CMBS Pricing: Evidence from Modern Conduit Issues

JOHN P. HARDING, C.F. SIRMANS, AND SANSANEE THEBPANYA

JOHN P. HARDING
is an associate professor at the University of Connecticut School of Business in Storrs, CT.
johnh@business.uconn.edu

C.F. SIRMANS
is a professor at the University of Connecticut School of Business in Storrs, CT.
cf@business.uconn.edu

SANSANEE THEBPANYA
is a lecturer at the Bangkok University School of Business Administration in Bangkok, Thailand.
sansanee.t@bu.ac.th

Most product life cycles include four distinct stages: introduction, growth, maturity, and decline. For modern commercial mortgage-backed securities, the introduction phase came in 1992-1995, when the Resolution Trust Corporation, aided by the investment banking community, developed a new security structure to help liquidate the RTC's large portfolio of commercial mortgages acquired in the closing of failed savings and loan institutions.

During the subsequent growth period (1996-1998), conduit lenders modified the basic structure to facilitate the funding of new commercial mortgage originations. They originated or purchased loans and then sold securities backed by the pools. Conduits do not hold loans for very long but transmit them from one holder to another.

Volume grew very rapidly in 1997 and 1998. The average annual growth rate over 1995-1998 was 62%. New investors were attracted to CMBS by their very strong relative returns. The expanding investor base and a growing infrastructure for conveying information contributed to a trend toward narrower spreads over Treasuries for all classes of CMBS, enhancing the returns.

The growth phase for CMBS ended in the liquidity crisis in fall 1998. Many conduits experienced significant pipeline losses, and CMBS investors, particularly leveraged investors in junior tranches, suffered significant losses as spreads suddenly widened. Conduits and investors alike were accustomed to hedging the interest rate risk associated with CMBS using short positions in Treasury securities. In the fall of 1998, Treasury yields fell while yields on CMBS increased. Most hedges became ineffective, and several conduits and many investors withdrew from the market.

The CMBS market began its recovery in 1999 and since then appears to be in a maturity phase. Although the dollar volume of new domestic issues remains below the 1998 peak, new CMBS issues in 2001 and 2002 were 22% above 1998 global issuance. In many ways, the overall market is stronger now. Rating agencies are more sophisticated in their analysis of commercial real estate and CMBS structures. Information and technology providers have developed on-line systems to facilitate direct analysis by investors and reduce asymmetric information. The swaps market has proven to be more effective for hedging than the Treasury market, so the swap curve has become the benchmark for pricing.

The CMBS structure has also evolved. New conduit deals are better diversified geographically and by property type. Prepayment protection has shifted from absolute lockouts followed by prepayment penalties to shorter lockout periods followed by a period allowing borrowers to defease their obligation using a portfolio of Treasury securities. These defeasance provisions provide both better prepayment protection for investors and additional flexibility for borrowers to refinance (if at a price).

In Harding and Sirmans [1997] we ana-

lyze the initial pricing of CMBS tranches issued between 1994 and 1996. This research finds that the quality of the underlying mortgages and property type mix significantly affect the pricing of new senior CMBS tranches. Somewhat surprisingly, the study does not show a significant effect for either pool diversification or the degree of prepayment protection.

Jacob and Gichon [1999] also study the pricing of new CMBS issues during the same period, confirming that the quality of the underlying loans significantly affects senior tranche pricing. AAA bonds with longer lockout protection were priced more favorably than those with shorter lockout protection. Again neither diversification nor the extent of prepayment penalties significantly influenced pricing.

The empirical findings of these two studies are puzzling, because, in theory, a well-diversified pool with strong prepayment protection should provide more stable and predictable cash flows to the senior investors. One would expect that stability to be priced.

We extend the research on the initial pricing of CMBS in several ways. First, we use a comprehensive data set covering all conduit issues from 1997 through 2001. The data provide a complete description of the deal and the underlying mortgage pool—including better information on diversification and prepayment protection than once available.

Second, consistent with current pricing practices, we model the pricing of CMBS relative to the swap curve, not the Treasury curve. We believe a swap spread comparison eliminates the noise added by the variation in swaps to Treasuries, which can be driven by unique factors affecting the Treasury market (e.g., the decline in new issues associated with budget surpluses in the late 1990s and the periodic flights to quality associated with geopolitical events).

Finally, we estimate a two-equation system to more accurately capture the fact that pricing and structure are jointly determined as a deal is brought to market. That is, we believe the level of subordination required by the rating agencies and the initial tranche pricing are jointly determined. If subordination is endogenous, it will be correlated with the error term in an equation describing pricing, and the estimated coefficient will be inconsistent.[1]

Although our focus here is primarily on explaining the cross-sectional variation in spreads, we also include several macroeconomic variables to control for predictable changes in spreads. Our model of initial pricing spreads is more consistent with theoretical pricing models than earlier empirical models, because both diversification and degree of prepayment protection in addition to the traditional underwriting variables and bond descriptors are shown to influence initial pricing.

Even after controlling for credit rating, our results show that senior tranche investors price expected cash flow uncertainty while junior tranche investors focus more on loan quality. Between 1997 and 2001 there has not been a significant trend in pricing spreads, although there has been a clear trend toward lower levels of credit enhancement as measured by required levels of subordination.

I. BACKGROUND AND HISTORY OF CMBS

Our data come from a number of sources including Commercial Mortgage Alert, the Federal Reserve System, Bloomberg, and prospectuses from conduit transactions. Commercial Mortgage Alert collects data on all new CMBS issues. We use the Federal Reserve data and Bloomberg for interest rates on the day of issuance and other market conditions.

Exhibit 1 displays the volume of new CMBS issues since 1985. The graph shows a very low level of activity prior to the RTC's first issue in summer 1991. The data in Exhibit 2 on new issues describe the evolution of the CMBS structure over the period.

Many of the issues prior to 1992 bear little resemblance to the modern CMBS structure. Most issues comprised one or two tranches sold to the public and generally followed a simple senior/junior structure. Many deals in this era were backed by a single loan. Even in 1989, the average number of loans per deal was only 11.2.

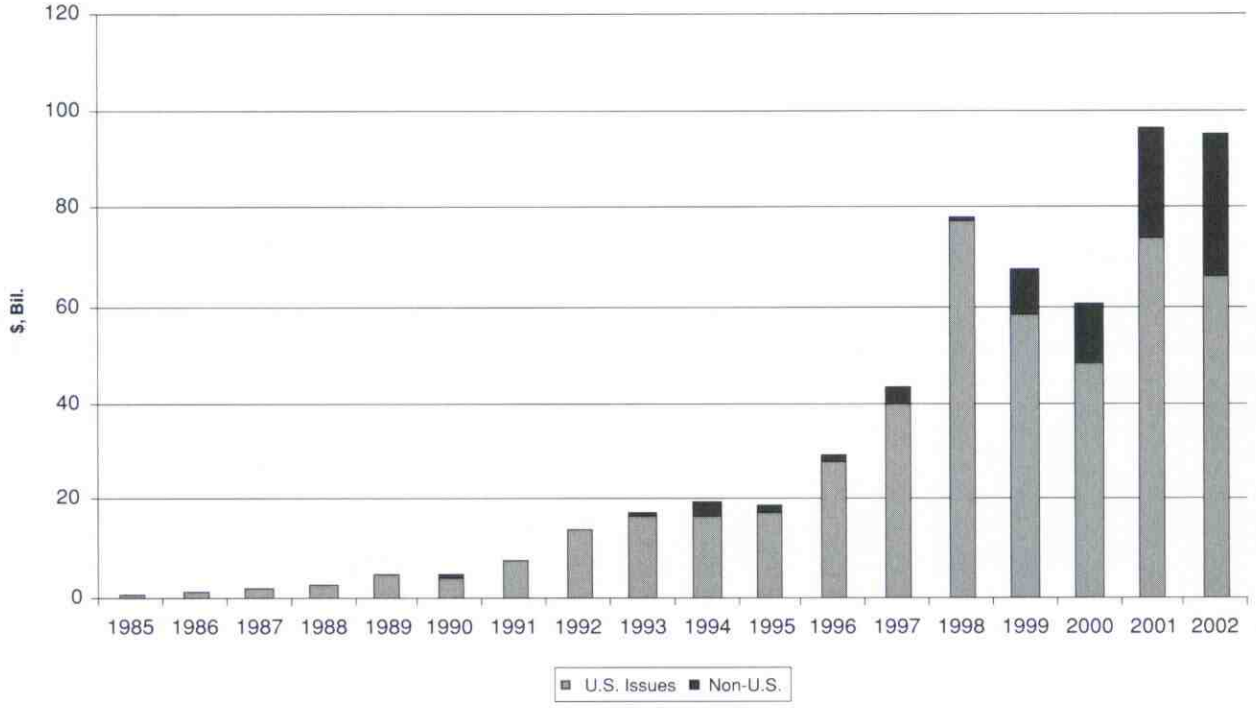
The "introduction" period from 1992 through 1995 shows a sharp increase in the growth rate. From 1991 through 1995 the average annual growth rate in new issues, measured in dollars, was approximately 25%. The growth rate from 1995 through 1998 was almost 2.5 times that rate (62% per year). This period marked the rise of the conduit lenders.

Deal structures also changed sharply during this time. The average deal size increased from $196 million in 1995 to $845 million in 1998. The crisis of 1998 and the subsequent shakeout of players in the market led to a drop in domestic dollar volume in 1999 and 2000, but since then the number of new domestic issues in 2001 and 2002 has exceeded the number of deals in 1998.

With dollar volume down and the number of deals increasing, average deal size declined to $660 million in 2002. Although the volume of U.S. CMBS issues has not exceeded the 1998 peak, global volume set a new record in 2001, and volume in 2002 was essentially the same.

Exhibit 2 shows that CMBS structures have become more complex over time, as measured by the average

EXHIBIT 1
Volume of New CMBS Issues



Source: Commercial Mortgage Alert.

number of tranches in a deal. Prior to 1993, the typical deal involved the sale of a single tranche to the public. Credit support was often provided by letters of credit or lease arrangements with highly rated tenants, not by security structure. During the growth phase, issuers began to sell more tranches to the public. The trend toward increased structural complexity has continued since the 1998 liquidity crisis. In 2001 and 2002, the average deal included roughly 12 different tranches—a 33% increase over the average in 1998.

Exhibit 3 provides more detailed information on the recent changes in CMBS structure, especially the increased use of defeasance to provide better prepayment protection to investors. Much of the detailed data reported in the first panel of Exhibit 3 for conduit issues is available only from the prospectus for the issue. The information in the second panel is based on Commercial Mortgage Alert data and covers all CMBS issues during the period.

Several trends are apparent. First, a significant change in prepayment protection is seen in an increase in the percentage of loans with defeasance provisions and in longer lockout or defeasance protection. Before 1997, there was minimal use of defeasance in commercial mortgage loans. Between 1997 and 2001, the percentage of loans with defeasance provisions increased from 25% to 93%.

The benefit for investors is that the period of protection from lockout and defeasance increased from just over five years to more than eight years in the case of all CMBS issues. As a result, most AAA tranches now have a high degree of prepayment protection covering almost all of their expected lives. At the same time, borrowers have more flexibility to sell or refinance their properties when market conditions dictate.[2]

For the conduit deals, we can look at lockout and defeasance individually. In 1997-1998, for loans with no defeasance, the average lockout period was about five years. The lockout period was then followed by a period of prepayment penalties that did not give investors absolute certainty about their cash flows.[3]

For loans with defeasance, the lockout period is somewhat shorter (approximately three years), but the combined lockout plus defeasance period is longer than nine years. In the last two years, loans without defeasance have had longer lockout periods, but these loans represent a very small fraction of the total loans (less than 10% in 2002).

Another significant trend is reduction in the level of

EXHIBIT 2

Trends in CMBS Issues 1985–2002

Item	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Deal Descriptor																		
# of Deals	4	4	22	48	49	35	50	54	122	115	94	104	91	92	101	87	114	100
# Non-U.S.	--	--	--	1	1	2	1	--	--	6	5	6	13	3	33	38	57	70
U.S. Issues ($,000)	649	1,554	2,633	2,905	4,938	4,812	7,633	13,997	17,422	17,404	18,407	29,694	40,442	77,726	58,482	48,871	74,303	66,277
Non-U.S. Issues ($,000)	--	--	--	160	150	152	564	--	--	2,819	1,051	958	3,557	629	9,402	12,116	22,660	29,300
Total	649	1,554	2,633	3,065	5,088	4,964	8,197	13,997	17,422	20,223	19,458	30,652	43,999	78,355	67,883	60,987	96,963	95,576
Average Deal Size (U.S. Deals only)	162	388	120	61	101	137	153	259	143	151	196	286	444	845	579	562	652	663
# of Tranches per Deal	1	1.75	1.18	1.27	1.14	1.31	1.82	2.8	3.18	3.65	4.96	5.64	7.31	8.8	8.8	10.64	12.38	11.82
Average Tranche Size	162	222	100	47	89	166	81	93	49	46	43	55	68	96	71	56	59	65
Properties per Deal	1	NA	NA	NA	NA	NA	NA	NA	NA	99.45	NA	NA	NA	166.37	147.4	107.65	82.03	81.93
Loans per Deal	1.0	5.0	3.0	14.7	11.2	65.2	132.9	812.4	209.6	99.2	67.5	127.6	133.3	184.2	129.0	86.2	65.9	56.5
Property Type Mix																		
% MF	0	14.28	26.92	34.42	16.07	13.04	51.65	37.09	34.58	35.44	36.51	33.17	26.82	25.84	22.1	16.69	16.85	20.73
% Office	100	42.86	30.77	3.28	32.14	19.56	4.4	3.31	4.26	13.72	15.38	15.68	20.01	20.24	22.16	31.4	35.31	35.2
% Retail	0	0	7.69	9.84	8.93	21.74	13.18	12.58	11.5	30.9	24.26	26.92	29.36	26.34	28.29	28.33	28.86	23.59
% Hotel	0	0	3.84	3.28	7.14	4.35	2.2	0	1.8	1.96	5.84	9.43	9.98	11.56	11.29	8.35	8.07	6.33
% Warehouse	0	0	0	0	1.79	4.35	1.1	0	2.5	4.46	6.7	8.81	6.61	6.47	7.76	8.27	6.06	10.51
% Other	0	42.86	30.78	49.18	33.93	36.96	27.47	47.02	45.36	13.51	11.11	5.98	7.22	9.55	7.91	6.95	4.85	3.64

Source: Commercial Mortgage Alert, deal prospectuses, and author calculations.

EXHIBIT 3

Trends in CMBS Structures 1997–2001

	1997	1998	1999	2000	2001
Prepayment Protection					
Conduit Deals Only (c. 58% of total)					
Average Lockout Time (months)					
for loans without defeasance	50.36	67.34	96.54	85.25	NA
for loans with defeasance	44.21	34.71	36.14	34.19	NA
Average Defeasance Time (months)	91.81	76.55	89.34	84.73	NA
Total Lockout plus Defeasance (months)	136.03	111.26	125.48	118.92	NA
Average Loan Maturity (months)	134.64	136.81	131.69	124.13	NA
% Subordination Below AAA	30.03	28.64	26.84	22.64	21.19
% Subordination Below BBB	12.36	11.81	11.20	9.45	9.07
All CMBS Issues					
% of Loans with Defeasance Provision	24.97	54.37	77.28	85.75	92.62
Average Length of Lockout + Defeasance (months)	63.22	88.19	102.97	100.79	104.36
% Subordination Below AAA*	NA	33.31	28.67	27.11	24.02
% of Loans With Cross-Collaterization	7.61	7.37	6.73	7.88	4.74
% Balloon Loans	66.72	62.4	78.6	74.14	77.36

Source: Commercial Mortgage Alert and prospectus for conduit deals.

**Commercial Mortgage Alert did not begin reporting average subordination level until 1998.*

subordination below the AAA level. This trend has been discussed in several trade publications, including periodic reports by Ernst & Young or Prudential Securities from 2000 through 2002. Most observers attribute the decline to a combination of factors, including the overall good performance of loans backing conduit issues, increased experience of rating agencies with the CMBS structure, and growing awareness of conduits and other originators of the rating agency criteria.

A similar trend toward lower subordination has occurred with the required subordination levels for junior tranches. The average level of subordination below BBB, for example, declined from 12.36% to 9.07% from 1997 to 2001. Because lower subordination levels mean that an issuer can sell a larger volume of securities at the lower rates required for senior tranches, lower subordination can be as beneficial to the issuer as narrower spreads. The precise trade-off depends on market conditions at the time of issuance.

There is substantial variation in the pricing of CMBS tranches, even after controlling for credit rating. The first panel of Exhibit 4 shows the mean, standard deviation, minimum, and maximum of AAA CMBS spreads for conduit issues from 1997 through 2001. The market turmoil of 1998 is reflected largely in the unusually high standard deviation of 16 basis points for that year. Nevertheless, there is substantial variation in spreads to the swap curve after holding year and rating constant. Exhibit 4 suggests that investors discriminate among the different new issues and favor some deals or structures over others.

There is also significant variation in spreads over time as shown by the shift in mean from 32 basis points in 1997 to 51 basis points in 1999. The wider spreads in the last few years do not mean, however, that the relative pricing of CMBS has changed because, as noted above, the level of subordination has declined over the same time period.

The second panel of Exhibit 4 shows the same information for BBB securities. Here the cross-sectional variation is even greater, as reflected by both the higher

EXHIBIT 4

Average Spread over Swap Curve for AAA and BBB CMBS Tranches (spreads measured in basis points)

	1997	1998	1999	2000	2001
AAA Tranches					
Mean	32.00	40.73	51.44	42.22	52.16
Stand. Dev.	6.94	15.99	8.58	4.53	5.48
Minimum	23.37	24.50	39.55	33.33	45.00
Maximum	53.00	78.39	75.47	55.00	63.00
Range	29.63	53.89	35.92	21.67	18.00
Number of Tranches	27	37	33	22	31
BBB Tranches					
Mean	69.62	133.83	152.20	122.36	141.21
Stand. Dev.	18.69	55.39	34.49	12.41	13.81
Minimum	49.16	76.00	101.05	91.00	125.00
Maximum	107.00	254.95	274.96	152.22	170.00
Range	57.84	178.95	173.91	61.22	45.00
Number of Tranches	19	30	31	23	25

Source: Commercial Mortgage Alert and Federal Reserve Bank of St. Louis.

standard deviation and the wider range of observations. Spreads for BBB securities after 1997 were much wider than for AAA securities. Nevertheless, neither the AAA nor the BBB tranche exhibits a monotonic trend over the 1999-2001 period.

II. LITERATURE ON CMBS PRICING

Most theoretical pricing models for mortgages have their roots in the option pricing methodology that began with Black and Scholes [1973] and Merton [1973]. These theoretical models view a mortgage as a combination of a riskless fixed-term debt obligation (which can be valued using the current term structure of Treasury rates) and an option that provides the borrower certain rights to terminate the debt prior to maturity through either prepayment or default.

The right to prepay is modeled as a call option on the riskless debt, and the default option is viewed as a put option on the underlying collateral. If one can value the imbedded option to terminate the mortgage before maturity, the market value of the mortgage can be calculated as the difference between the market value of the riskless debt and the market value of the joint option to prepay or default. The owner of a mortgage holds a long position in the riskless debt but is short the imbedded joint option. For a review of this literature, see Kau and Keenan [1995].

The options imbedded in mortgages are complex American options and, in general, can be valued only numerically. Complicating the option valuation is the fact that the option to terminate the mortgage before maturity is a single option providing the borrower the right to either default or prepay—but not both. As a result, one cannot simply value the call, value the put, and add the two values. Consequently, many researchers have simplified the problem by assuming away one or the other of the two components of the joint option.

In residential mortgages, where default is rare, researchers tend to focus exclusively on the prepayment option. Because commercial mortgages generally have strong prepayment protection, many early studies of commercial mortgages have assumed no prepayment. See, for example, Titman and Torous [1989].

Valuing commercial mortgage-backed securities adds another layer of complexity, because the cash flows to the various tranches depend on both the cash flows from the underlying mortgages and the structure of the CMBS. For example, if a mortgage in a pool defaults, the servicer will liquidate the collateral, typically generating cash proceeds that do not pay off the mortgage balance. The cash proceeds are allocated to the senior tranches as a prepayment and the loss is allocated to the most junior tranche.

Kau et al. [1987, 1990] were the first to explicitly model commercial mortgage-backed securities contingent on their underlying mortgages. They apply contingent claims techniques to price commercial mortgage instru-

ments subject to default and prepayment risk. Their model of commercial mortgages depends on the term structure of interest rates and the value of the underlying property. Both variables enter the model because they are likely to trigger prepayment or default of the mortgage loan.

Kau et al. provide numerical analyses of the pricing of CMBS and the effect of other loan features such as prepayment penalties. They do not discuss how the structure of a CMBS can impact the value of each tranche.

Childs, Ott, and Riddiough [1996a] use a contingent claims methodology to price multiclass commercial mortgage-backed securities. The approach involves a two-step procedure. In the first step, the optimal default boundaries for individual borrowers are determined using the traditional numerical option pricing methodology. For example, if default is triggered by a decline in property values, the first step would define the level of property value that would trigger default each month over the life of the loan. In the second step, the authors use Monte Carlo simulation to generate cash flows from the pool of mortgages, and then allocate those cash flows to each tranche in a CMBS structure based on the specified priority rules.

Unlike Kau et al. [1987, 1990], Childs, Ott, and Riddiough [1996a] assume that the commercial mortgages are locked out (i.e., cannot prepay before maturity), so the uncertainty of cash flows is attributable entirely to default. They also consider the structure of deals, and are able to value each tranche separately. They show that, in theory, pool diversification should affect the value of CMBS by adding value to the senior tranche investors while reducing the value of the first-loss tranche.[4]

The empirical research on pricing CMBS has been limited. Maxam and Fisher [2001] study the pricing of 40 AAA- and AA-rated CMBS over the 1994–1996 period. They use kernel density techniques to explain the pricing of senior tranches as a function of property price volatility, loan-to-value ratio, mortgage rate, yield curve steepness, interest rate volatility, and the amortization characteristics of the underlying loans. The results show that default-related variables such as property volatility, amortization, and loan-to-value ratio significantly influence pricing. Maxam and Fisher conclude that even though the senior tranche CMBS are immune from default loss, they are not immune from early return of principal due to default; therefore, the default risk of the underlying loans negatively affects the pricing of these tranches.

Harding and Sirmans [1997] and Jacob and Gichon [1999] model the spreads of newly issued CMBS as a function of property-, loan-, and bond-level variables. Both studies discuss the factors that theory suggests should be related to initial pricing spreads, and both analyze the 1994–1996 period. The results for AAA and AA tranches show that the quality of the mortgages and property type are significantly related to the initial pricing of these securities.[5]

Poorer loan quality or higher-risk collateral is found to be associated with wider spreads. Higher concentrations of multifamily collateral are associated with narrower spreads, while a higher concentration in either hotel or office collateral results in wider spreads for these senior tranches.[6]

For BBB tranches, Harding and Sirmans [1997] find that tranche order within the same rating category is significant. Jacob and Gichon [1999] find that quality of collateral, size of the tranche, and average life of the tranche are significant variables.

Maris and Segal [2002] study initial pricing spreads from 1992 through 1999, but their focus is more on explaining longer-term trends in average spreads than in explaining the cross-sectional variation. Maris and Segal argue that spreads should widen as the risk of default increases and that corporate bond spreads and predictors of economic growth are good proxies for default risk. Using the traditional option valuation results, they include the level and volatility of interest rates to capture the value of the prepayment option. Although they use individual tranche yield spreads as the dependent variable, they include very few deal or tranche descriptors on the right-hand side of their model because their analysis period includes the early years when very little data were available.

Maris and Segal find that yield spreads to Treasuries are positively related to the spread between AAA corporate bonds and Treasuries and the Stock and Watson [1990] recession predictor index. Even after controlling for economic factors and the limited number of deal characteristics available to them, Maris and Segal find a significant trend in spreads that narrows from 1992 to 1997, and then reverses sharply. They speculate that the initial trend toward narrower spreads was attributable to a learning process, in that market participants reduced their required risk premiums as they became more familiar with the product. The authors further speculate that the reversal might be due in part to an increase in caution resulting from the adverse events of 1998.

Riddiough [2002] studies the evolution of the CMBS market and discusses the role of rating agencies in the process of issuing CMBS. He analyzes cross-sectional and time series variation of CMBS attributes during 1994–1996 using 119 AAA-rated security tranches. He finds that pool characteristics and market effects (e.g., REIT returns)

explain 83% of the variation in subordination level. For the security yield spread estimation, he finds that the coefficients on loan-to-value ratio, debt service coverage ratio, pool diversification, and property type mix are not significant. He concludes that rating agencies adjust subordination levels in a satisfactory manner to investors.

III. DATA AND EMPIRICAL MODEL

We built the data base used to examine the initial pricing of CMBS tranches from various sources. We purchased the Commercial Mortgage Alert (CA) data covering all CMBS issues since 1985. The CA data provide basic information describing the issue including deal size, number and size of tranches sold to the public, coupon rates and life for each tranche, and credit ratings for each tranche. The data include summary statistics for the underlying collateral pool such as number of loans in the pool, average loan-to-value (LTV) ratio, average debt service coverage ratio (DSCR) for the pool, and the property type distribution. The data also include a description of the property type distribution.

The initial pricing information for most publicly traded tranches generally consists of specifying a benchmark for pricing (e.g., the ten-year Treasury or the ten-year swap rate) and a spread over the benchmark. For example, a particular tranche might be reported as having been sold to provide a 50 basis point spread over the five-year swap rate.

We augment these data by obtaining the prospectuses for all conduit deals brought to market between 1997 and 2001. We focus on conduit transactions because they are the largest sector of the CMBS market.[7]

Non-conduit transactions are frequently unique deals that are highly dependent on a small number of properties or a single lender. Their pricing is not expected to be homogeneous across different transactions.

From the prospectus, we obtain detailed information about the loan pool and a description of the type of prepayment protection incorporated into the underlying loans. We could get length of the lockout and defeasance periods, average loan age, and information on the use of cross-collateralization and minimum and maximum LTV and DSCR.

We select all deals characterized by Commercial Mortgage Alert as conduit deals issued between 1997 and 2001, to include a total of 167 conduit deals. When we eliminate deals with incomplete information or for which we could not obtain a prospectus, we have a sample comprising 135 deals and 930 public tranches.

We obtain information on market conditions at the time of pricing from Bloomberg and the web site of the Federal Reserve Bank of St. Louis. We use Bloomberg data for the swap curve and the St. Louis Federal Reserve Bank data for Treasury rates. In addition, we obtain a leading indicator of economic conditions from the Stock-Watson web site.[8]

Before bringing a deal to market, an issuer must obtain credit ratings from two of the three major rating agencies. To obtain these ratings, the issuer must provide detailed information to the rating agency about the proposed deal and the pool of loans to be used as collateral. Ratings provide investors with a consistent indicator of the likelihood that the cash flow from the underlying mortgages will be sufficient to meet the promised payments of principal and interest on the certificate.

While the rating agencies do not quantify the probability of default associated with each rating class, history shows that fewer than 1% of all bonds with original ratings of AAA default during the first ten years.[9] For mortgage-backed securities, the cash flows from the underlying mortgages are subjected to stress tests, and the cash flows for higher-rated tranches are expected to withstand increasingly severe economic conditions as reflected by both default rates on individual loans and the severity of loss. In order to accomplish this, progressively greater credit support is needed at higher rating levels.

The analysis of the rating agencies is extensive. We see this in "CMBS: Moody's Approach to Rating U.S. Conduit Transactions" [2000]. The agencies typically begin with the reported cash flow from the underlying property. They verify reported numbers and make adjustments to leases, vacancy rates, and operating expenses according to their own analysis. Using these adjusted cash flows, they make their own estimates of both LTV and DSCR.

The agencies also look at other characteristics of the pool including measures of diversification. Less subordination is required for pools that are well diversified in all dimensions: geographically, by property type, and by loan size. Additional subordination is required for pools with large dollar concentrations in a small number of loans. Rating agencies also take into consideration the quality and track record of the originator, the servicer, and the master servicer.[10]

After an initial review, the rating agency provides the issuer a schedule of the subordination levels required to achieve the various rating levels. For example, a 25% AAA subordination level means that for a $100 million pool, an issuer could sell $75 million AAA securities and a total of $25 million of securities with claims subordinate to those

of the AAA security holders. Normally, the $25 million of subordinated securities will be allocated to several different rating categories ranging from AA to unrated. Different levels of subordination are set for each rating category to limit the risk of default on the rated tranche to a level comparable to that of similarly rated securities of other types such as corporate or municipal bonds.[11]

The determination of a subordination level is not an exogenous event independent of the current prices in the market. After the initial subordination levels are reported by the rating agency, the issuer can respond by making modifications to the pool of loans or the structure to achieve better overall execution.

For example, if AAA securities are expected to sell at a 90 basis point lower yield than BBB securities, a 1% reduction in the AAA subordination level (on a billion dollar issue) means the issuer can sell $10 million more lower-cost AAA securities and $10 million less of higher-cost junior securities. Using the BBB rate as a proxy for the average cost of junior securities, a 1% reduction in the AAA subordination level saves the issuer $90,000 per year of interest expense on a $1 billion deal.[12] This savings is roughly equal to the savings from a 1.2 basis point reduction in the spread for the AAA tranche.[13]

The issuer's objective is to obtain the best overall execution from the sale of securities. The issuer does not care whether that best execution entails selling a smaller amount of AAA securities at a narrow spread or a larger amount at a somewhat wider spread. Thus, depending on market conditions, the issuer might eliminate certain loans deemed risky by the rating agency in order to achieve a lower level of subordination. These changes would likely reduce the average LTV and increase the average DSCR of the pool, but the lower risk associated with a higher-quality pool would be offset by higher risk from a lower level of subordination. Thus, it is clear that subordination and pricing are jointly determined.

Because subordination and pricing are jointly determined, we estimate a two-equation system:

$$\textit{Subordination \%} = f(\textit{loan quality, diversification, spread, other factors}) \quad (1)$$

$$\textit{Spread} = f(\textit{loan quality, diversification, subordination, prepayment protection, other factors}) \quad (2)$$

To estimate this system empirically we must identify each individual equation. That is, we must find some variables that influence subordination and not pricing and vice versa.

Rating agency criteria are described in various publications; see, for example, "CMBS: Moody's Approach" [2000], "Rating Performing Loan Pools" [2001], and Wheeler [2001]. Moody's and Fitch use a diversification measure known as a Herfindahl index to measure market share concentration. In an industry with a fixed number of participants, the Herfindahl index is calculated by squaring each firm's market share and adding all the squared shares. Highly concentrated markets will have a high index number, while less concentrated markets have lower index values. The rating agencies calculate an analogous index using the share of the pool represented by each individual loan. While investors consider diversification, it is unlikely they use this particular measure, because this detailed information is generally difficult to obtain during the initial pricing period.

Similarly, according to Quigg [1993], rating agencies consider the age of the loans in the pool as an indicator of loan quality. Like the Herfindahl index, this measure requires detailed analysis of the schedule of individual loans, and we find little in the CMBS pricing literature to suggest that investors give it significant weight. We therefore use these two variables to identify the subordination equation.

Identifying the pricing (spread) equation is easier, as we believe investors are influenced by market conditions at the pricing date (such as the level of yields and yield curve shape), but this information is not mentioned in any of the rating methodology literature. The rating agencies focus on the longer-term performance of the loans and primarily on default risk. Consequently, lockout provisions and prepayment penalties are much more significant in pricing than in determining subordination. Therefore, we use variables describing current economic conditions on the pricing date and variables describing the prepayment protection to identify the spread equation.

Exhibit 5 provides a complete list of the variables in each model and the hypothesized sign for the estimated coefficients. Exhibit 6 provides summary statistics for all variables.

Loan Quality

The primary measures of pool loan quality are the traditional underwriting variables: loan-to-value ratio and debt service coverage ratio. We expect that poorer-quality pools will require higher levels of subordination. The fur-

ther impact of these variables on pricing spreads is likely to vary with the tranche rating. While AAA investors may believe that the possibility of a direct loss of principal is remote, they may still demand higher spreads for lower-quality pools because of the cash flow effects of defaults. Investors in lower-rated tranches may have more concern that a high level of default could result in a lower credit rating, resulting in a decline in the market value of their tranche. We include the average LTV ratio and average DSCR in both the spread and subordination models.

We include an indicator of the presence in the loan pool of any loans with LTV > 1 and an indicator of the presence of any loan with a DSCR < 1. On an individual loan basis, these loans would not be considered investment-grade, but it is not uncommon to find such loans included in a pool of loans backing a CMBS. For example, 19% of all conduit pools in our study included at least one loan that exceeded one of these limits.[14] We include an indicator flagging deals with more than 20% of the loans subject to some form of cross-collateralization agreement.[15]

We also include the level of subordination as a measure of the unobserved loan quality. The effect of subordination in the spread model could be positive or negative, depending on whether the direct effect of increased subordination on the likelihood of default is greater than the signaling effect for poor loan quality.

Diversification

We use five variables related to diversification in each model. In the spread model, we include an indicator of geographic concentration. The indicator takes on a value of 1 when more than 20% of the collateral value is located in a single state.

A second indicator identifies what the market calls a fusion deal, or a deal that includes a small number of unusually large loans. We use the Commercial Mortgage Alert classification as our basis for the indicator.

We also include number of loans and the ratio of properties to loans in the deal. Unless all properties are perfectly correlated, more loans should reduce the variation in cash flows arising from prepayment and default. As Exhibit 2 shows, there has been a trend toward including loans backed by multiple properties. In theory, these loans should have a lower probability of default and a lower loss severity than a loan secured by a single property because the borrower would face foreclosure on all properties should it default on the loan. Loans backed by multiple properties have a degree of diversification built into the individual loan.

We include these four variables in both models. In the spread model, we include a measure analogous to a Herfindahl index calculated using the shares represented by each major property type as a percentage of the total pool. A high index value is associated with a heavy concentration in a few property types.[16] In the subordination model, we include a Herfindahl index where the shares are the percentages of the total pool represented by each individual loan.

Prepayment Protection

We measure prepayment protection using the ratio of the weighted average lockout plus defeasance period to the life of the tranche and an indicator that more than 10% of the pool of loans has no lockout protection. Even if a pool has good prepayment protection, on average, the cash flows to the senior tranches could be significantly altered by prepayments from a small percentage of the pool that has no lockout provision.

Market Indicators

We include several different measures of current market conditions in the spread model. Because the level of interest rates and the volatility of interest rates affect the value of the option to prepay, we include the ten-year Treasury rate on the pricing date and the volatility of the ten-year rate over the preceding year.[17]

We also include the slope of the yield curve as measured by the difference between the ten-year Treasury and the one-year Treasury. If the expectations hypothesis holds, the slope of the yield curve reflects investor expectations about the future course of interest rates. We include the spread between AAA corporate bonds and BBB corporate bonds as a proxy for the market's attitude toward default risk.

Finally, we include the Stock and Watson [1998] experimental recession index, a monthly estimate of the probability of a decline in gross domestic product over the next six months. We expect that CMBS spreads should widen when the probability of a recession increases.[18]

None of the market indicators is included in the subordination models.

Property Mix Variables

We include variables measuring the percentage of the loan pool (measured by dollars) that is backed by multifamily

EXHIBIT 5
Variable Definitions and Expected Effects

Variable	Definition	Predicted and Actual Effects (AAA Model Only) Subordination		Spread	
Measures of Loan Quality		Predicted	Actual	Predicted	Actual
Loan to Value Ratio (LTV)	Average LTV for pool	+	+***	+	+***
Debt Service Coverage Ratio (DSCR)	Average DSCR for pool	-	-***	-	
LTV Indicator > 1	Indicator of presence of loan with LTV > 1 in pool	+	-*	+	
DSCR indicator < 1	Indicator of presence of loan with DSCR < 1 in pool	+	+**	+	+***
Measures of Diversification					
Geog. Conc. Indicator	Indicator that more than 20% of prop. in one state	+	+***	+	+***
Fusion Deal Indicator	Indicator of fusion deal	+	+***	+	+*
Number of Loans	Total number of loans in the pool	-	-***	-	
Property to Loan Ratio	Ratio of properties to loans	-	-***	?	
Property Type Herf Index	Sum of property type shares squared			+	
Loan Size Herf. Index	Sum of loan shares squared	+			
Measures of Prepayment Protection					
Lockout & Defeas/Tranche Life	Ratio: length of lockout & defeasance to tranche life			-	-**
No Lockout Indicator	Indicator that more than 10% of loans in pool have no lockout/defeasance provision			+	-**
Market Indicators					
10-Year Treasury	10-year Treasury at pricing date			-	-***
Rate Volatility	Volatility of 1-year Treasury over the preceding year			+	+***
Yield Curve Slope	10-year Treasury-1-year Treasury on pricing day			+	
AAA-BBB Spread	Spread between AAA corp. and BBB corp.			+	+*
Stock-Watson Recession Index	Predicted prob. of recession in next six months			+	+***
Property Mix Variables					
Multifamily % of Pool	% of pool backed by multifamily properties	0	+***		
Office % of Pool	% of pool backed by office buildings	+	+***		
Retail % of Pool	% of pool backed by retail properties	0			
Hotel % of Pool	% of pool backed by hotels	+	+***		
Industrial/Warehouse % of Pool	% of pool backed by warehouse/industrial properties	0			
Indicator Multifamily > 35%	Ind. that multifamily loans represent > 35% of pool			-	-*
Indicator Office > 35%	Ind. that office loans represent > 35% of pool			+	
Indicator Retail > 35%	Ind. that retail loans represent > 35% of pool			?	
Bond and Deal Variables					
Deal Size	Dollar amount of all securities sold in the deal (000)			?	
Tranche Size	Dollar size of the particular tranche (000)			?	-**
Tranche Life	Average life of tranche at 0% prepay (months)			+	+***
Other Variables					
Cross-Collat. Indicator	Ind. that> 20% of loans have cross-collateralization	?	+***		
Average Loan Seasoning	Average age of loans in the pool	+			

Source: Commercial Mortgage Alert.

, **, and * Significant at the 10% level, 5% level, and 1% level.*

properties, office buildings, retail stores, or hotels in the subordination model. In the spread model, we include only indicator variables flagging deals with an unusually high concentration in any one property type. Specifically, we set the indicator for a property type to a value of one if more than 35% of the mortgage pool is loans backed by that property type. Only multifamily properties, office properties, and retail properties exceed this limit in our sample.

Bond Descriptors

For each tranche, we include the natural log of the tranche size and the natural log of the deal size. The size of a security issue can have conflicting effects. Increased size translates into added liquidity in the secondary market, and liquidity is a positive for investors. Then again, simple supply and demand considerations can also come into play. As the total value of securities sold increases, the issuer may have to reduce the price to sell the entire inventory.

We also include the average life of the tranche as reported by Commercial Mortgage Alert. The average lives are calculated assuming no prepayment and no default on the underlying loans but do take into account the scheduled amortization and the priority of a particular tranche in the overall deal structure.

Other Factors

For tranches with ratings below AAA, we include a dummy variable for whether the tranche is a plus or a

minus rated security (e.g., BBB+ or BBB– for Standard & Poor's or Baa1/Baa3 for Moody's).

Both models include quarterly dummy variables indicating the time of issuance. The coefficients on these variables provide an estimate of the trend in pricing and subordination level that is not explained by the independent variables in the model.

IV. RESULTS

We estimate Equations (1) and (2) using three-stage least squares for all tranches sorted into the major rating groupings: AAA, AA, A, and BBB. We limit our discussion to the AAA and BBB tranches, because they capture the two extremes of the quality spectrum and represent the largest sample sizes.[19]

AAA Tranches

Exhibit 7 presents the results for the AAA tranches. The first two columns report the estimated coefficient and the t-statistic for the subordination model; the last two columns report the same items for the spread model. All spreads are measured relative to the swap curve on the day of pricing.

The model explains a substantial portion of the overall variability in each dependent variable: 92% for the subordination model and 81% for the spread model. The unexplained pricing spread is approximately +/– 6 basis points.

Because the various measures of loan quality, diversification, prepayment protection, and market indicators tend to be correlated, for each model we test the joint hypothesis that the coefficients of all variables in the group are equal to zero. In the subordination equation, loan quality, diversification, and property type all significantly influence the level of subordination required to achieve an AAA rating. Within the loan quality group, high average LTV, low average DSCR, and the presence of loans with very low DSCR are all statistically significant individually and raise the required level of subordination.

The five variables that measure diversification are also jointly significant. Fusion deals and deals with a heavy concentration in one state require approximately 1.0%-1.5% additional subordination below the AAA securities. Deals with a large number of loans and deals with a high ratio of properties to loans require less subordination.

The four variables measuring property type are jointly significant. The individual coefficients suggest that pools with greater concentrations in hotel loans require significantly more subordination. Concentrations in office and multifamily loans require more subordination than that associated with the excluded group of industrial/warehouse loans.

Among the other variables, only the indicator of a substantial use of cross-collateralization is significant in the subordination model. A heavy use of cross-collateralization signals a significant concentration of loans to single borrowers and, as a result, the coefficient is positive.

The coefficients on the quarterly time indicators (not tabulated) show a significant trend toward lower levels of subordination over time. The difference between the first quarter of 1997 and the average quarter in 2001 is approximately 9 percentage points, all things equal.

In the AAA spread model, the joint tests of significance for the variables measuring loan quality, diversification, prepayment protection, market conditions, and property type show that these factors are all priced by investors. Within these groupings, pools with high average LTV and pools with low DSCR are priced at wider spreads. For AAA investors, this does not necessarily mean that investors do not believe the rating agencies have appropriately compensated with subordination. The risk of default increases the risk of early return of principal for AAA investors, and the pricing reaction is most likely a response to uncertainty about the timing of cash flows, not the ultimate return of principal.[20] Deals with high geographic concentration and fusion deals are priced at wider spreads. As with loan quality, AAA investors are concerned that if a particular region's economy turns down or a very large loan defaults, there could be a significant unscheduled return of principal.

Tranches with good prepayment protection, as measured by the ratio of the lockout/defeasance period to the tranche life are priced at narrower spreads. Among the market factors, spreads are narrower at higher levels of interest rates. The shape of the yield curve and the credit quality spread also influence pricing spreads in the expected direction.

Other variables that are significant in the spread model include the average life of the tranche. Most CMBS securities include more than one AAA tranche. Generally, the AAA tranches are divided into a short average life tranche and a longer average life tranche by giving one security priority claim to all principal repayments. Roughly speaking, the shorter securities have an average life of about five years while the longer AAA tranches are ten-year securities. The coefficient here shows that on average, the ten-year tranche is priced roughly 10 basis points higher than the five-year tranche.

The natural logarithm of the tranche size also enters

EXHIBIT 6
Summary Statistics

	AAA		BBB	
	Mean	**Stand. Dev.**	**Mean**	**Stand. Dev.**
Dependent Variables				
Number of Observations (tranches)	317		264	
Number of Deals	133		126	
Spread to Swap Curve	35.17	14.12	126.83	41.75
% Subordination	25.65%	4.11%	11.56%	2.25%
Measures of Loan Quality				
Loan to Value Ratio (LTV)	68.96%	3.28%	68.87%	3.27%
Debt Service Coverage Ratio (DSCR)	1.43	0.11	1.44	0.11
LTV Indicator > 1	6.77%	--	7.14%	--
DSCR Indicator < 1	15.04%	--	15.08%	--
Measures of Diversification				
Geog. Conc. Indicator	45.11%	--	47.62%	--
Fusion Deal Indicator	23.31%	--	23.81%	--
Number of Loans	198.6	95.3	199.3	96.5
Property to Loan Ratio	1.12	0.16	1.12	0.14
Property Type Herf. Index	0.2354	0.0423	0.2332	0.0420
Loan Size Herf. Index	0.0166	0.0084	0.0167	0.0085
Measures of Prepayment Protection				
Lockout & Defeas/Tranche Life	1.63	0.70	0.75	0.22
No Lockout Indicator	8.27%	--	8.73%	--
Property Mix Variables				
Multifamily % of Pool	26.04%	8.97%	25.91%	8.78%
Office % of Pool	21.65%	9.57%	21.70%	9.29%
Retail % of Pool	27.95%	7.23%	27.72%	7.20%
Hotel % of Pool	8.17%	4.51%	8.32%	4.54%
Industrial/Warehouse % of Pool	9.20%	5.64%	9.27%	5.65%
Indicator Multifamily > 35%	12.78%	--	12.70%	--
Indicator Office > 35%	6.77%	--	6.35%	--
Indicator Retail > 35%	18.05%	--	16.67%	--
Market Indicators				
10-Year Treasury (%)	5.54	0.59	5.55	0.59
Rate Volatility (%)	0.64	0.75	0.60	0.74
Yield Curve Slope (%)	0.36	0.09	0.36	0.09
AAA-BBB Spread (%)	0.77	0.17	0.77	0.16
Stock-Watson Recession Index	0.0812	0.0476	0.0798	0.0498
Bond and Deal Variables				
Deal Size ($ mil)	1,101	496	1105	508
Tranche Size ($ mil.)	333	258	30	28
Tranche Life (yrs.)	7.42	2.31	10.68	1.56
Other Variables				
Cross-Collat. Indicator	25.56%	--	23.02%	--
Loan Seasoning (months)	4.8	2.4	4.8	2.4
Indicator: BBB+			10.23%	--
Indicator: BBB–			42.42%	--

Source: Commercial Mortgage Alert.

the equation with a significant negative coefficient. Consistent with the liquidity argument, larger issues are priced tighter to the swap curve. The coefficients on the quarterly indicators show that AAA spreads fluctuated over the period. Spreads were tighter than average from early 1997 through the third quarter of 1998. During 1999 and 2000, most of the coefficients are not significantly different from zero. In 2001, spreads narrowed again to levels tighter than average.

To our knowledge, this is the first time one single study has found empirical evidence that loan quality, pool diversification, and prepayment protection all influence the pricing of senior CMBS tranches. A simple ordinary least squares model of spread using the actual subordination level

EXHIBIT 7

Three-Stage Least Squares Regression Results for AAA Tranches

	Subordination Model		Spread Model	
	coef.	t-stat	coef.	t-stat
Endogenous Variables				
Spread to Swap Curve	-0.0002	-2.02	--	
% Subordination	--		-129.9994	-2.53
Measures of Loan Quality				
Loan to Value Ratio (LTV)	0.5616	13.19	102.5211	2.99
Debt Service Coverage Ratio (DSCR)	-0.0341	-3.04	-7.8552	-1.39
LTV Indicator > 1	-0.0054	-1.73	-0.7661	-0.48
DSCR Indicator < 1	0.0056	2.21	3.3593	2.62
Measures of Diversification				
Geog. Conc. Indicator	0.0119	6.80	2.9258	3.21
Fusion Deal Indicator	0.0167	5.72	2.3182	1.88
Number of Loans (/100)	-0.0032	-2.67	-0.1427	-0.19
Property to Loan Ratio	-0.0173	-3.03	4.0426	1.39
Property Type Herf. Index	--		14.3939	1.09
Loan Size Herf. Index	-0.1746	-1.22	--	
Measures of Prepayment Protection				
Lockout & Defeas/Tranche Life	--		-2.2861	-2.22
No Lockout Indicator	--		-3.8616	-2.53
Market Indicators				
10-Year Treasury	--		-15.8071	-6.97
Rate Volatility	--		11.1370	3.6
Yield Curve Slope	--		0.4425	0.04
AAA-BBB Spread	--		7.8531	1.7
Stock-Watson Recession Index	--		37.0573	3.43
Property Mix Variables				
Multifamily % of Pool	0.0638	4.91	--	
Office % of Pool	0.0406	3.07	--	
Retail % of Pool	0.0020	0.16	--	
Hotel % of Pool	0.1381	6.78	--	
Industrial/Warehouse % of Pool	--			
Indicator Multifamily > 35%	--		-2.2082	-1.68
Indicator Office > 35%	--		-2.1140	-1.25
Indicator Retail > 35%	--		-1.3117	-1.12
Bond and Deal Variables				
Deal Size	--		-0.8901	-0.48
Tranche Size	--		-1.1616	-2.24
Tranche Life	--		1.9797	8.13
Other Variables				
Cross-Collat. Indicator	0.0053	2.75	--	
Average Loan Seasoning	0.0004	1.19	--	
Number of Observations	317		317	
R^2	0.9172		0.8077	
RMSE	0.0121		5.8271	
χ^2 Statistic	3548.27		1482.54	
p-value	0.0000		0.0000	

Source: Commercial Mortgage Alert.

as an independent variable (as in Harding and Sirmans [1997] and Jacob and Gichon [1999]) does not capture the effect of loan quality. This suggests that our findings related to loan quality are attributable to estimation of a system of simultaneous equations rather than a simple OLS model, and confirms our belief that pricing and subordination are jointly determined. Our methodology explicitly allows for the endogeneity of the level of subordination and the fact that loan quality influences the subordination level and the pricing in somewhat different ways.

A simple OLS model using our data shows a significant effect of the level of prepayment protection. We believe our ability to measure this effect is attributable to the detailed information obtained from the prospectuses and the fact that the average level of protection changed substantially over the sample period, providing more variability in the data we use to estimate the effect.

BBB Tranches

Exhibit 8 provides the results for BBB tranches. The independent variable in the subordination model is the level of subordination below BBB. The average level of subordination for BBB securities is 10.7% (versus 25.7% for AAA tranches), and the standard deviation is half that of the AAA subordination level (2% versus 4%).

For the pricing spread, the average BBB spread is 127 basis points (more than three times the 35 basis point average for AAA), and the standard deviation is 42 basis points (versus 14 basis points for AAA). The estimated model in Exhibit 8 explains 84% of the variation in subordination and 87% of the pricing variation.

As in the AAA model, the joint tests of significance for variables measuring loan quality, diversification, and property type show that these factors significantly influence the required level of subordination. Within the loan quality group, only the coefficient on LTV is significant individually, and its sign is consistent with the expectation that riskier pools require more subordination.

Vandell [1992] and Ciochetti and Vandell [1999]) have shown that LTV and DSCR are the most significant indicators of default risk for commercial mortgages. Wheeler [2001] argues that DSCR is a better indicator of the probability of default, while LTV is a better indicator of the loss in the event of default. A rating agency focus on LTV is consistent with this view, because BBB investors need to be concerned only with the actual losses and not the number of defaults.

Deals that are less well diversified, such as deals with geographic concentration and fusion deals require more subordination. Deals with more loans require less subordination. The Herfindahl index for loan size concentration is significant in the subordination model and has a negative sign. This index is highly correlated with the number of loans (which has a negative sign in the model), which probably explains the anomalous sign on the index itself.

Concentration in either office buildings or hotels is penalized in terms of subordination as are deals with seasoned collateral. For conduit loans, a higher loan age is most likely an indicator that a loan was eliminated from an earlier deal as representing too great a risk, and thus a high average loan age signals greater risk. As expected, more subordination is required for a BBB+ rating and less for a BBB– rating.[21]

The coefficients on the quarterly dummy variables are consistent with a trend toward lower subordination levels for BBB tranches as well. In this case, the extent of the decline is less—about 4 percentage points between 1997 and 2001.

In the BBB spread model, the variables measuring loan quality, diversification, and market conditions are jointly significant. The variables describing prepayment protection and exposure to particular property types are not. A lack of significance for variables measuring prepayment protection is to be expected because prepayments will disrupt the cash flow to the BBB only after all the AAA, AA, and A tranches have been paid off.

On an individual variable basis, the only variable in the loan quality group that is significant is DSCR. A joint test of the assumption that the coefficients of all four variables (LTV, DSCR, LTV indicator, and DSCR indicator) are equal to zero is rejected at the 1% level of significance.

The indicator of geographic concentration is individually significant at the 1% level, and the ratio of properties to loans is significant at the 5% level. The level of the ten-year Treasury enters the equation with a significant negative coefficient, and interest rate volatility enters with a significant positive coefficient. The sign of the coefficient on the level of rates is negative (as it is in the AAA model), consistent with a narrowing of all spreads as rates increase. The positive coefficient on the volatility measure is consistent with option pricing literature that shows that the prepayment option value increases with rate volatility.

The coefficients on the quarterly time dummies are generally not significantly different from zero, suggesting no significant trend in pricing spreads for BBB tranches. Their signs show a similar pattern to that in the AAA

EXHIBIT 8

Three-Stage Least Squares Regression Results for BBB Tranches

	Subordination Model		Spread Model	
	coef.	t-stat	coef.	t-stat
Endogenous Variables				
Spread to Swap Curve	-0.0341	0.01	--	
% Subordination	--		-325.0979	0.94
Measures of Loan Quality				
Loan to Value Ratio (LTV)	0.3966	11.09	119.3546	0.83
Debt Service Coverage Ratio (DSCR)	0.0077	0.75	-78.7045	-3.43
LTV Indicator > 1	-0.0003	-0.12	-3.1712	-0.54
DSCR indicator < 1	0.0022	1.07	6.7540	1.38
Measures of Diversification				
Geog. Conc. Indicator	0.0049	3.29	12.3299	3.41
Fusion Deal Indicator	0.0078	3.32	2.7655	0.63
Number of Loans (100)	-0.0031	-3.07	3.2806	1.09
Property to Loan Ratio	-0.0002	-0.03	48.1772	3.53
Property Type Herf. Index			23.0506	0.4
Loan Size Herf. Index	-0.5837	-4.8	--	
Measures of Prepayment Protection				
Lockout & Defeas./Tranche Life	--		-10.3577	-0.8
No Lockout Indicator	--		-14.4562	-1.91
Market Indicators				
10-year Treasury	--		-29.7334	-2.81
Rate Volatility	--		3.4770	0.22
Yield Curve Slope	--		102.8987	1.67
AAA-BBB Spread	--		28.8260	1.36
Stock-Watson Recession Index	--		26.5360	0.58
Property Mix Variables				
Multifamily % of Pool	0.0141	1.24	--	
Office % of Pool	0.0346	3.01	--	
Retail % of Pool	0.0081	0.77	--	
Hotel % of Pool	0.0860	5.11	--	
Industrial/Warehouse % of Pool	--			
Indicator Multifamily > 35%	--		-0.1794	-0.03
Indicator Office > 35%	--		-6.2242	-0.86
Indicator Retail > 35%	--		-2.4016	-0.51
Bond & Deal Variables				
Deal Size	--		-0.3788	-0.04
Tranche Size	--		-7.6774	-1.72
Tranche Life	--		2.3335	-1.99
Other Variables				
Cross Collat. Indicator	-0.0011	-0.66	--	
Average Loan Seasoning	0.0009	2.98	--	
Indicator: BBB+	0.0143	6.97	-4.1161	-0.57
Indicator: BBB-	-0.0163	-4.11	42.9388	6.22
Number of Observations	264		264	
R^2	0.8421		0.8714	
RMSE	0.0087		20.59	
χ^2 Statistic	1409.05		1814.51	
p-value	0.0000		0.0000	

Source: Commercial Mortgage Alert.

model—negative in 1997 and the first half of 1998, positive in 1999 and 2000, and negative again in 2001.

V. CONCLUSION

Our review of the evolution of the more mature CMBS market indicates, first, that the investor base is more diversified. More than 20% of all new issues in 2001 and 2002 were non-domestic issues.

Second, CMBS structures have evolved. The pools of loans backing modern CMBS are better diversified both geographically and by property type. The size of new deals has stabilized, and the complexity of new issues, as measured by the number of different tranches, has leveled off at roughly 10 to 12 tranches per deal.

Finally, most new CMBS provide investors better prepayment protection and provide borrowers greater flexibility in managing their properties through the use of defeasance provisions.

We find investors discriminate within rating categories. Some AAA bonds are priced better than others. We also find that the observed pricing differences are consistent with theoretical predictions. AAA investors are willing to pay a premium for the added cash flow certainty associated with higher-quality loans and better diversified pools. AAA investors are also willing to pay for better prepayment protection as measured by longer lockout/defeasance periods and more comprehensive lockout provisions.

BBB investors require higher spreads for poorly diversified pools or pools with lower-quality underwriting standards. As would be expected, they are not willing to pay a premium for prepayment protection.

Both AAA and BBB spreads are influenced by current market conditions—primarily the level and volatility of interest rates. The average life and size of the tranche also influence spreads for both types of securities.

The results reported here should be of interest to all parties involved in the CMBS market. While credit ratings are very important, one AAA tranche can be priced very differently from another. The variations in pricing, moreover, are predictable according to the nature of the underlying mortgage loan pool. Issuers and investors can use the descriptive data in the prospectus to predict initial pricing.

Our research improves upon earlier work by combining better data with a model that accounts for the endogeneity of pricing and subordination. It would be interesting to see whether initial pricing differences persist in the secondary market and how the changing quality of the pool over time is reflected in secondary market spreads.

ENDNOTES

[1]Both Harding and Sirmans [1997] and Jacob and Gichon [1999] use the level of subordination as a proxy for loan quality on the premise that rating agencies would require higher levels of subordination for pools with poorer loan quality.

[2]See Quan and Torous [2001] for a more detailed study of the costs and benefits of defeasance.

[3]Although the penalties for some loans required a payment sufficient to make the investor whole (e.g., full yield maintenance), the penalties on other loans were a fixed number of points, and frequently declined with seasoning.

[4]In most CMBS transactions, the first-loss tranche is privately placed. Because our data are limited to publicly distributed securities, we do not include first-loss tranches.

[5]Both studies use the required level of subordination as a proxy for loan quality in addition to the standard measures of average loan-to-value ratio and average debt service coverage ratio. The rationale for using the level of subordination is that if the rating agency analysis shows greater risk from any source (poor location, high level of competition in the area, poor operator track record), a higher level of subordination will be required.

[6]In general, commercial property investors view multifamily properties as lower risk because they have shown less sensitivity to the overall business cycle. Office buildings and hotels are viewed as more procyclical and consequently as entailing greater systematic risk.

[7]We use the Commercial Mortgage Alert designation of a conduit transaction. Conduits may include fusion deals with a small number of loans that are larger than average within a large pool. According to Commercial Mortgage Alert, conduit deals accounted for an average of 58% of total CMBS issues between 1997 and 2001.

[8]The web site addresses are: www.stls.frb.org, and http://ksghome.harvard.edu/~JStock.Academic.ksg/xri/rpress4.htm.

[9]See "Corporate Defaults Peak in 2002" (S&P [2003]) and "Default and Recovery Rates" (Moody's [2003]).

[10]The master servicer administers the pool of mortgages on behalf of and for the benefit of the security holders. Although duties can vary, normal responsibilities include collection of payments, preparing reports on mortgage performance, advancing payments to the trustee for any loans that are delinquent, and transferring non-performing loans to a special servicer. The special servicer assumes administrative responsibilities when a loan goes into default and conducts the workout or foreclosure process. The responsibilities of both sevicers are specified in a formal servicing agreement.

[11]Most CMBS include more than one AAA tranche. Within the AAA rating, there will normally be some securities with first claim to principal repayments, creating tranches with

different weighted average lives.

[12]Because rating agency standards are well known, the issuer may anticipate the rating agency's response to a given pool of mortgages and adjust the pool before initial submission to the rating agency. This scenario does not change the conclusion that pricing and subordination are jointly determined.

In general, the issuer will sell claims to all future net interest cash flow (i.e., any excess interest income over the interest expense associated with all the tranches) over time in the form of an interest-only (IO) strip. The sale of IO securities converts a claim to future cash flows into current cash proceeds.

[13]Using a subordination level of 25%, a 1.2 basis point savings in AAA yield would save the issuer $90,000 per year on a total AAA issue of $750 million.

[14]7% of our pools include a loan with LTV ratio higher than 1.0, and 14% of the pools include a loan with DSCR lower than 1.0.

[15]In general, cross-collateralization can take two forms: cross-default and cross-collateralization. With a cross-default provision, a default on one loan in a designated group is deemed to be a default on all loans in the group. In the second case, the excess cash flow (over that required to pay debt service) from properties collateralizing performing loans in a group can be used to make up a cash shortfall on a non-performing loan. Childs, Ott, and Riddiough [1996b] explain that recourse and cross-default clauses in commercial mortgage contracts should reduce default risk by lengthening expected time to default and increasing expected loss recoveries. They find that the benefit of the cross-default provision is enhanced when the underlying properties of crossed loans are not correlated, and the benefit is reduced when the properties are located in the same region.

[16]For example, if all five property types were equally represented in the pool, the index would equal 5 $(0.2)^2$. If the pool comprised only multifamily loans, the index would equal 1.0.

[17]The volatility is measured as the standard deviation of the previous 12 monthly rates.

[18]The Stock-Watson experimental recession index is constructed using data on building permits, unfilled durable goods orders, exchange rates, help wanted advertising, average hours worked, delivery time, and capacity utilization.

[19]Results for the AA and A tranches are available from the authors upon request.

[20]Supporting this argument is the fact that loan quality is not significant in the AA and A spread equations. AA and A tranche investors are protected from default risk from below and from early returns of principal by the AAA tranche, so loan quality is not a major concern for these investors.

[21]In much of the mortgage literature, a seasoned loan is a loan that is several years old and has performed as promised over that period. Empirically, such loans are less prone to default in the future. In our sample, the average loan age is 5 months, and the oldest loan is 15 months.

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