CMBS Mortgage Pool Diversification and Yields:
An Empirical Note

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I. Background

As recently as 1985, all of the issues in the nascent Commercial Mortgage-Backed Securities, or CMBS, market were backed by mortgages on a single property type. In 1992, the multifamily category of nonagency CMBS was the most common, with 33 percent of all issues so classified. In that same year, only 21 percent of CMBS were classified as "mixed." By 1995, 69 percent of the nonagency CMBS issues were backed by a mixed pool of mortgages. (Fabozzi and Jacob, 1997.)1 As shown in Figure 1, the decline in the percentage of CMBS backed by mortgages on a single type of property continued until 1998, with a slight reversal in the years since then.2

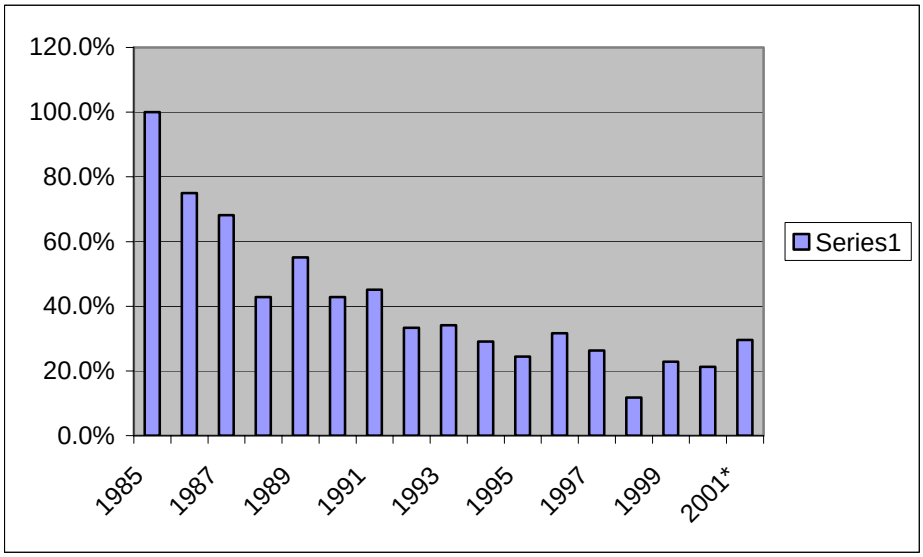

Figure 1. Percentage of CMBS backed by single property type, by year. *Through 6/30/01.

Issuers might change the composition of CMBS mortgage pools to accommodate investor preferences. There is no obvious reason for investors to prefer CMBS issues supported by a diversified pool of mortgages. Because of imperfect correlation between property values across property types, diversification of the mortgage pool reduces the variance of losses on the mortgage pool resulting from default, but does not affect the expected loss. In principle, investors could easily achieve the same diversification without sacrificing yield by holding a variety of CMBS securities, each backed only by a single property type. (In reality, these have been hard to find in some years, as Figure 1 indicates.) However, if investors prefer CMBS supported by a diversified pool, it is our expectation that investor preferences will be reflected in relative yield spreads. Another possible justification for diversification of CMBS mortgage pools is that it might be advantageous to CMBS issuers. For example, it might take longer to create a

[1] Because securitization of commercial mortgages by Fannie Mae, Freddie Mac, and Ginnie Mae has been restricted exclusively to multifamily collateral, which is by definition undiversified, this analysis of CMBS diversification is restricted to nonagency issuances.

[2] Regarding changes in commercial mortgage markets in 1998, see Maris and Segal (2001).

sufficiently large homogeneous pool that it would take if the issuer feels free to combine mortgages on a variety of property types. The longer the CMBS issuer holds mortgages before issuing CMBS, the greater the possibility of an adverse market move resulting in losses to the issuer, a phenomenon known as "pipeline risk."

II. Other Research On CMBS Yield Spreads

Childs *et al*. (1996) present the results of what they characterize as a "combined backward/forward numerical analysis" of CMBS relating yield spreads to (among other things) pool diversification. Pool diversification is represented by varying the correlation between underlying property values. Three classes of securities are considered: a senior tranche, a mezzanine tranche, and a junior, or first loss tranche. The senior tranche is allocated 70 percent of the pool, and the remaining 30 percent is allocated varyingly between the other two. In their model, it is assumed that the sum of the values of the CMBS tranches equals the total pool value. As a result, in their model, if pool diversification increases yield spreads on one tranche, it must reduce them on another. Whether or not that is, in fact, true, is an empirical issue addressed in this paper.

A. Senior Tranche

Due to the assumed parameters of their model, the senior tranche is virtually immune from default loss, but is affected by early return of principal when default occurs. With a diverse pool, the probability of at least some defaults increases, resulting in early repayment of principal. This early return of principal is characterized by Childs *et al*. as resembling interest rate call risk, and depending on credit market conditions, could either benefit or harm senior tranche holders. If default is more likely to occur in low interest rate environments (as asserted by Childs *et al*.) the early repayment of principal to senior security holders resulting from default is a negative factor. The results reported by Childs *et al.* are consistent with that interpretation, as they show that yield spreads on the senior tranche are two to four basis points higher if the mortgage pool is diversified.

B. Mezzanine Tranche

For the mezzanine tranche, pool diversification has an entirely different impact. Unlike the senior securities, the mezzanine class is not immune from default loss. According to Childs *et al*., increasing the diversification of the pool increases the probability that the mezzanine class will receive full repayment of principal. (Childs *et al*., 1996, pp. 593-94.) Therefore increased pool diversification increases the value of the mezzanine class, resulting in lower yield spreads. For the mezzanine class, the results of Childs *et el.* indicate that pool diversification is associated with yield spreads that are lower, in some cases by more than 300 basis points.[3]

C. Junior Tranche

The results of Childs *et al*. indicate that it is on the yield spreads of the junior, or first-loss tranche that mortgage pool diversification has the greatest impact. For the junior tranche, they show that a diversified mortgage pool is associated with higher yield spreads, in some cases up to more than twenty percent higher. Unfortunately limitations in our data prevent us from testing the impact of mortgage pool diversification on yield spreads of the first-loss pieces of CMBS.

[3] In addition to the diversification of the underlying mortgage pool, Childs *et al*. allow other parameters to change, including the term structure, asset price volatility, asset price-interest rate correlation, and the size of the junior and mezzanine tranches. As a result, it is not possible to cite one number as representing the impact of mortgage pool diversification on yield spreads.

III. Alternative Hypothesis

Childs *et al*. assume the total value of CMBS equals the total value of the underlying mortgage pool. In other words, value is neither created nor lost in the process of issuing CMBS. An alternative hypothesis is that holders of the highly-rated CMBS tranches prefer diversified mortgage pools and will accept lower returns on issues supported by diversified pools. In contrast to Childs *et al*. (1996), Maxam and Fisher (1997) show that the senior tranches might actually benefit from moderate default experience due to accelerated repayment of principal in a rising interest-rate environment. Whether or not accelerated repayment benefits or harms investors depends on the existing interest rate environment. If interest rates are "low," investors are better off receiving payments as scheduled. A diversified mortgage pool increases the probability that at least some defaults will occur, but reduces the probability that defaults will be severe enough to reduce the repayment of principal to senior tranches.

The results of Childs *et al*. indicate that senior tranches might have a slight preference for undiversified mortgage pools, and the results of Maxam and Fisher indicate that senior tranches will prefer diversified mortgage pools. As stated above, it is expected that investor preferences for the composition of the mortgage pool will be reflected in different yield spreads for CMBS that are otherwise similar.

A third possibility is that issuers create more diversified CMBS mortgage pools for reasons unrelated to investor preferences. CMBS issuers might create mixed pools of commercial mortgages to reduce the "pipeline risk." Once a firm begins acquiring mortgages, it is exposed to the risk that market conditions might change, resulting in a decline in the value of the mortgages. If the issuer restricts acquisitions to a single property type, it could increase the length of time it takes to accumulate a sufficiently large pool to support an MBS issue. On the other hand, greater flexibility regarding the types of mortgages reduces the time required to assemble a pool. If the motivation for greater diversification in the mortgage pool is on the supply side, it is possible that average CMBS yields are unrelated to mortgage pool diversification.

IV. Research Methodology and Results

To test the relationship between CMBS pool diversification and yields, a multiple regression model is estimated. The dependent variable is the yield spread on fixed-rate CMBS securities. Independent variables include measures of pool diversification, and other variables identified by previous research as related to CMBS yield spreads. The linear regression model is shown in equation 1:

$$SP_i = a + b_1(ISSAMT) + b_2(TRAMT) + b_3(R\ DV) + b_4(yr\ DV) + b_5(FORDV) + b_6(PROP) + e_i \quad (1)$$

where: SPi = yield spread on CMBS tranche "i"[4]

ISSAMT = natural logarithm of total CMBS issue amount (in millions of $)

TRAMT = natural logarithm of tranche amount (in millions of $)

R DV = dummy variables of highest rating on tranche i

yr DV = dummy variables for year of issue

FORDV = dummy variable for mortgages on foreign property

PROP = the number of different property types represented in the mortgage pool.[5]

The data required for the analysis are from the *CMBS Database*, which includes information on all publicly-issued CMBS during the sample period (the beginning of 1994 through June 31, 2001).[6] The sample includes all fixed-rate CMBS during that period that were rated by one of the four major security-rating organizations.[7] Previous research (Maris and Segal, 2001) has identified several variables, including security rating, issue size and tranche size, and the year of issue that are related to yield spreads on fixed-rate CMBS. CMBS yield spreads are inversely related to rating, as expected, and they generally trended down from 1994 until mid-1998, after which time they recovered somewhat.[8] In addition, Maris and Segal (2001) found that CMBS spreads are positively related to the natural logarithm of issue size, and inversely related to the natural log of tranche size.

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[4] Yield spreads are from the *CMBS Database*, and are the difference between yield on the CMBS and the yield on a low-risk benchmark of similar maturity. The benchmark is often the yield on Treasuries, but in some cases is reported as the swap rate, LIBOR or in the case of some issues backed by mortgages on foreign properties, yields on the corresponding government's securities.

[5] This measure of diversity is based on the results of Hartzell *et al.* (1986), who show that the correlation of returns between categories of real estate is much lower than one, and conclude that investing in different categories of real estate offers considerable potential for diversification. Other measures of pool diversity, including the number of loans, and the number of states in which mortgaged property were located, and use of a dummy variable for pools with more than one property type (rather than the number of property types) were included individually in the regression, but did not result in statistically significant coefficients.

[6] The sample period begins in 1994 because few, if any of the CMBS prior to that date that met the conditions to be included in the sample were backed by diversified mortgage pools, as defined in the study.

[7] Raters are Moody, Standard and Poor's, Fitch, and Dun and Bradstreet.

[8] The Russian bond crisis in 1998 triggered a flight to quality among fixed income investors that caused significant widening in spreads between Treasuries and CMBS.

Table 1. Regression Results for All Rating Categories

Independent Variable	Coefficient (t-statistic)
Constant	129.781 (10.123)
ISSAMT	5.883 (2.348)
TRAMT	-9.524 (-5.596)
AADV	2.134 (0.487)
ADV	23.183 (5.054)
BBBDV	94.736 (20.106)
BBDV	262.717 (34.728)
BDV	518.984 (46.872)
95DV	-3.344 (-0.515)
96DV	-35.063 (-5.606)
97DV	-76.501 -12.289
98DV	-10.308 (-1.518)
99DV	34.545 (5.321)
00DV	-13.337 (-2.091)
01DV	-47.119 (-6.932)
DIV	-1.713 (-2.495)

Adjusted R^2 : .704 F-statistic: 326.715 N: 2187

The regression results of the linear regression reported in Table 1 are consistent with those reported by Maris and Segal (2001). Yield spreads are positively related to total issue size, which is attributed to the need for issuers to offer higher rates on large issues to attract sufficient investors to market the issue in a timely manner. On the other hand, yield spreads are inversely related to tranche size, which is attributed to increased liquidity (and therefore a lower liquidity premium). The coefficients for the rating dummy variables indicate that spreads become progressively higher as ratings drop, as expected. Coefficients for the year dummy variables indicate that yield spreads decline from 1994 until 1998, then recover substantially in 1999 before

dropping again in 2000 and the first half of 2001. The coefficient for the mortgage pool diversification variable (PROP) is negative and statistically significant, indicating that each time an additional category of property is included in the mortgage pool, spreads are, on average, two basis points lower.[9] This is interpreted as indicating that investors have a slight preference for CMBS backed by a diversified mortgage pool, however, that preference might not be uniform across all ratings.

To determine the relationship, if any, between rating category, pool diversification, and yields, the regression was rerun separately on each rating category, with the specification (except for rating dummy variables) shown above in Eq. 1. The regression results for each rating category run separately are shown in Table 2. Because the coefficients for the common variables are quite consistent with those reported in Table 1, only the coefficients for the diversification variable are reported. The results indicate that for AAA-rated CMBS, each time an additional category of property is included in the mortgage pool, yield spreads decline 1.5 basis points. The difference is statistically significant. The lower a tranche is rated, the lower the estimated impact of diversification on yield spread, and the difference is not statistically significant for any other rating. This result indicates that it is only investors in the highest-rated CMBS that prefer a diversified mortgage pool.

Table 2. Regression Results for Single Rating*

Rating	Coefficient	t-statistic	N	F-statistic
AAA	-1.535	-2.626**	685	34.650
AA	-1.405	-1.520	386	19.014
A	-0.777	-0.707	451	20.377
BBB	-0.384	-0.244	544	28.681

*Because results are not substantially different from those reported in Table 1 for the other variables, this table reports results for coefficients on the diversification variable only. Complete results are available from the corresponding author. Sample sizes were too small to allow ratings lower than BBB to be run separately.

**Statistically significant at the 5% level.

Our results do not support conclusions derived from the numerical analysis results of Childs *et al*. (1996). Their results indicate that if the mortgage pool is diversified, yields on the "senior" tranche are two to four basis points higher, and yields are up to 300 basis points lower on the "mezzanine" class. (Our data do not include the first loss piece.) Maxam and Fisher, on the other hand, conclude that investors in senior CMBS benefit from a diversified mortgage pool. Our results are consistent with that view.

With regard to the "pipeline" hypothesis outlined above as an alternative to both the Childs et. al. and Maxam and Fisher views, these results do not bear directly on the validity of this alternative approach. Additional research including controls for interest-rate volatility is needed in order to more fully investigate this possibility.

[9] There are eight categories of property reported in the *CMBS Database*.

V. Conclusions

The impact of mortgage pool diversification on CMBS yield spreads is estimated in this study. The results of linear regression show a very small, but statistically significant reduction of yield spreads for CMBS with diversified mortgage pools. When the regression is run separately for each rating category, the reduction in yield spreads is greatest for AAA-rated securities, and in fact that is the only rating for which the difference is statistically significant. The results indicate that investors in the highest-rated CMBS prefer diversified mortgage pools, and are willing to accept slightly lower yields on issues supported by diversified pools. For CMBS rated less than AAA, there is no evidence that mortgage pool diversification affects yields.

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