	-1.937***
			(1.84)	(4.32)			(1.79)	(4.05)
O.C. Thickness	-0.669***	-0.898***	-0.995***	-1.012***	-0.659***	-0.892***	-0.990***	-1.007***
	(4.53)	(5.17)	(4.80)	(4.84)	(4.57)	(5.17)	(4.78)	(4.82)
Deal-Level Collateral Controls:								
FICO Score	0.001	0.002	-0.000	-0.000	0.001	0.002	-0.001	-0.001
	(0.32)	(0.39)	(0.06)	(0.09)	(0.28)	(0.35)	(0.14)	(0.17)
Combined Loan-to-Value Ratio	-0.036	-0.037	-0.040	-0.040	-0.036	-0.038*	-0.040	-0.041
	(1.57)	(1.64)	(1.33)	(1.33)	(1.59)	(1.67)	(1.38)	(1.39)
Percent of Loans No Doc./Low Doc.	-1.148**	-1.106**	-1.534***	-1.523***	-1.102**	-1.060**	-1.520***	-1.509***
	(2.36)	(2.30)	(3.49)	(3.47)	(2.39)	(2.32)	(3.77)	(3.75)
Average. House Price Appreciation t-1	-0.015	-0.027	-0.094	-0.096	-0.011	-0.023	-0.087	-0.089
	(0.25)	(0.45)	(1.12)	(1.15)	(0.18)	(0.39)	(1.03)	(1.05)
Percent of Loans with Adjustable Rate	0.858**	0.787*	0.982*	0.955*	0.852**	0.779*	0.990*	0.964*
	(2.02)	(1.89)	(1.95)	(1.94)	(1.97)	(1.84)	(1.89)	(1.86)
Constant	8.779***	8.587***	8.242***	8.335***	8.931***	8.736***	8.428***	8.521***
	(2.81)	(2.88)	(2.81)	(2.87)	(2.96)	(3.05)	(2.95)	(3.01)
Fixed Effects								
Servicer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter of Origination	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering of Standard Errors								
Servicer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter of Origination	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,003	1,003	512	512	1,003	1,003	512	512
Adj. R2	0.501	0.406	0.522	0.524	0.521	0.536	0.538	0.540