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Originators' subordination as instruments to mitigate adverse selection: Evidence from asset-backed securities issued in Japan*

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Abstract: This paper examines how adverse selection is responsible for the observed differences in swap spreads (issue yields to maturity over interest-rate swap rates) among AAA-rated asset-backed (consumer credit, auto loans, or lease receivables) securities issued in Japan between 1996 and 2002. The results indicate that the cross-sectional differences in swap spreads reflect not only the characteristics of the originator and underlying assets but also the extent to which asymmetric information between originators and investors can be mitigated by originators' subordination. In particular, by holding larger subordinated portions than required to cover possible losses on underlying loans, originators can narrow swap spreads as well as mitigate the market impact when asset-backed securities are issued.

Key words: asset backed securities, optimal security design, adverse selection.
JEL classification: D82, G12, G20, G32.

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1. Introduction

Suppose that a firm issues a security backed by part of its assets to outside investors. If the firm holds advantageous information concerning the underlying assets not available to outside investors, then the capital that the firm can raise may depend crucially on the design of the security, such as how the sequence of payoffs is constructed, how the issue is divided into separate tranches, and how the underlying risks are shared among stakeholders. In the field of optimal security design, a number of theoretical papers have investigated securitization design under this form of adverse selection.

The purpose of this paper is to test empirically several implications obtained from these security design models using a dataset of AAA-rated asset-backed securities (ABS) backed by consumer credit, auto loans, or lease receivables issued in Japan. More precisely, we investigate empirically the extent to which adverse selection problems have effects on both pricing and the market impact of ABSs when they are issued, and we explore what kinds of security design can mitigate such adverse selection.[1]

In issuing ABSs, originators usually retain subordinated portions of underlying assets such that senior portions, which are sold to outside investors, become AAA-rated, or free of credit risk. In many cases, the subordinated portions held by the originators are larger than necessary to cover any possible loan losses. If the originators and outside investors have symmetric information and the Modigliani–Miller theorem holds, then originators do not have to retain these subordinated portions in excess of required reserves; prices of senior portions do not change when excess subordinated portions are held, while the volume of senior portions sold to investors decreases.

On the other hand, if originators have advantageous information not available to outside investors, retaining excess subordinated portions may benefit originators. In the theoretical context of optimal security design with adverse selection,[2] Riddiough (1997) shows that when originators have private information about the payoffs of

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[1] In general, moral hazard may create an incentive problem in securitization. In particular, it is generally important to provide a proper incentive to a servicer who collects cash flow from the underlying assets. However, in the case of securitization backed by consumer credit, auto loans, and lease receivables, as employed in this analysis, the method of collection, the skills and the terms can be specified in servicer contracts in a more verifiable manner, such that the problem of moral hazard is less serious. For this very reason, our dataset is well suited to the exploration of adverse selection in the context of security design.

[2] For surveys, see Allen and Gale (1994), and Duffie and Rahi (1995). Myers and Majluf (1984) examine the choice of financial instrument issued to uninformed investors by an informed firm. Nachman and Noe (1994) extend Myers and Majluf’s analysis in a similar setting. Demange and Laroque (1995) and Rahi (1996) analyze optimal security design when an informed originator issues a security to uninformed investors. Boot and Thakor (1993) analyze security design when some investors are informed, and show that splitting an asset into separate securities can increase sale value. Gorton and Pennacchi (1990) show that splitting an asset into securitized products with an intermediary can mitigate adverse selection. Glaeser and Kallal (1997) analyze security design by an originator that sells a security to an intermediary, who faces, if informed, price discounts due to adverse selection by uninformed investors in the resale security market. Garmaise (2001) studies security design with rational belief for investors.

underlying assets, they cannot reduce the spread of an ABS over risk-free rates sufficiently, unless they hold subordinated portions. DeMarzo (2005), DeMarzo and Duffie (1999), and Ohashi (1999) demonstrate that when originators have private information as to the payoffs of the underlying assets, retention of subordinated portions by originators helps to mitigate discounts in prices and the market impact of ABS issues. As in Leland and Pyle (1977), uninformed outside investors interpret the larger volume of ABSs as a signal of a lower level of future payoffs, and they discount ABS issue prices accordingly. In such a case, by retaining greater subordinated portions, originators can make the payoffs of ABSs less dependent on their own private information, as well as signal the higher profitability of ABSs to uninformed outside investors. This leads to the reduction of the price discounts and the market impact associated with adverse selection. We investigate empirically such effects on ABS issue rates.

For this purpose, we construct a dataset of the AAA-rated asset-backed securities (backed by consumer credit, auto loans or lease receivables) issued by public placement between September 1996 and September 2002 as based on official financial reports and investment prospectuses.[3] Every ABS in the dataset was confirmed to be AAA rated by at least one rating agency such that (1) it legally satisfied bankruptcy remoteness so as to be free from originators' credit risk, and (2) originators completely absorbed the credit risk of the underlying assets by holding sufficiently large subordinated portions.

Such AAA-rated ABSs, issued after completely separating the credit risk of originators and underlying assets, should have been traded as risk-free assets (subject only to interest-rate risk) with the same maturity. More concretely, swap spreads, meaning the yields to maturity of ABSs less interest-rate swap rates (one representative credit-risk-free rate) with the same maturity, should have been close to zero, putting aside the prepayment risks in the underlying assets and premiums associated with the illiquidity of corporate liabilities.[4] Inspection of the data, however, shows that the swap spread of the AAA-rated ABSs differs substantially among issues, and some of them were indeed far from zero.[5] Our task is to test empirically whether asymmetric information between originators and outside investors can explain this puzzling observation.

Our empirical investigation requires careful specification of the econometric models. A major reason for this is that it is extremely difficult to impose particular empirical restrictions directly from the theory of optimal security design under adverse selection. Thus, we adopt the following empirical strategy by which theoretical implications of interest to us are examined in an indirect manner. First, we set the Modigliani–Miller theorem as the null hypothesis. Thanks to the decomposition of subordination into required and excess portions, we can construct the null hypothesis such that swap spreads should be zero and completely independent of *excess*

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[3] During this period, ABSs played a major role in the Japanese securitization market, amounting to some 2.1 trillion yen in 2002.

[4] As discussed in Sections 2.2 and 3.2, the econometric specification employed takes into consideration the ability of these alternative factors to generate differences in swap spreads among AAA-rated ABS issues.

[5] Differences in swap spreads among AAA-rated issues are also observed to some extent in European and US securitization markets.

subordination and any contractual factors of issued ABSs. Second, we interpret the extent to which the null hypothesis is rejected in terms of the alternative hypotheses, including the theoretical predictions based on optimal security design with adverse selection. Within this procedure, an econometric model is properly specified under the null hypothesis or the Modigliani–Miller theorem. This strategy allows us to avoid any potential difficulty[6] that could arise when an econometric model is specified under any alternative hypothesis to the Modigliani–Miller theorem.

A further consideration is that we also have to take institutional friction into consideration given the immature state of the Japanese ABS market.[7] First, domestic rating agencies may not have developed skills in processing information for potential investors. Second, ABS arrangers, such as security companies and investment banks, may not be familiar with market practices, institutional constraints or legal arrangements. Finally, the practice of bankruptcy remoteness had not been sufficiently established, and the credit risk of originators may not have been reflected in ABS swap spreads. According to our results, the price discounting of the senior AAA-rated ABS was lowered when originators took more subordinated portions in excess of the required reserves. Around three quarters of the total sample in the neighborhood of the average excess subordination ratios; on the other hand, the market impact of large-sized issues is reduced to the extent that originators held excess subordinated portions. Thus, originators' subordination generated the observed differences in swap spreads among the AAA-rated ABSs. Our estimation results also suggest that although institutional frictions had some effect on swap spreads, adverse selection between issuers and investors still plays an important role in determining the swap spreads of AAA-rated ABSs.

Several empirical studies are concerned with the design of securitization markets. For example, by examining the prices of collateralized mortgage obligations (CMOs), Bernardo and Cornell (1997) attribute the difference in auction prices among investors to asymmetric information about the underlying assets. By investigating contracts made for AAA-rated commercial mortgage-backed securities (CMBSs), Riddiough and Chiang (2003) find that as contracts become more standardized, and as the underlying information asymmetry becomes less serious, CMBS contracts carry lower subordinated portions and issue prices rise. In addition, Downing, Jafee and Wallace (2005) and Ambrose, LaCour-Little, and Sanders (2004) examine mortgage-backed securities (MBSs) to test the effects of asymmetric information on the credit risk and prepayment risks of the underlying assets. Downing and Wallace (2005) empirically investigate levels of subordination in the CMBS market. Cuchra (2005) conducts a systematic empirical investigation of credit spreads on structured bonds, such as MBS and ABS issued in Europe. While the current study is closely related to this earlier work, it is differentiated by a focus on originators' subordination in excess of required reserves among AAA-rated traditional ABSs, and the effect of excess subordination on pricing and the market impact. The approach to data construction

6 Simultaneity among the dependent and explanatory variables is one of the most serious problems given the scarcity of instrumental variables.

7 Unlike the US, the history of ABSs in Japan is rather short. While the Regulation for Securitization of Specific Credit was enforced in 1993, issuance of ABSs was still severely regulated. Only after this Regulation was amended in 1996 could firms and financial institutions use ABSs as important financial tools.

allows us to specify the Modigliani–Miller theorem as the null hypothesis in a straightforward manner and to set security design with adverse selection as the alternative hypothesis.

The paper itself is organized as follows. Section 2 describes how the ABS issue market is organized in Japan and presents evidence for substantial differences in swap spreads among newly issued ABSs. Section 3 computes the required reserves against possible loan losses and divides originators' subordination into required and excess portions. This section also presents the results concerning the effect on pricing and the market impact. Section 4 concludes.

2. Differences in swap spreads among AAA-rated ABSs

2.1 Security designs of the AAA-rated ABSs

The sample employed covers 51 AAA-rated ABS public placement issues in Japan between September 1996 and September 2002. All issues included are backed by consumer credit, auto loans or lease receivables.[8] Each of the 51 issues is divided into multiple tranches with different maturities. The 458 tranches in the 51 issues is made up of 11 consumer-credit backed issues divided into 56 tranches, 18 auto-loan backed issues divided into 131 tranches, and 22 lease-receivable backed issues divided into 271 tranches. The first public placement of an ABS issue was in September 1996. The number of public issues has fallen drastically since mid-2002, and since then private issues have dominated the Japanese ABS market. Nevertheless, we construct a database based on public issues because the information required for our empirical investigation is available to outside observers only through official financial reports or the public issue investment prospectuses.

For most issues included in the sample, we obtain tranche-by-tranche swap spreads of issue rates (issue rates minus interest-rate swap rates with the same maturity) on the day when the issue terms were determined completely, from the database compiled by I-N Information Systems, Ltd. (hereafter, I-N). For this, I-N successfully surveyed the managing securities companies as to the swap spreads of most issues immediately after the conditions of issuance were determined. For the tranches where the swap spread was not disclosed to I-N by managing securities companies, we computed the corresponding swap spread using a plain interest-rate swap rate of the same maturity on the day when the issue terms were determined for tranches with lump-sum (bullet) repayments. Any tranches with nonbullet repayments where the swap spread was not disclosed were excluded.

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8 For our estimation purposes, the sample excludes the following issues: 12 issues that included tranches rated as AA or lower (138 tranches); three AAA-rated issues (14 tranches) whose financial reports did not include the loan loss ratio for the underlying assets over the previous six months; and three AAA-rated issues (32 tranches) where originators made a commitment to future subordinate undertakings. In addition, the sample excluded ten tranches without lump-sum (bullet) repayments, for which we could not find or compute the corresponding swap spread. However, only three issues were actually removed as a consequence because the remaining issues contained tranches where the swap spreads were available.

In the securitization scheme, an originator (original owner of the loan) transfers a loan pool to an entity called a special purpose vehicle (SPV) to ensure bankruptcy remoteness; that is, the legal protection of the underlying assets transferred to SPVs from the bankruptcy of the originators. In our sample, the four SPVs made multiple issues (ranging from two to six issues), but in the contract terms, the underlying assets were divided precisely into each of the corresponding issues. Accordingly, we can treat each issue as representing an independent and separate SPV, even in the case of multiple issues by a single SPV.

There are two ways to transfer loan pools to SPVs in Japan. The first method is to transfer loan pools directly to SPVs, and SPVs themselves have loan pools in their custody. The second is to put a loan pool in the separate custody of a trust bank first, and then to transfer only its trust certificates to an SPV. The latter method establishes a true sale from an originator to an SPV and secures bankruptcy remoteness in a more legitimate manner, although at the cost of trust fees.

In the case of an AAA-rated ABS, an originator completely absorbs the credit risk involved with the underlying loan assets by holding enough subordinated portions, thereby making senior portions sold to outside investors perfectly free from the credit risk of the underlying assets. Because an ABS pool consists of anywhere between several thousand and one million loan contracts, it is possible to estimate loan loss ratios from historical data precisely using the law of large numbers. The official financial report or investment prospectus of an ABS reports both loan loss ratios and delinquency percentages based on historical data of existing loan contracts.

Even after issuing ABSs, in most cases, an originator acts as a servicer that collects principal and interest from obligors. A back-up servicer is arranged in case of the originator's bankruptcy. When an originator goes bankrupt, its creditors may seize a part of the cash flows collected by the bankrupt originator (as a servicer) from obligors. An originator must hold additional subordinated portions against such commingling risks; the size of additional subordinations usually amounts to the cash flows collected from obligors for two months.

A rating agency rates an ABS as AAA only after it establishes that: (1) bankruptcy remoteness is legally established, (2) a back-up servicer is properly arranged, and (3) the subordinated portion held by an originator can fully cover any possible loan losses and commingling risks. In principle, an AAA-rated ABS is completely free from the credit risk of both originators and the underlying loan assets. An SPV invests in money markets or government bonds when it carries extra reserves for future payments to investors. Because of the holding of sufficient subordinated portions by an originator, an SPV usually has some cash reserves, even after payoff to investors at maturity.[9] Of course, any remaining reserves are eventually assigned to the originator.[10]

2.2 Differences in swap spreads among AAA-rated ABSs

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[9] Some issues are allowed to pay dividends on subordinated portions, even before completing payments on senior portions, when cash reserves are sufficient.

[10] With the first issue of the Orient Corporation's ABS, for example, the ratio of the subordinated portion held by the originator relative to the total value of the underlying assets was 14.3 percent. On the other hand, the realized loan loss amounted to only 3.4 percent of the value of the underlying assets. Accordingly, about 10 percent of the value of the underlying assets eventually belonged to Orient.

While an AAA-rated ABS is free from the credit risk of an originator thanks to bankruptcy remoteness, it is free from the credit risk of the underlying loan assets because of the originators' sufficient subordination. Hence, the issue yield to maturity of an AAA-rated ABS should lie close to the risk-free rate (subject to only interest-rate risk) after controlling for the length of maturity. More concretely, the swap spreads (issue yields to maturity over interest-rate swap rates with the same maturity) of the AAA-rated ABSs should be close to zero.

As shown in Table 1, however, the swap spreads in our sample of AAA-rated ABSs are not necessarily close to zero. The sample average of the swap spreads per annum is equal to 22.40 basis points. The classified average is 29.31 basis points for consumer credit, 23.57 basis points for auto loans, and 20.41 basis points for lease receivables. On the other hand, there are substantial differences in the swap spreads among issues with the swap spread ranging between –3.00 and 71.00 basis points.

Besides adverse selection[11] and institutional frictions, there are two potential factors responsible for such differences in swap spreads: illiquidity premiums and prepayment risks. There are fluctuations in swap spreads over time: the highest average is 41.86 basis points in 1998, while the lowest is 6.54 basis points in 2000. Such time-varying components of swap spreads may be explained by the strength of demand for safe and liquid assets issued by a government, or financially sound private banks, relative to safe, but illiquid, corporate bonds. During an unstable financial period, for example, there is a flight of capital to safe liquid assets, such as Japanese Government Bonds (hereafter, JGBs) and bank-issued interest-rate swap contracts, from safe, but illiquid, corporate liabilities. Accordingly, larger swap spreads on safe corporate liabilities may emerge. As shown in Section 3.3, even after such time-series effects are controlled for, the observed swap spreads may still display substantial cross-sectional differences.

Another potential factor that generates differences in swap spreads is the prepayment risk of consumer credit and auto loans. For the following reasons, however, the premiums associated with these prepayment risks may be small, or even negligible, in our sample. First, unlike mortgage-backed securities (MBS), loan contracts in ABSs have short maturities; premiums for prepayment options, if any, tend to be rather small. Second, medium-term and short-term risk-free rates in Japan have been fairly low and less volatile since the mid-1990s; debtors had little incentive to exercise prepayment options. Third, ABSs with a pass-through redemption option may pass prepayment risks to investors, but as shown in the following section, we cannot find any prepayment premium on swap spreads in our results. There are also potential cancellation risks of lease receivables before maturity. In most cases, however, originators guarantee the remaining payment of lease contracts and completely bear the cancellation risk. Given that the ABSs were properly rated as AAA, it is not possible to explain these observed difference in swap spreads among the issues with credit risk. The next subsection explores the possible hypotheses to explain the observed differences in swap spreads among the AAA-rated ABSs.

[11] As discussed earlier, moral hazard problems are unlikely to matter in the traditional ABS market.

2.3 Possible hypotheses for the observed difference in swap spreads

This subsection argues for the originators' subordination as a possible factor in explaining the observed differences in swap spreads among the AAA-rated ABSs.[12] To organize our null and alternative hypotheses, we first divide the subordinated portion held by an originator into (1) the reserves required for possible loan losses and commingling risks, and (2) the portion in excess of those required reserves. As explained in greater detail in Section 3.1, it is possible to compute the required reserves for potential loan losses and commingling risks precisely using data on both loan loss ratios and delinquency percentages reported in the official financial reports (or the investment prospectuses).

If originators and potential investors have symmetric information concerning the underlying assets, and the Modigliani–Miller theorem holds, then either the subordinated portion in excess of the required reserves or its ratio to the entire underlying assets (the excess subordination ratio) should have no effect on swap spreads. One reason is that as long as the subordinated portions exceed the amount necessary for the required reserves, the remaining senior portions rated as AAA, and their yields (or the corresponding swap spreads), should not depend on the amount of excess subordination. If any systematic relationship between excess subordination and swap spreads is found, the Modigliani–Miller theorem is violated.

Accordingly, we take the Modigliani–Miller theorem as our null hypothesis, and we consider several alternative hypotheses. The first alternative hypothesis is that originators' credit risk are still reflected in the yields to maturity of the AAA-rated ABSs because of investors' concern about the practice of bankruptcy remoteness. Without any precedent for originators' default in the early stage of the ABS market, investors may be concerned whether bankruptcy remoteness would really work on their behalf. In such a case, the subordinated portion in excess of the required reserves may help to absorb originators' credit risk. In addition, the credit risk of originators may have a direct adverse impact on swap spreads, given the insufficient enforcement of bankruptcy remoteness. Second, given the immature development of the Japanese ABS market, rating companies, particularly domestic agencies, may not properly evaluate the credit risk involved with the underlying loan assets. Accordingly, originators' subordinated portions may fall short of even the reserves required for possible loan losses and commingling risks. In this case, an additional holding of subordinated portions by originators would contribute to the reduction of credit risk in senior portions.

Third, and as discussed in the introduction, if originators and outside investors have asymmetric information about the underlying assets, the subordinated portion in excess of the required reserves may help to mitigate any adverse selection problems. In the presence of asymmetric information, uninformed investors may discount ABS issue prices because of the possibility that the underlying assets involve latent defects. Moreover, with adverse selection, even if outside investors are risk neutral, their demand curve for ABSs becomes downward sloping, and hence the large-scale issue of ABSs may have stronger the market impact with adverse effects on issue prices. In response to such investor behavior, originators may use excess subordination as an instrument to alleviate the problem of adverse selection.

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12 Mitchell (2004) surveys the theoretical implications applicable to securitization instruments.

In sum, under the Modigliani–Miller theorem (which we take as our null hypothesis), the excess subordinated portion held by originators has no impact on swap spreads. Given the early stage of development of the Japanese ABS market, serious concerns about bankruptcy remoteness as a legal practice, or insufficient subordinated portions as a result of rating companies' shortcomings, may yield a systematic relationship between the excess subordinated portion and the swap spread. In the presence of information asymmetry between originators and potential investors, on the other hand, the excess subordinated portion would help to mitigate price discounts and the market impact, both of which are motivated by adverse selection.

3. Econometric analysis of swap spreads of the AAA-rated ABSs

As discussed in the previous section, the subordinated portion held by originators in excess of the required reserves for possible loan losses and commingling risks plays a key role in defining both null and alternative hypotheses in our model specification. For this purpose, we first compute the required reserves and then explore how large the reserves are an originator holds as excess subordination. Finally, by estimating the relationship between excess subordination and the swap spread, we investigate whether the Modigliani–Miller theorem as a null hypothesis is rejected, and we examine the extent to which the rejection of the null hypothesis can be associated with several alternative hypotheses.

3.1 Computation of excess subordination ratios

We first define the ratio of subordinated portions to the total value of underlying assets (the subordination ratio) as follows:

$$\text{Subordination Ratio}_i\ (\%) \equiv \frac{J_i}{I_i + J_i} \times 100, \tag{1}$$

where I_i denotes a senior portion issued to outside investors by originator i, while J_i represents a subordinated portion held by originator i. In this paper, we define as J_i, a subordinated portion net of both cash reserves and initial setup costs. As conservative measures of subordination and its ratio, we subtract cash reserves, potentially belonging to originators, from both assets and liabilities of SPVs. As shown in the first panel in Table 2, the average subordination ratio (denoted as *SUB*) is 17.36 percent, with subordination ratios ranging between 10.85 percent and 31.02 percent. The classified average is 22.42 percent for consumer credit, 15.44 percent for auto loans, and 16.40 percent for lease receivables. We then divide the subordinated portion into the required reserves for possible loan losses and commingling risks, and the excess subordinated portion (the portion in excess of the required reserves). To compute the required reserves for possible loan losses, we use both the loan loss ratios and delinquency percentages reported in the ABS investment prospectuses.

For most issues, the official financial report or the corresponding prospectus reports the monthly series of the loan loss ratio as well as the percentage of longer-than-three-month delays of payments over at least the past six months prior to issue. We compute the six-month average (m_i) and the standard error (s_i) of the sum of the loan loss ratio and the percentage of longer-than-three-month delays for each issue. The average plus two standard errors ($m_i + 2s_i$) is used as the loan loss ratio per month (d_i). While we also adopt more conservative ratios such as $m_i + 3s_i$ and $m_i + 4s_i$, for estimation purposes, the results do not change substantially, although coefficients on several variables are more or less significant. The three panels in Table 3 report m_i, s_i, and d_i (defined as m_i+2s_i) respectively in monthly terms. The average of the adopted loan ratio (d_i) is 0.302 percent per month on the average for all issues, 0.370 percent for consumer credit, 0.335 percent for auto loans, and 0.240 percent for lease receivables.

Given the loan loss ratio d_i, for issue i, the relationship between the outstanding underlying asset at time $t–1$ (A_{it-1}) and at time t (A_{it}) is determined according to:

$$A_{it} = (A_{it-1} - B_{it}) \times (1 - d_i), \quad t = 1, \ldots, T. \tag{2}$$

up to the last maturity of this issue (T), where B_{it} corresponds to a refund of principal at time t. The plan of principal redemption (B_{it}) is described in the investment prospectus: normally bullet repayment, amortization, or pass-through. With the assumption of $A_{iT} = 0$, it is possible to derive from equation (2) the initial outstanding of underlying assets (A_{i0}) that is required to complete a series of refunds of principal as follows:

$$A_{i0} = \sum_{t=1}^{T} \frac{B_{it}}{(1-d_i)^{t-1}}. \tag{3}$$

Subtracting the senior portion issued to outside investors ($I_i = \sum_{t=1}^{T} B_{it}$ under the assumption that the discount rate is equal to the yield to maturity on an ABS tranche), the required reserves for possible loan losses (JD_i) amount to:

$$JD_i = \sum_{t=1}^{T} \frac{B_{it}}{(1-d_i)^{t-1}} - I_i . \tag{4}$$

Here, we implicitly make two assumptions to compute JD_i. First, a servicer is assumed to collect from obligators the cash flow that is needed for ABS redemption at maturity. We use this simplifying assumption because it is not possible to obtain the detailed collection schedules of a principal from the obligors. Once a servicer collects a part of the cash flow prior to the redemption date, the credit risk corresponding to this portion disappears immediately. If it is common for a servicer to collect the cash flow before the redemption date, then the required reserves calculated as above for possible loan losses turn out to be more than necessary.

Second, it is assumed that the value of interest revenues from the underlying assets is equal to the value of interest payments to investors in terms of the present value based on yields to maturity of ABSs. We again use this assumption because it is not possible to trace in detail the interest revenues from the underlying assets. In practice, interest revenues from underlying assets may exceed interest payments to investors. Thus, the second assumption also makes the required reserves calculated more than those necessary. In sum, these two assumptions constitute rather conservative estimates for the required reserves.

An originator must hold subordinated portions not only for possible loan losses but also for commingling risks (a possibility that in the case of the originator's bankruptcy, originators' creditors will seize a part of collective cash flows). The reserves required for such commingling risks usually amount to two-month cash flows received from obligors. Thus, the required reserves for this purpose (JC_i) can be approximated as follows:

$$JC_i = \frac{2 \times (J_i + I_i)}{T}. \quad (5)$$

We now define the excess subordination ratio as the ratio of the subordinated portion in excess of the required reserves for both possible loan losses and commingling risks ($JD_i + JC_i$) to the total value of underlying assets as:

$$\text{Excess Subordination Ratio}_i \text{ (\%)} \equiv \frac{J_i - (JD_i + JC_i)}{I_i + J_i} \times 100. \quad (6)$$

Table 2 presents some descriptive statistics of the reserves ratios for loan losses and commingling risks, and the corresponding excess subordination ratios (denoted as *EXSUB*). In most issues, originators hold the subordinated portions in excess of the required reserves. The excess subordination ratios are positive in 46 of 51 issues. The average excess subordination ratio is 6.95 percent: 9.64 percent for consumer credit, 5.04 percent for auto loans, and 7.18 percent for lease receivables. The standard error of the excess subordination ratio (5.70%) is larger than that of the subordination ratio (4.72%). For the underlying assets, it is 7.07 percent for consumer credit (5.67% as the standard error of the subordination ratio), while it is 4.97 percent for auto loans (3.28%) and 5.15 percent for lease receivables (3.40%). Figure 1 depicts the distribution of issues according to the excess subordination ratios.

As discussed, the two assumptions adopted for this computation tend to cause overestimation of the required reserves, and thus the excess subordination ratio is underestimated. In addition, we adopt rather conservative measures for the subordination ratio itself and its corresponding ratio. Accordingly, the calculated excess subordination ratio may be low or even negative. Some issues with extremely negative excess ratios, however, may have subordinated portions seriously short of the required reserves. In other words, in such cases there may be credit risk left in the senior portions issued to investors. On the other hand, in some issues with extremely large excess ratios, the required reserves may be severely underestimated, and the excess subordination portion may not be free from the credit risk of underlining assets.

For these reasons, our estimates exclude from the sample issues that have extremely high or low excess subordination ratios, defined as the two highest and the two lowest ratio issues. The refined sample then consists of 47 issues (with 430 tranches). Figure 2 plots swap spreads against excess subordination ratios for the total sample and draws the conditional average estimated by local smoothing. As shown, overall, swap spreads respond negatively to excess subordination ratios, but in both ends, swap spreads tend to be low (high) given low (high) ratios. As shown later, the exclusion of these four issues located at both ends helps to generate a negative relationship between the excess subordination ratios and swap spreads.

3.2 Econometric specification

In this subsection, we specify an econometric model with the swap spread on each tranche as the dependent variable, such that the Modigliani–Miller theorem serves as the null hypothesis, and we estimate this specification using the sample of 430 tranches (47 issues). We then interpret the extent to which the null hypothesis is rejected in terms of the alternative hypotheses discussed in Section 2.3.

One major advantage of this procedure is that an econometric model is properly specified under the null hypothesis. That is, under the null, swap spreads should be zero and completely independent of any contractual factors including excess subordination ratios. In other words, this specification allows us to avoid the potential difficulty that would arise when an econometric model is specified properly under a hypothesis alternative to the Modigliani–Miller theorem. For example, within our theoretical framework of security designs all terms of a security contract, including issue yields and excess subordination ratios, are determined simultaneously. However, it is difficult to identify variables to serve as instruments for excess subordination ratios. One caveat is that it is not specified properly under alternative hypotheses in which swap spreads would simultaneously interact with contractual factors. In this regard, we should carefully interpret the magnitude of the estimated coefficients because simultaneity may invoke some upward or downward bias.

We employ two forms of specification. The first specification mainly concerns the relationship between swap spreads and excess subordination ratios after controlling for possible factors on swap spreads. The second specification analyzes the effect of originators' excess subordination on the market impact in the ABS issue market. Each specifies tranche-by-tranche swap spreads as the dependent variable, while contractual factors are specified as explanatory variables. Because swap spreads are completely independent of contract terms under the Modigliani–Miller theorem, estimation by ordinary least squares is a proper specification under the null hypothesis.

We first specify **Model 1** as follows:

$$\begin{aligned} SPREAD_{ij} &= a + b \times EXSUB_{ij} + (c \times SUB_{ij}) + d \times MONTH_{ij} + e \times CREDIT_{ij} + f \times AUTO_{ij} \\ &+ g \times TRUST_{ij} + h \times NOHARD_{ij} + i \times BONDSPREAD_{ij} + j \times MOODYS_{ij} \\ &+ k \times DEBTRATIO_{ij} + l \times LNASSET_{ij} + \varepsilon_{ij} \quad , \end{aligned} \tag{7}$$

where $SPREAD_{ij}$ (measured in terms of basis points) denotes a swap spread of tranche j in issue i as a dependent variable. A set of explanatory variables includes a constant term, excess subordination ratios ($EXSUB_{ij}$, percent), remaining months to maturity ($MONTH_{ij}$), the average spread of AAA-rated corporate bonds over JGBs ($BONDSPREAD_{ij}$, basis points), debt–asset ratios of originators ($DEBTRATIO_{ij}$, percent), a logarithm of the total assets (measured in terms of one million yen) held by originators ($LNASSET_{ij}$), and dummy variables for consumer credit, auto loans, separate custody by a trust bank, repayment with a nonhard bullet, and rating companies ($CREDIT_{ij}$, $AUTO_{ij}$, $TRUST_{ij}$, $NOHARD_{ij}$, and $MOODYS_{ij}$). In addition, ε_{ij} represents the error term of tranche j in issue i. We may replace excess subordination ratios ($EXSUB_{ij}$) by ordinary subordination ratios (SUB_{ij}) to examine the relevance of the former explanatory variable for the explanation of swap spreads.

A tranche under the same issue takes the same value for the above explanatory variables except for the remaining months up to maturity ($MONTH_{ij}$) and a nonhard bullet dummy[13] ($NOHARD_{ij}$). As Panel (b) of Table 4 shows, the average months up to

[13] Even within the same issue, different repayment methods can be made for different tranches. In our dataset, however, with issues with hard-bullet repayment, the

maturity is 30.2, with a standard error 17.3. A significant estimated coefficient for $MONTH_{ij}$ may indicate the time invariant shape of the term structure of swap spreads. The extended Model 1 also adopts the squared remaining months ($MONTH2_{ij}$) as a further explanatory variable.

As discussed in Section 2.2, the time-series fluctuation of swap spreads may reflect the strength of demand for safe assets issued by a government or financially sound private banks, relative to safe but illiquid corporate liabilities. The average spread of the issue yields on 12-year AAA-rated corporate bonds over the issue yields on 10-year JGBs (issued during the same month as each ABS) ($BONDSPREAD_{ij}$) may control for this time-series effect. As shown in Panel (c) of Table 4 and Table 1, $BONDSPREAD_{ij}$ generates a time-series pattern similar to the yearly average of swap spreads of ABSs included in our sample: high in 1998 and low in 2000.

When investors are concerned about the practice of bankruptcy remoteness, the credit status of an originator may have a direct impact on swap spreads. We choose both debt–asset ratios ($DEBTRATIO_{ij}$) and the logarithm of total assets (in terms of one million yen) measured in terms of book value ($LNASSET_{ij}$) as a proxy for an originator's credit status.[14] The sample average of $DEBTASSET_{ij}$ is 97.09%, while the sample average of total assets is 2,769 billion yen. As a related issue, the coefficient on the dummy variable $TRUST_{ij}$ may indicate whether the separate custody of underlying assets by a trust bank would more effectively secure the effect of bankruptcy remoteness. $TRUST_{ij}$ takes a value of one for 13 issues (129 tranches) in our sample.

As discussed earlier, how well an AAA-rated ABS is arranged may depend on the ability of rating companies at the earliest stage of development in the ABS market. To examine this effect, we construct a dummy variable for Moody's, the most experienced rating company in the ABS market. This variable, $MOODYS_{ij}$, may be able to discern the effects of the ability differences among rating companies, including domestic rating companies. $MOODYS_{ij}$ takes a value of one for 35 issues (343 tranches) in our sample. We also construct a dummy variable associated with rating by S&P (SP_{ij}), which is used for the extended version of Model 1. SP_{ij} takes a value of one for 25 issues (191 tranches). Most issues received a rating from both Moody's and S&P. A dummy variable is also specified for the type of underlying loan asset. Relative to lease receivables (21 issues, 261 tranches), a coefficient on $CREDIT_{ij}$ corresponds to the effect of consumer credit (9 issues, 46 tranches), while a coefficient on $AUTO_{ij}$ to the effect of auto loans (17 issues, 123 tranches). These coefficients may represent the difference between underlying loans to individuals and those to corporations.

We adopt the following additional tranche-based explanatory variables.[15] With the pass-through redemption method, a tranche may not repay the principal in a lump-sum manner at maturity (through a hard bullet). Options include a soft bullet, a controlled (predetermined) amortization, and an undetermined amortization. In these three repayment methods, the pass-through redemption option is triggered when an SPV

identical method is applied to all tranches within the same issue.

14 For one issue organized by multiple originators (19 tranches), the average weighted by the corresponding underlying assets is used for both $DEBTRATIO_{ij}$ and $LNASSET_{ij}$.

15 Some issues transfer underlying credit risk to a third party (a casualty insurance company in all cases). Because there are only two issues (11 tranches) with such third-party credit enhancement, we do not include an issue-based dummy variable associated with this option in a list of explanatory variables.

fails to collect cash flows sufficient to cover ABS payments prior to maturity dates, or when a substantial amount of prepayment of underlying assets occurs. Once the pass-through option is exercised, ABS investors receive cash flows on a monthly (or quarterly) pass-through basis instead of the bullet payment at maturity.

A major difference between a soft bullet, a controlled amortization and an undetermined amortization is that with the first two methods, a redemption schedule prior to the exercise of the pass-through redemption is determined in advance (lump-sum repayment at maturity for a soft bullet, and an equally installed repayment for a controlled amortization). For the third method, however, and even before exercise, a redemption schedule is not strictly determined. We thus construct a tranche-based dummy variable, $NOHARD_{ij}$, which takes a value of one for a tranche without a hard bullet, and zero for a tranche with a hard bullet. $NOHARD_{ij}$ takes a value of one for 319 tranches. Two opposing effects are reflected with a significant coefficient on this variable. A positive coefficient indicates that prepayment risks transferred from an originator to investors are dominant, while a negative coefficient implies that the option lowers credit risk as a result of possible early redemption.

For the extended specification of Model 1, we classify tranches without a hard bullet into those with a soft bullet (302 tranches for $SOFT_{ij} = 1$), those with a controlled amortization (4 tranches for $CONTROL_{ij} = 1$), and those with an undetermined amortization (13 tranches[16] for $UNDET_{ij} = 1$). We also consider the relative share of each tranche volume within the same issue ($TRANCHERATIO_{ij}$) and the redemption order of each tranche within the same issue (measured by the ratio of junior tranches relative to the corresponding tranche within the entire issue volume, $TRANCHEORDER_{ij}$).

Furthermore, for the estimation of the extended version, we construct dummy variables associated with two contract terms in which a servicer may advance to an SPV before the collection of cash flows from obligors (30 issues or 220 tranches for $PAYMENT_{ij} = 1$) and in which an originator may repurchase nonperforming loans, if any, from an SPV (25 issues or 250 tranches for $REPURCHASE_{ij} = 1$). Using a dummy variable associated with maturity longer than three years (146 tranches for $LONG_{ij} = 1$), we also construct cross terms with contract characteristics for the extended version. Table 4 reports basic statistics of these explanatory variables.

In addition to a list of explanatory variables for Model 1, **Model 2** adds the issue-based volume ($ISSUEVOL_{ij}$, one hundred million yen per issue) or the tranche-based volume ($TRANCHEVOL_{ij}$, one hundred million yen per tranche), and the cross term of the issue volume with excess subordination ratios ($EXSUB_{ij} \times ISSUEVOL_{ij}$ or $EXSUB_{ij} \times TRANCHEVOL_{ij}$) in order to evaluate the market impact on swap spreads. We use the issue-based (tranche-based) volume measured in terms of a nominal value, partly because nominal price levels were stable for the sample period, and partly because the face amount was constant at one hundred million yen during the sample period.[17]

[16] There is one among 13 tranches whose repayment method is a pass-through redemption from the beginning of the contract.

[17] Only two issues specified 10 million yen as the face amount.

$$
\begin{aligned}
SPREAD_{ij} = {} & a + b \times EXSUB_{ij} + c \times ISSUEVOL_{ij} + d \times (EXSUB_{ij} \times ISSUEVOL_{ij}) \\
& + \left(e \times TRANCHEVOL_{ij} + f \times (EXSUB_{ij} \times TRANCHEVOL_{ij}) \right) \\
& + g \times MONTH_{ij} + h \times CREDIT_{ij} + i \times AUTO_{ij} + j \times TRUST_{ij} \\
& + k \times NOHARD_{ij} + l \times BONDSPREAD_{ij} + m \times MOODYS_{ij} \\
& + n \times DEBTRATIO_{ij} + o \times LNASSET_{ij} + \varepsilon_{ij}, \qquad (8)
\end{aligned}
$$

Direct market impact can be confirmed by a positive coefficient on issue volume ($c > 0$ for the issue-based volume or $e > 0$ for the tranche-based volume). In the case where an additional holding of subordinated portions by an originator would mitigate the market impact of large-sized issues, a coefficient on issue volume is still positive, but a coefficient on the cross term is negative ($c > 0$ and $d < 0$ for the issue-based volume, or $e > 0$ and $f < 0$ for the tranche-based volume). In the issue-based specification, the marginal effect of an excess subordination ratio can be evaluated by $ME_{EXSUB} = b + d \times V$, where V is the sample average of the issue volume, while the marginal effect of issue volume can be measured by $ME_{ISSUEVOL} = c + d \times E$, where E is the sample average of excess subordination ratios. Similarly, ME_{EXSUB} and $ME_{TRANCHEVOL}$ can be defined for the tranche-based specification. Under the Modigliani–Miller theorem, the explanatory variables including excess subordination ratios ($EXSUB_{ij}$,) do not have any impact on swap spreads for Models 1 (or its extended version) and 2. To the extent that the null hypothesis is rejected, we interpret estimation results using several alternative hypotheses.

3.3 Estimation results

This subsection reports the ordinary least squares estimation results of Models 1 and 2. The reported standard error is robust with respect to clustering. That is, this robust standard error considers possible correlation of error terms among tranches within the same issue.[18] As discussed, we estimate **Model 1** for the sample consisting of 47 issues (430 tranches) that, in order to remove the effects of extreme values, exclude the two issues with the lowest excess subordination ratios and the two issues with the highest ratios.

Table 5 presents the estimation results. The results of **Model 1** indicate significantly negative coefficients on the excess subordination ratios. As shown in the second column of Table 5, on the other hand, once the excess subordination ratio (*EXSUB*) as an explanatory variable is replaced by the standard subordination ratio (*SUB*), a coefficient on *SUB* is no longer different from zero. That is, the subordinated portion in excess of the required reserves is indeed responsible for a significantly negative coefficient on *EXSUB*. These results indicate that the Modigliani–Miller theorem is strongly rejected, and that either insufficient control of credit risk of underlying assets and originators, or information asymmetry between investors and originators may be responsible.

There is no strong evidence that swap spreads reflect the credit status of an originator. That is, while swap spreads are expected to increase with the debt–asset ratio of originators and to decrease with the corporate size of originators, neither the former

[18] See Cameron and Trivedi (2005) for references. We use STATA (Version 8) to compute the clustering-robust standard error.

nor the latter parameter is statistically significant. In other words, bankruptcy remoteness works to isolate ABS issues from the credit risk of originators. A swap spread does not depend on whether the underlying assets are in the separate custody at a trust bank or in the direct custody at an SPV. There is a significant difference in swap spreads between issues rated by Moody's (the most experienced in the ABS market) and other, including domestic, rating companies. Swap spreads on the issues rated by Moody's are also significantly lower. Accordingly, outside investors may put less confidence in the credit ratings of domestic rating companies.

As to the coefficients on the remaining explanatory variables, swap spreads have upward-sloping term structures, as implied by a significantly positive coefficient on remaining months to maturity. The ABS swap spread moves together with the spread of AAA-rated corporate bonds over JGBs; in other words, yields on both ABSs and corporate bonds share illiquid premiums over safe and liquid assets such as JGBs and bank-issued interest-rate derivatives. A significantly negative coefficient on a nonhard bullet dummy indicates that the effect of prepayment risks on spreads is negligible and that credit risk of underlining assets are reduced by possible early redemption. Finally, as indicated by the significantly positive coefficients on the dummies for consumer credit, ABSs whose underlying loan assets are originated for individuals tend to yield higher swap spreads.

As shown in Table 6, we estimate the extended versions of **Model 1** (**Models 1-a and 1-b**) in particular by exploiting the detailed tranche-based information. According to the estimation results of **Model 1-a**, the estimated coefficients on *MONTH* and *MONTH2* indicate that the term structure of swap spreads is upward sloping for up to 34 months, though at a diminishing rate. As suggested by the significantly negative coefficient on *TRANCHEORDER*, within the same issue, the late-repaid tranches tend to be discounted more heavily than the early-repaid tranches, possibly reflecting that the former may be subject to higher credit risk. All types of nonhard bullet repayment contribute to decreases in swap spreads (see coefficients on *SOFT*, *CONTROL*, and *UNDET*); investors may prefer flexible redemption plans to rigid hard bullet plans. The advance payment term lowers swap spreads by reducing commingling risks (see estimated coefficient on *PAYMENT*). Investors put more confidence on rating not only by Moody's but also by S&P, although the former still has stronger effects than the latter.

According to the estimation results of **Model 1-b** with the cross terms with *LONG*, swap spreads tend to reflect the credit risk of originators among longer term tranches (more than three years). That is, swap spreads are larger for the longer term tranches that are issued by less creditworthy originators. This indicates that investors may not be assured of bankruptcy remoteness with respect to long-term ABS contracts. Investors also require premiums on long-term ABS issues with a soft bullet and a repurchase term, as well as those backed by consumer credit.

In terms of the estimation results of **Model 2**, there is no significant effect of excess subordination ratios on the market impact. That is, we cannot find $c > 0$ and $d < 0$ for the issue-based volume, or $e > 0$ and $f < 0$ for the tranche-based volume in estimating equation (8). However, there tend to be effects on the market impact among the sample located in the neighborhood of the average excess subordination ratio. Using the sample consisting of 31 issues (281 tranches) that excludes the 10 issues with the highest subordination ratios and the 10 issues with the lowest subordination ratios, we find that an additional holding of subordinated portions mitigates the market impact. More particularly, the effect of excess subordination on the market impact is obtained for the sample where the excess subordination ratios are between 4.44 and 10.95 percent.

As shown in Table 7 for the issue-volume and tranche-volume based specifications, the estimated coefficient for issue volume is found to be significantly positive, while that for the cross term of issue volume and the excess subordination ratio is significantly negative. Although the coefficient on excess subordination ratio is positive, the marginal effect of excess subordination ratio on swap spreads, at the subsample mean (25,725 million yen for issue volume and 2,848 million yen for tranche volume), is still significantly negative (–1.340 and –1.603) and is comparable to the estimated coefficient for the excess subordination ratio in Model 1 (–1.321).

The estimation results based on Model 2 demonstrate that additional holding of subordinated portions by originators decreases swap spreads by mitigating the market impact caused by larger issues. A closer look at the estimated market impact reveals that the marginal effect of issue size on swap spreads is still negative when it is evaluated at the average excess subordination ratios of subsample (7.12%), but it becomes positive and consistent with the market impact on swap spreads if the excess subordination ratios are slightly below the subsample average (7.06% for the issue volume and 6.35% for the tranche volume). As to the effects of the remaining explanatory variables, the estimation results are similar to those for Model 1, except that the coefficient on the rating dummy while still negative is insignificant.

The estimation results appear quite robust with respect to the number of issues with extremely high and low excess subordination ratios, which are excluded from the initial sample. In fact, much the same estimation outcomes are obtained by excluding as few as six to as many as 11 issues with high and low subordination ratios for the issue-based volume specification, and nine through 10 issues for the tranche-based volume specification. That is, we still find significant effects of excess subordination on the market impact in the sample where the excess subordination ratios are between 2.87 and 12.83 percent, or about three-quarters of the total sample.

In sum, the estimation results highlight the potential role of originators' excess subordination as an instrument to mitigate adverse selection problems. That is, an additional holding of subordinated portions by originators would make swap spreads narrower among the overall sample, and mitigate the market impact on swap spreads among about three quarters of the sample in the neighborhood of the mean excess subordination ratio. These findings seriously contradict the Modigliani–Miller theorem based on symmetric information between originators and investors but are fairly consistent with the implications of optimal security design with adverse selection.

4. Conclusion

This paper explores the factors that explain the observed differences in swap spreads among newly issued AAA-rated ABSs in Japan between September 1996 and September 2002. Even after controlling for the effect of prepayment risks involved in the underlying loan contracts and time-varying premiums associated with safe but illiquid corporate liabilities, there are substantial cross-sectional differences in swap spreads on ABSs. To describe these observed differences in swap spreads, we examined the potential role of originators' subordination as a means of mitigating the problems with adverse selection. In particular, we divided originators' subordination into the portion required to cover credit and commingling risks and the portion in excess of that required, and we examined the impact of the latter on swap spreads. The construction of originators' subordination in this manner allowed the specification of an econometric model with the Modigliani–Miller theorem serving as the null hypothesis. The extent to which the null was rejected was then ascertained using several alternative hypotheses.

The estimation results have strongly rejected the Modigliani–Miller theorem as based on the assumption of symmetric information between originators and investors. Instead, the observed difference in swap spreads among the ABS issues reflects not only insufficient risk control by originators, differences in abilities among rating companies, and several contract options, but also the adverse selection problems caused by asymmetric information between originators and investors. In particular, the results clearly demonstrate that an additional holding of subordinated portions by an originator would make swap spreads narrower for the total sample, as well as mitigating the market impact of large-sized issues among a substantial portion of the sample.

These empirical findings are fairly consistent with the findings of theoretical models of optimal security design including DeMarzo (2005), DeMarzo and Duffie (1999), Ohashi (1999), and Riddiough (1997). While past empirical studies have examined the implications of adverse selection on security design using micro data in securitization markets, our study is different in that owing to the division of originators' subordination, the Modigliani–Miller theorem is properly specified as the null hypothesis, and the rejection of the null is interpreted using several important alternative hypotheses. Our empirical strategy is, however, somewhat indirect in the sense that our rejection of the Modigliani–Miller theorem as a null hypothesis is interpreted in the context of several alternative hypotheses. A more direct method would include specifying instrumental variables for some contractual factors and estimating the structural form based on a particular alternative hypothesis. This particular limitation would serve as a useful starting point for future research in this area.

Two main policy outcomes are obtained from the analysis. First, our results indicate that investors may be concerned about the practice of bankruptcy remoteness, particularly in the case of long-term ABS contracts with much less creditworthy originators.[19] The future development of the Japanese ABS market obviously requires the practice of bankruptcy remoteness to be legitimized and made common among market participants. Second, our analysis demonstrates that originators' subordination plays an important role in not only absorbing credit risk involved in underlying assets but also mitigating the asymmetry of information between originators and investors. Nevertheless, existing tax codes, accounting rules and regulatory frameworks tend to impose strict penalties on corporations and financial institutions that issue ABSs with relatively high subordination ratios, on the ground that the whole subordinated portion corresponds to originators' taking credit risk involved in the underlying assets.[20] These

[19] In fact, when Mycal Corporation, a large-scale retailer, filed for bankruptcy in September 2001, some creditors attempted to seize the real estate kept in custody for the CMBS issued by Mycal. It took more than a year for Mycal creditors finally to agree on bankruptcy remoteness, at least partly due to the ambiguous interpretation of the pertinent clause by Mycal's stakeholders.

[20] For example, the tax code in Japan does not regard the securitization of real estate as a true sale from an originator to an SPV if the subordination ratios are higher than

institutional constraints make originators' subordination for mitigating asymmetric information quite costly.[21] The fact that originators' subordination may be an effective mitigation instrument should then be taken into consideration when tax codes, accounting rules and regulatory systems are first designed for securitization schemes.

five percent. The newly introduced BIS rule requires private banks to hold more capital against their holding of subordinated portions in securitization schemes.

[21] Such costly subordination as a result of unfavorable institutional treatment may be responsible for the recent trend where issues by private placement have dominated the ABS market. However, private issues always involve the differential treatment of major and small investors in securitization deals. Therefore, the widespread use of private placement would make it quite difficult for securitization schemes to be developed as major tools in financial markets.

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Table 1: Swap Spreads of AAA-Rated Asset-Backed Securities

This table reports the summary statistics of the swap spread (basis points, or bp), or the issue yield to maturity over the interest-rate swap rate with the same maturity among the AAA-rated asset-backed security (backed by either consumer credit, auto loans, or lease receivables) that was issued by public placement between September 1996 and September 2002 in Japan.

	Number of Tranches	Number of Issues	Mean (bp)	Standard Deviation (bp)	Minimum (bp)	Maximum (bp)
All Samples	458	51	22.40	14.71	–3.00	71.00
Underlying Asset						
Credit	56	11	29.31	18.78	3.00	71.00
Auto Loan	131	18	23.57	15.84	–1.00	65.00
Lease	271	22	20.41	12.62	–3.00	48.00
Classified by Issue Year						
1996	4	1	19.50	10.38	13.00	35.00
1997	40	4	14.84	6.624	5.00	30.00
1998	59	7	41.86	11.96	20.00	71.00
1999	169	21	25.38	13.51	5.00	65.00
2000	57	8	6.54	6.43	–3.00	25.00
2001	60	5	13.68	7.64	1.00	35.00
2002	69	5	23.68	10.16	4.60	45.00

Table 2: Subordination Ratios and Excess Subordination Ratios of AAA-Rated Asset Backed Securities

This table reports the summary statistics of the subordination ratio (**SUB**, percent) defined as the subordinated portion held by the originator to the total value of underlining assets, as well as the excess subordination ratio (**EXSUB**, percent) defined as the subordinated portion in excess of required reserves for both possible loan losses and commingling risks to the total value of underlining assets. It also compiles the reserve ratio for both possible loan losses and commingling risks to the total value of underlining assets (percent).

		Number of Issues	Mean (%)	Standard Deviation (%)	Minimum (%)	Maximum (%)
Subordination Ratio (SUB)	**All Samples**	51	17.36	4.72	10.85	31.02
	Credit	11	22.42	5.67	11.93	31.02
	Auto Loan	18	15.44	3.28	11.60	22.21
	Lease	22	16.40	3.40	10.85	25.46
Excess Subordination Ratio (EXSUB)	**All Samples**	51	6.95	5.70	–10.92	20.17
	Credit	11	9.64	7.07	–3.36	20.17
	Auto Loan	18	5.04	4.97	–10.92	8.37
	Lease	22	7.18	5.15	–5.35	14.86
Reserves Ratio for Loan Loss	**All Samples**	51	6.49	5.06	1.46	22.24
	Credit	11	8.60	5.09	4.23	22.24
	Auto Loan	18	5.95	5.24	1.46	19.96
	Lease	22	5.87	4.85	1.59	21.31
Reserves Ratio for Commingling Risk	**All Samples**	51	3.92	0.76	2.78	5.56
	Credit	11	4.18	0.75	3.33	5.56
	Auto Loan	18	4.45	0.64	3.70	5.56
	Lease	22	3.35	0.38	2.78	4.44

Table 3: Loan Loss Ratios of AAA-Rated Asset Backed Securities

This table reports the summary statistics of the monthly loan loss ratio (percent), defined as the percentage of longer-than-three-month delays of payments over the past six months prior to the issuance. The reported statistics include the average (**m**), the standard deviation (**s**), and the assumed monthly loan loss ratio (**d**) defined as **m + 2s**.

		Number of Issues	Mean (%)	Standard Deviation (%)	Minimum (%)	Maximum (%)
Monthly Average (m)	**All Samples**	51	0.218	0.206	0.024	0.930
	Credit	11	0.303	0.191	0.155	0.608
	Auto Loan	18	0.285	0.264	0.072	0.930
	Lease	22	0.120	0.101	0.024	0.408
Standard Deviation (s)	**All Samples**	51	0.042	0.038	0.010	0.167
	Credit	11	0.034	0.020	0.014	0.072
	Auto Loan	18	0.025	0.016	0.010	0.062
	Lease	22	0.060	0.049	0.015	0.167
Monthly Loan Loss Ratio (d = m + 2s)	**All Samples**	51	0.302	0.232	0.069	1.053
	Credit	11	0.370	0.205	0.183	0.729
	Auto Loan	18	0.335	0.287	0.104	1.053
	Lease	22	0.240	0.185	0.069	0.742

Table 4: Data Description

This table reports the summary statistics of the sample consisting of 47 issues (430 tranches) that excludes the two issues with the highest excess subordination ratios and the two issues with the lowest excess subordination ratios. Panels (a), (b) and (c) report the issue-based data, the tranche-based data, and the aggregate data, respectively.

(a) Issue-based Data	Definition	Mean	Standard Deviation
SUB	Subordination ratio (percent)	16.85	4.03
EXSUB	Excess subordination ratio (percent)	7.10	4.35
ISSUEVOL	Issue-based volume (100 million yen)	281.60	137.45
CREDIT	One if the underlying assets are consumer credit, zero otherwise.	0.19	0.40
AUTO	One if the underlying assets are auto loans, zero otherwise.	0.36	0.49
TRUST	One if the underlying assets are managed by a trust bank, zero otherwise.	0.28	0.45
MOODYS	One for rating by Moody's, zero otherwise.	0.74	0.44
SP	One for rating by S&P, zero otherwise.	0.53	0.50
DEBTRATIO	Debt–asset ratio of the originator (percent)	97.09	1.54
LNASSET	Logarithm of the total assets of the originator (measured in terms of one million yen)	14.31	1.15
	Total assets of the originator (one million yen)	2,769,225	2,506,238
PAYMENT	One if there is a contract term in which the servicer may advance to the SPV before the collection of cash flows from obligors, zero otherwise.	0.64	0.49
REPURCHASE	One if there is a contract term in which the originator may repurchase nonperforming loans, if any, from the SPV, zero otherwise.	0.53	0.50

(b) Tranche-based Data	Definition	Mean	Standard Deviation
SPREAD	Swap spread (basis point)	22.14	14.86
MONTH	Remaining months up to maturity (month)	30.16	17.33
MONTH2	Squared **MONTH** (month)	1209.32	1167.74
TRANCHEVOL	Tranche-based volume (100 million yen)	29.98	32.52
TRANCHERATIO	Ratio of the tranche-based volume to the issue-based volume (percent)	10.63	9.27
TRANCHEORDER	Share of junior tranches relative to the corresponding tranche within the issue-based volume (percent)	41.68	29.44
NOHARD	One if the redemption method is not a hard bullet, zero otherwise.	0.74	0.44
SOFT	One if the redemption method is a soft bullet, zero otherwise.	0.70	0.46
CONTROL	One if the redemption method is a controlled amortization, zero otherwise.	0.01	0.10
UNDET	One if the redemption method is an undetermined amortization, zero otherwise.	0.03	0.17
LONG	One if **MONTH** is longer than 36 months, zero otherwise.	0.34	0.47

(c) Aggregate Data	Definition	Mean	Standard Deviation
BONDSPREAD	Average spread of the issue yield on 12-year AAA-rated corporate bonds over the issue yield on the 10-year JGBs (basis point)	45.47	25.86
	BONDSPREAD corresponding to the subsample issued in 1996 (1 issue)	19.50	
	BONDSPREAD corresponding to the subsample issued in 1997 (4 issues)	61.12	21.63
	BONDSPREAD corresponding to the subsample issued in 1998 (6 issues)	88.20	17.36
	BONDSPREAD corresponding to the subsample issued in 1999 (19 issues)	37.00	22.85
	BONDSPREAD corresponding to the subsample issued in 2000 (8 issues)	25.89	8.11
	BONDSPREAD corresponding to the subsample issued in 2001 (5 issues)	43.68	2.98
	BONDSPREAD corresponding to the subsample issued in 2002 (4 issues)	53.78	14.54

Table 5: Estimation Results (Model 1)

$$SPREAD_{ij} = a + b \times EXSUB_{ij} + (c \times SUB_{ij}) + d \times MONTH_{ij} + e \times CREDIT_{ij} + f \times AUTO_{ij}$$
$$+ g \times TRUST_{ij} + h \times NOHARD_{ij} + i \times BONDSPREAD_{ij} + j \times MOODYS_{ij}$$
$$+ k \times DEBTRATIO_{ij} + l \times LNASSET_{ij} + \varepsilon_{ij}$$

(1) This table reports the estimation results based on tranche-by-tranche swap spreads (basis point) for the sample consisting of 47 issues (430 tranches) that excludes the two issues with the highest excess subordination ratios and the two issues with the lowest excess subordination ratios.

(2) The set of explanatory variables includes the excess subordination ratio (**EXSUB**, percent), the remaining months to maturity (**MONTH**, month), the average spread of the issue yield on 12-year AAA-rated corporate bonds over the issue yield on the 10-year JGBs (**BONDSPREAD**, basis point), the debt–asset ratio of the originator (**DEBTRATIO**, percent), and the natural logarithm of the total assets (in terms of one million yen) of the originator (**LNASSET**). The estimation reported in the second column replaces **EXSUB** by the subordination ratio (**SUB**, percent).

(3) The dummy variables used as explanatory variables include **CREDIT**, **AUTO**, **TRUST**, **NOHARD**, and **MOODYS**, which take a value of one for consumer credit, auto loans, separate custody by a trust bank, a redemption other than a hard bullet, and rating by Moody's, respectively.

(4) Cluster-robust standard errors reported; ***, **, * indicate significantly different from 0 at the 1%, 5%, and 10% levels, respectively.

	Using Excess Subordination Ratio			Using Subordination Ratio		
Variable	Coefficient		Robust S.E.	Coefficient		Robust S.E.
CONSTANT	5.736		101.710	12.878		111.899
EXSUB	–1.321	**	0.505			
SUB				–0.227		0.652
MONTH	0.253	***	0.043	0.271	***	0.047
CREDIT	12.634	**	5.120	15.324	*	8.302
AUTO	1.193		5.530	6.492		7.338
TRUST	–1.811		4.128	–4.110		4.651
NOHARD	–15.642	***	4.452	–10.937	**	4.201
BONDSPREAD	0.180	**	0.074	0.180	**	0.078
MOODYS	–12.184	**	4.700	–9.738	*	4.951
DEBTRATIO	0.346		1.077	0.499		1.260
LNASSET	–0.211		1.879	–2.716		2.612
R-squared	0.490			0.421		
Number of Issues	47			47		
Number of Tranches	430			430		

Table 6: Estimation Results (Extended Model 1)

$$SPREAD_{ij} = a + b \times EXSUB_{ij} + c \times MONTH_{ij} + d \times MONTH2_{ij} + e_1 \times TRANCHERATIO_{ij}$$
$$+ f_1 \times TRANCHEORDER_{ij} + g_1 \times CREDIT_{ij} + h_1 \times AUTO_{ij} + i_1 \times TRUST_{ij} + j_1 \times SOFT_{ij}$$
$$+ k_1 \times CONTROL_{ij} + l_1 \times UNDET_{ij} + m_1 \times BONDSPREAD_{ij} + n_1 \times MOODYS_{ij} + o_1 \times SP_{ij}$$
$$+ p_1 \times DEBTRATIO_{ij} + q_1 \times LNASSET_{ij} + r_1 \times PAYMENT_{ij} + s_1 \times REPURCHASE_{ij}$$
$$+ e_2 \times (LONG_{ij} \times TRANCHERATIO_{ij}) + \cdots + s_2 \times (LONG_{ij} \times REPURCHASE_{ij}) + \varepsilon_{ij}$$

(1) This table reports the estimation results based on tranche-by-tranche swap spreads (basis point) for the sample consisting of 47 issues (430 tranches) that excludes the two issues with the highest excess subordination ratios and the two issues with the lowest excess subordination ratios

(2) The set of explanatory variables includes the excess subordination ratio (**EXSUB**, percent), the remaining months to maturity (**MONTH**, month), the squared MONTH (**MONTH2**, month), the ratio of the tranche volume to the issue volume (**TRANCHERATIO**, percent), the share of junior tranches relative to the corresponding tranche within the issue-based volume (**TRANCHEORDER**, percent), the average spread of the issue yield on 12-year AAA-rated corporate bonds over the issue yield on the 10-year JGBs (**BONDSPREAD**, basis point), the debt–asset ratio of the originator (**DEBTRATIO**, percent), and the natural logarithm of total assets (in terms of one million yen) of the originator (**LNASSET**).

(3) The dummy variables used as explanatory variables include **CREDIT**, **AUTO**, **TRUST**, **SOFT**, **CONTROL**, **UNDET**, **MOODYS**, **SP**, **PAYMENT**, and **REPURCHASE**, which take a value of one for consumer credit, auto loans, separate custody by a trust bank, a soft bullet, a controlled amortization, an amortization with undetermined amounts, rating by Moody's, rating by S&P, the advance of the servicer to SPV, and the repurchase of nonperforming loans by the originator, respectively.

(4) The explanatory variables of Model 1-b, indicated as "**LONG ×,**" are the cross term of a variable and the dummy variable (**LONG**) which takes one for a tranche whose **MONTH** is longer than 36 months.

(5) Cluster-robust standard errors reported; ***, **, * indicate significantly different from 0 at the 1%, 5%, 10% levels, respectively.

	(a)			(b)		
Variable	Coefficient		Robust S.E.	Coefficient		Robust S.E.
CONSTANT	–25.815		82.504	–34.933		84.176
EXSUB	–1.440	***	0.501	–1.358	***	0.479
MONTH	0.266		0.181	0.297		0.454
MONTH2	–0.004	***	0.001	–0.005		0.004
TRANCHERATIO	0.083		0.175	0.124		0.226
TRANCHEORDER	–0.167	**	0.070	–0.168		0.145
CREDIT	13.385	**	5.158	9.023		5.885
AUTO	–1.681		5.562	–3.455		6.212
TRUST	2.280		3.779	2.722		3.899
SOFT	–14.680	***	4.228	–16.372	***	4.388
CONTROL	–23.191	***	7.820	–25.618	***	8.821
UNDET	–15.208	***	5.338	–26.929	**	12.412
BONDSPREAD	0.140	**	0.064	0.141	**	0.064
MOODYS	–15.665	***	4.527	–16.353	***	4.767
SP	–11.381	***	3.875	–10.790	***	3.895

Table 6 (Continued)

DEBTRATIO	0.356		0.861	0.419		0.905
LNASSET	3.820	**	1.670	4.149	**	1.595
PAYMENT	–6.879	**	3.068	–6.080	*	3.462
REPURCHASE	–3.949		3.273	–5.840	*	3.087
LONG×TRANCHERATIO				0.160		0.268
LONG×TRANCHEORDER				–0.090		0.137
LONG×CREDIT				12.745	**	6.146
LONG×AUTO				9.519		8.495
LONG×TRUST				–1.931		3.785
LONG×SOFT				6.085	**	2.835
LONG×CONTROL				–8.220		14.115
LONG×UNDET				19.602		11.980
LONG×BONDSPREAD				–0.006		0.057
LONG×MOODYS				1.579		3.512
LONG×SP				–0.465		3.627
LONG×DEBTRATIO				0.467	*	0.254
LONG×LNASSET				–4.126	**	2.009
LONG×PAYMENT				–4.142		3.403
LONG×REPURCHASE				8.544	*	5.018
R-squared	0.630			0.664		
Number of Issues	47			47		
Number of Tranches	430			430		

Table 7: Estimation Results (Model 2)

$$SPREAD_{ij} = a + b \times EXSUB_{ij} + c \times ISSUEVOL_{ij} + d \times (EXSUB_{ij} \times ISSUEVOL_{ij})$$
$$+ \left(e \times TRANCHEVOL_{ij} + f \times (EXSUB_{ij} \times TRANCHEVOL_{ij})\right)$$
$$+ g \times MONTH_{ij} + h \times CREDIT_{ij} + i \times AUTO_{ij} + j \times TRUST_{ij}$$
$$+ k \times NOHARD_{ij} + l \times BONDSPREAD_{ij} + m \times MOODYS_{ij}$$
$$+ n \times DEBTRATIO_{ij} + o \times LNASSET_{ij} + \varepsilon_{ij}$$

$$ME_{EXSUB} = b + d \times V_{ISSUEVOL} \quad or \quad b + f \times V_{TRANCHEVOL} \ ,$$
$$ME_{ISSUEVOL} = c + d \times E \ , \quad ME_{TRANCHEVOL} = e + f \times E$$

(1) This table reports the estimation results based on tranche-by-tranche swap spreads (basis point) for the sample consisting of 31 issues (281 tranches) that excludes the 10 issues with the highest excess subordination ratios and the 10 issues with the lowest excess subordination ratios
(2) The set of explanatory variables includes the excess subordination ratio (**EXSUB**, percent), the issue volume (**ISSUEVOL**, 100 million yen), the cross term of the excess subordination ratio and the issue volume (**EXSUB×ISSUEVOL**), the tranche volume (**TRANCHEVOL**, 100 million yen), the cross term of the excess subordination ratio and the tranche volume (**EXSUB×TRANCHEVOL**), the remaining months to maturity (**MONTH**, month), the average spread of the issue yield on 12-year AAA-rated corporate bonds over the issue yield on 10-year JGBs (**BONDSPREAD**, basis point), the debt–asset ratio of the originator (**DEBTRATIO**, percent), and the natural logarithm of total asset value (in terms of one million yen) of the originator (**LNASSET**).
(3) The dummy variables used as explanatory variables include **CREDIT**, **AUTO**, **TRUST**, **NOHARD**, and **MOODYS**, which take a value of one for consumer credit, auto loans, separate custody by a trust bank, a redemption other than a hard bullet, and rating by Moody's, respectively.
(4) The marginal effect of the excess subordination ratio (**ME_{EXSUB}**) is evaluated at the subsample mean of **ISSUEVOL** (**$V_{ISSUEVOL}$**, 25,725 million yen) or that of **TRANCHEVOL** (**$V_{TRANCHEVOL}$**, 2,848 million yen), while the marginal effects with respect to the issue volume (**$ME_{ISSUEVOL}$**) and the tranche volume (**$ME_{TRANCHEVOL}$**) are evaluated at the subsample mean of **EXSUB** (**E**, 7.12%).
(5) Cluster-robust standard errors reported; ***, **, * indicate significantly different from 0 at the 1%, 5%, and 10% levels, respectively.

	Using Issue-based Volume			Using Tranche-based Volume		
Variable	Coefficient		Robust S.E.	Coefficient		Robust S.E.
CONSTANT	156.132		170.742	88.852		163.864
EXSUB	3.378	*	1.843	–0.370		0.984
ISSUEVOL	0.127	***	0.043			
EXSUB×ISSUEVOL	–0.018	***	0.006			
TRANCHEVOL				0.273	**	0.105
EXSUB×TRANCHEVOL				–0.043	***	0.015
MONTH	0.231	***	0.049	0.208	***	0.051
CREDIT	14.373	**	6.462	13.583	**	6.566
AUTO	4.277		5.830	0.176		5.486
TRUST	–1.681		2.660	–2.774		2.744
NOHARD	–14.054	***	4.838	–9.403	**	3.572
BONDSPREAD	0.382	***	0.077	0.334	***	0.080
MOODYS	–2.833		4.248	–4.260		4.478
DEBTRATIO	–1.770		1.621	–1.033		1.529
LNASSET	–0.002		2.487	1.723		2.501
Marginal Effect						
ME_{EXSUB}	–1.340	**	0.602	–1.603	*	0.798
$ME_{ISSUEVOL}$	–0.004		0.016			
$ME_{TRANCHEVOL}$				–0.035		0.039
R-squared	0.671			0.649		
Number of Issues	31			31		
Number of Tranches	281			281		

Figure 1: Distribution of Issues According to Excess Subordination Ratios

The figure depicts the histogram of issues according to the excess subordination ratio (percent). The sample consists of 51 issues.

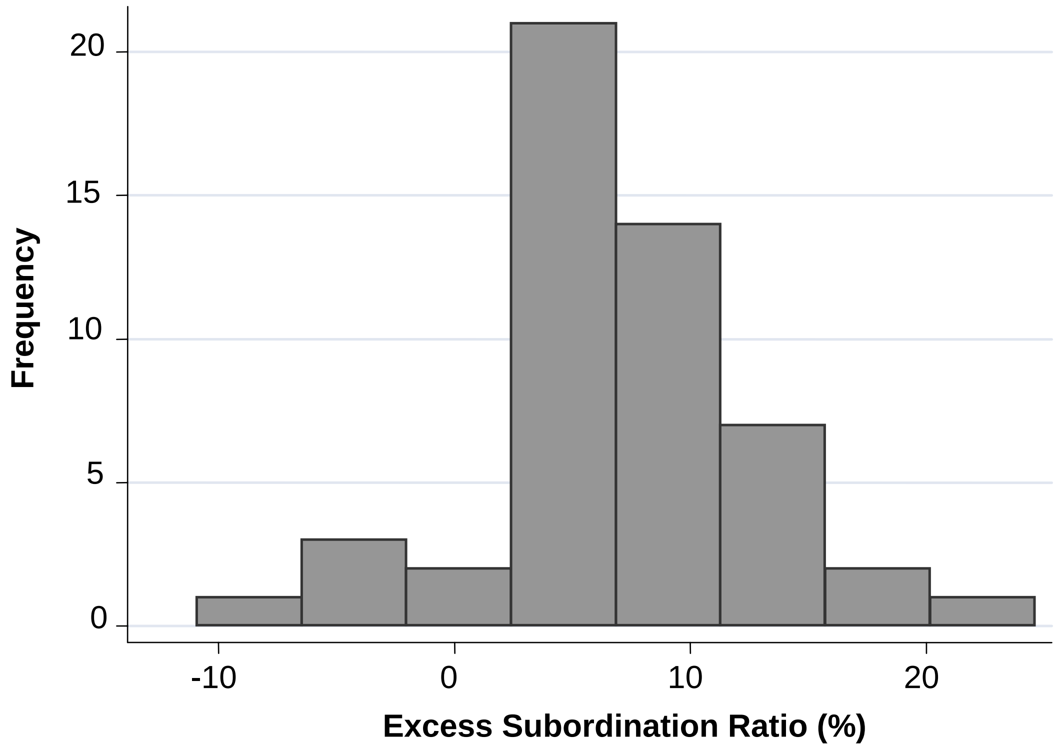

Figure 2: Swap Spreads and Excess Subordination Ratios

The figure plots the relationship between the swap spread (basis point) of the AAA-rated asset-backed security and the excess subordination ratio (percent). The solid line indicates the conditional average estimated by the local smoothing. The sample consists of 51 issues (458 tranches).