# What Drives the Return on CMBS?

*Likely by more than the commercial property market.*

Xiaoqing Eleanor Xu

Commercial mortgage-backed securities (CMBS) are securities collateralized by a pool of mortgages on commercial real estate. In the United States, CMBS is one of the fastest growing asset classes, with an aggregate outstanding balance of $597 billion as of December 2005, representing 24% of the $2.53 trillion commercial mortgage market. In 2005 alone, $169 billion of CMBS were issued in the U.S., which is 50 times the CMBS issuance in 1988 or triple the issuance in 2000.

Like the residential mortgage-backed securities (RMBS), CMBS is a securitization product of mortgages. Unlike RMBS, which are mostly agency-guaranteed pass-throughs of cash flows from residential mortgages, CMBS are mostly sequential-pay multiple tranches backed by cash flows from commercial mortgages. CMBS investors are more concerned with default risk, because the product is backed by a less diversified pool of commercial mortgages that are not guaranteed and do not have any recourse to the borrower. CMBS investors are largely protected from prepayment risk by contractual provisions such as prepayment lockout, yield maintenance, defeasance, and prepayment penalties.

CMBS research focuses primarily on theoretical valuation (see Kau et al. [1987, 1990], Titman and Torous [1989], and Childs, Ott, and Riddiough [1996]); empirical pricing (see Maxam and Fisher [2001] and Harding, Sirmans, and Thebpanya [2004]); and default modeling (see Holmes [2003], and Chen and Deng [2004]). Other articles examine the determinants of commercial mortgage credit spreads (see Titman, Tompaidis, and Tsyplakov [2005]) or yield spreads on CMBS (see Maris and Segal [2002]).

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Despite its growth as an asset class and increasing interest by institutional investors, empirical evidence on the investment performance of CMBS has been limited to a small number of studies on the pricing of and yields on individual CMBS issues, plus some basic descriptive statistics on yield, return, and risk (see Hess and Liang [2001] and Nomura's, "Commercial CMBS 2006 Outlook 2005 Review" [2005]). There have been no studies examining the long-term return and risk characteristics of CMBS as an asset class and their role in a broadly diversified investment portfolio (including stocks, Treasuries, corporate bonds, and RMBS).[1]

Several authors have examined fundamental economic variables and their impact on the returns on stocks, bonds, and residential MBS, including Chen, Roll, and Ross [1986], Campbell and Ammer [1993], Elton, Gruber, and Blake [1995], and Xu and Fung [2005]. Yet little is known on the type of economic variables relevant for CMBS returns.

The major findings and implications of my research are as follows. First, CMBS outperformed other major asset classes (stocks, Treasuries, and corporate bonds) over the past ten years. This performance should be interpreted with caution, however, given the short history of available data and the relatively accommodating interest rate and commercial real estate environment.

Second, CMBS are most strongly affected by interest rate levels, the term structure of interest rates, and stock market returns. This is consistent with the empirical evidence on other fixed-income instruments.

Third, CMBS investment performance is highly correlated with performance in non-traded commercial mortgages, but only weakly correlated with the return performance and vacancy rate of commercial properties.

Finally, CMBS investors, especially high-yield CMBS investors, should be concerned about the creditworthiness of the underlying commercial mortgages, the credit spread, and overall CMBS market issuance. These CMBS-specific factors are also important drivers of CMBS returns.

## METHODOLOGY

I first provide a quantitative examination of the risk-return characteristics of CMBS and the role of CMBS in a broadly diversified investment portfolio. Average return (means), risk (standard deviations), and risk-adjusted return (Sharpe ratios) on Lehman Brothers investment-grade (IG) and high-yield (HY) CMBS indexes are estimated for comparison with the risk-return distribution of RMBS and traditional asset classes such as stocks, Treasury bonds, and corporate bonds during the sample period. Correlation statistics are computed to assess the degree of comovement between returns on CMBS and RMBS and traditional asset classes. This should advance the understanding of the risk and return performance of CMBS as a new and complex investment class, and allow professional money managers to make optimal decisions on the strategic asset allocation of CMBS in a broadly diversified portfolio.

Next I determine the factors that drive the return of CMBS and how each factor does so. Depending on the cash flow and risk characteristics of CMBS, I have identified several real and financial economic variables as potential forces that move the return on CMBS:

- Monthly growth rate in seasonally adjusted industrial production.
- Inflation rate (monthly percentage change in the seasonally adjusted CPI).
- Monthly change in the 30-year mortgage rate.
- Monthly change in the term structure spread (between the ten year and three month Treasury yield).
- Monthly change in the investment-grade credit spread (yield spread between long-term AAA corporate bonds and long-term Treasury bonds).
- Monthly change in the high-yield credit spread (yield spread between long-term BB corporate bonds and long-term Treasury bonds).
- Excess return on the S&P 500 stock index.
- Monthly delinquency rate on CMBS.
- Monthly change in the amount of CMBS issuance.
- Monthly change in the average debt service coverage (DSCR) ratio of securitized commercial mortgages.

The justification for the selection of these variables is explained in the Appendix.[2]

Although the use of contemporaneous regression to explain asset return is appealing, given its simplicity, it has little to say about channels through which economic variables affect CMBS returns. I use instead a structural vector autoregressive (VAR) model to examine economic factors that are important for the return on CMBS. Although Hasbrouck [1991], Lee [1992], Campbell and Ammer [1993], and Xu and Fung [2005] have used the VAR model in finance research, this approach has not been used for CMBS research.

## EXHIBIT 1

**Descriptive Statistics for Lehman Brothers Indexes (as of June 2006)**

| | Coupon (%) | Duration | Yield to Worst (%) | Option-adjusted Spread (%) | Amt Outstanding (MM) | Market Value (MM) | Number of Issues |
|---|---|---|---|---|---|---|---|
| U.S. Aggregate Bond Index | 5.290 | 4.796 | 5.788 | 0.477 | 8,358,009 | 8,312,471 | 6,837 |
| U.S. Universal Bond Index | 5.514 | 4.802 | 6.012 | 0.707 | 9,769,279 | 9,710,198 | 13,867 |
| Global Aggregate | 4.373 | 5.373 | 4.358 | 0.277 | 21,746,053 | 22,130,428 | 10,720 |
| U.S. Treasury Index | 4.919 | 4.925 | 5.178 | -0.005 | 2,019,099 | 2,080,819 | 130 |
| Asset-Backed Securities | 4.809 | 2.757 | 5.763 | 0.591 | 103,710 | 102,029 | 546 |
| Residential MBS | 5.360 | 4.560 | 6.107 | 0.569 | 3,003,632 | 2,904,383 | 397 |
| CMBS Investment Grade (IG) | 5.444 | 4.661 | 5.879 | 0.737 | 435,380 | 424,371 | 3,970 |
| *CMBS AAA* | 5.381 | 4.565 | 5.843 | 0.702 | 383,446 | 373,573 | 1,722 |
| *CMBS AA* | 5.845 | 5.180 | 5.968 | 0.822 | 18,036 | 17,723 | 644 |
| *CMBS A* | 5.946 | 5.229 | 6.052 | 0.909 | 16,723 | 16,462 | 708 |
| *CMBS BBB* | 5.938 | 5.686 | 6.421 | 1.270 | 17,175 | 16,613 | 896 |
| CMBS High Yield (HY) | 5.716 | 5.228 | 11.759 | 6.595 | 25,469 | 16,334 | 2,410 |
| *CMBS BB* | 5.776 | 5.384 | 7.739 | 2.596 | 10,890 | 9,610 | 946 |
| *CMBS B* | 5.734 | 5.309 | 13.238 | 8.068 | 6,681 | 4,279 | 928 |
| *CMBS High Yield Other* | 5.619 | 4.468 | 24.974 | 19.735 | 7,898 | 2,445 | 536 |
| Corporate Investment Grade (IG) | 5.937 | 5.840 | 6.143 | 0.944 | 1,584,009 | 1,596,240 | 2,697 |
| *Corporate AAA* | 5.110 | 5.092 | 5.787 | 0.611 | 72,356 | 72,176 | 80 |
| *Corporate AA* | 5.325 | 4.769 | 5.853 | 0.677 | 325,040 | 323,449 | 372 |
| *Corporate A* | 5.900 | 6.002 | 6.084 | 0.874 | 635,469 | 640,205 | 1,132 |
| *Corporate BBB* | 6.450 | 6.370 | 6.424 | 1.221 | 551,143 | 560,410 | 1,113 |
| Corporate High Yield (HY) | 7.888 | 4.606 | 8.575 | 3.204 | 603,005 | 589,323 | 1,598 |
| *Corporate BB* | 7.282 | 4.846 | 7.859 | 2.552 | 253,676 | 248,400 | 552 |
| *Corporate B* | 8.196 | 4.518 | 8.385 | 2.994 | 258,960 | 257,927 | 746 |
| *Corporate CCC* | 8.717 | 4.216 | 10.848 | 5.343 | 79,667 | 74,870 | 263 |
| *Corporate CC to D* | 9.321 | 3.494 | 19.188 | 12.980 | 5,752 | 4,187 | 22 |

## EXHIBIT 2

**CMBS and Corporate Bonds by Credit Rating (as of June 2006)**

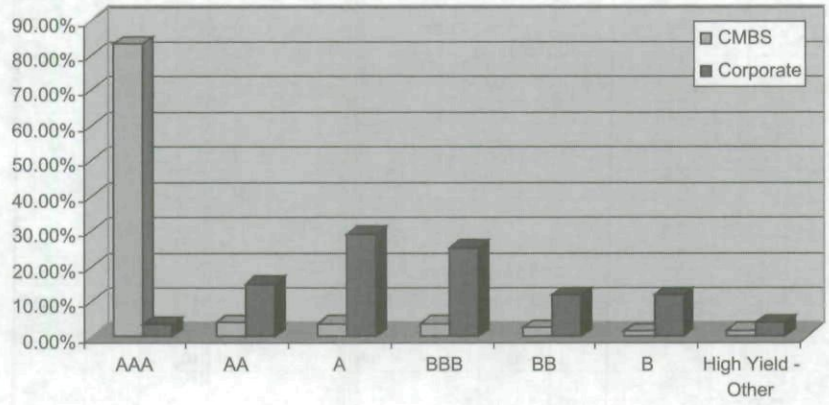
| Credit Rating | By Amount Outstanding | | By No. of Issues | |
|---|---|---|---|---|
| | CMBS | Corporate | CMBS | Corporate |
| AAA | 83.20% | 3.32% | 26.99% | 1.87% |
| AA | 3.91% | 14.90% | 10.09% | 8.69% |
| A | 3.63% | 29.12% | 11.10% | 26.45% |
| BBB | 3.73% | 25.26% | 14.04% | 26.00% |
| BB | 2.36% | 11.63% | 14.83% | 12.90% |
| B | 1.45% | 11.87% | 14.55% | 17.43% |
| High Yield - Other | 1.71% | 3.91% | 8.40% | 6.66% |
| | | | | |
| Investment -Grade Total | 94.47% | 72.59% | 62.23% | 63.01% |
| High-Yield Total | 5.53% | 27.41% | 37.77% | 36.99% |

In the reduced form of VAR, each endogenous variable in the system is modeled as a function of the lagged values of all the endogenous variables in the system, and the error terms may be correlated with one another. In the structural form of VAR, restrictions are placed on the contemporaneous relations between the endogenous variables to allow for the identification of uncorrelated and independent structural shocks.

One general approach to structural VAR identification is the Cholesky decomposition proposed by Sims [1980], which restricts the variable higher in the ordering to have no contemporaneous effect on variables lower in the ordering. From the structural VAR model, I can decompose the forecast variance of CMBS returns into components that can be explained by each of these variables. The structural VAR also enables me to investigate the extent to which an economic variable helps explain CMBS returns and understand how returns of IG and HY CMBS respond to shocks in these economic variables over time. The empirical results will help illuminate the dynamic relations between CMBS returns and these economic variables.

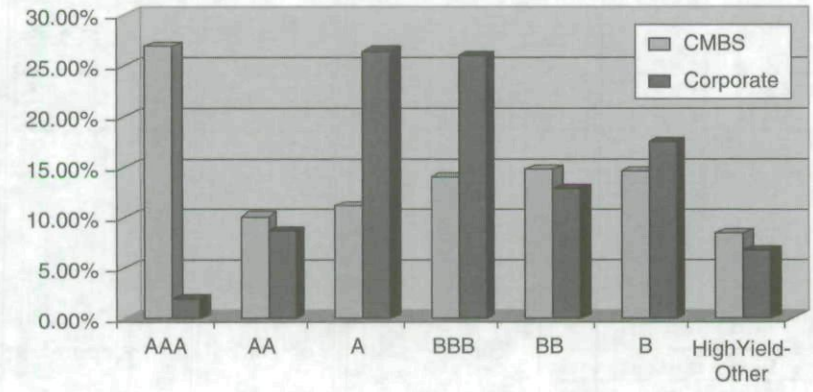
## EXHIBIT 3

**Distribution of CMBS and Corporate Bonds by Amount Outstanding**




## EXHIBIT 4

**Distribution of CMBS and Corporate Bonds by Number of Issues**




## DATA

As the investor base for CMBS broadened in the late 1990s, Lehman Brothers recognized the need for a formal CMBS index for use as a performance benchmark. It introduced its CMBS index in January 1999, backdated to January 1997 (see "A Guide to the Lehman Global Family of Fixed Income Indices" [2002]).

Monthly data from January 1997 through June 2006 on the price return, coupon return, paydown return, weighted average maturity, duration, and yield on the investment-grade and high-yield CMBS indexes, corporate bond indexes, and other key fixed income indexes are obtained from Lehman Brothers.[3] Monthly data on CMBS issuance and delinquency rate are obtained from Nomura Securities.[4] Monthly data on the average debt service coverage ratio (DSCR) of securitized commercial mortgages are obtained from Trepp, LLC. Monthly data on the 30-year mortgage rate, Treasury yields, consumer price index, and industrial production come from the Federal Reserve Board.

Quarterly data on the average vacancy rate of commercial properties are obtained from Torto Wheaton Research. Quarterly data on the NCREIF commercial property performance index (see "The NCREIF Property Index Detailed Quarterly Report" [2005]) and the Giliberto-Levy commercial mortgage performance index (see Giliberto [1997]) were also obtained to allow for comparison of the return performance on CMBS with returns on non-traded commercial mortgage or commercial property.[5]

For the first part of the study on risk and return, I present results on the entire sample period from January 1997 (the inception of Lehman CMBS index available data) through June 2006 and results on the standard CMBS sample period from May 2000 (inception of CMBS underwriting standardization) through June 2006. For the second part of the study on structural VAR modeling of factors driving CMBS excess return, I focus on the standard CMBS sample period to ensure the availability of data for all relevant factors.

## EMPIRICAL RESULTS

Exhibit 1 presents descriptive statistics on the Lehman Brothers CMBS indexes and other major fixed-income indexes as of the end of the sample period. As of June 2006, there were 3,970 issues in the Lehman Brothers investment-grade (IG) CMBS index, with $435.4 billion outstanding, and 2,410 issues in the Lehman Brothers high-yield (HY) CMBS index, with $25.5 billion outstanding. These represent more than 75% of the CMBS market. The IG and HY CMBS have option-adjusted spreads (OAS) of 0.737% and 6.595% above the Treasury, compared to OAS for IG and HY corporate bonds of 0.944% and 3.204%, respectively.

Investment-grade CMBS (rated BBB or higher) account for 94% of all CMBS in terms of outstanding

# EXHIBIT 5

## Return and Risk Measures of Indexes (%)

Panel A. Whole sample period: January 1997 to June 2006

| | Mean Total Return | Median Total Return | Mean Excess Return | Median Excess Return | Std Dev of Excess Return | Sharpe Ratio |
|---|---|---|---|---|---|---|
| S&P 500 | 0.709 | 0.925 | 0.411 | 0.708 | 4.532 | 0.091 |
| U.S. Aggregate Bond Index | 0.494 | 0.585 | 0.196 | 0.240 | 1.039 | 0.189 |
| U.S. Universal Bond Index | 0.504 | 0.582 | 0.206 | 0.258 | 1.006 | 0.205 |
| Global Aggregate | 0.448 | 0.289 | 0.150 | 0.032 | 1.597 | 0.094 |
| U.S. Treasury Index | 0.480 | 0.503 | 0.182 | 0.224 | 1.324 | 0.138 |
| Asset-Backed Securities | 0.477 | 0.470 | 0.179 | 0.122 | 0.755 | 0.237 |
| Residential MBS | 0.483 | 0.570 | 0.185 | 0.198 | 0.747 | 0.248 |
| CMBS Investment Grade (IG) | 0.574 | 0.573 | 0.276 | 0.252 | 1.396 | 0.198 |
| *CMBS AAA* | 0.563 | 0.547 | 0.265 | 0.270 | 1.360 | 0.195 |
| *CMBS AA* | 0.606 | 0.677 | 0.309 | 0.260 | 1.561 | 0.198 |
| *CMBS A* | 0.614 | 0.612 | 0.316 | 0.319 | 1.554 | 0.203 |
| *CMBS BBB* | 0.670 | 0.683 | 0.372 | 0.418 | 1.743 | 0.213 |
| CMBS High Yield (HY) | 0.978 | 1.103 | 0.680 | 0.759 | 2.940 | 0.231 |
| *CMBS BB* | 0.904 | 0.902 | 0.607 | 0.600 | 2.882 | 0.210 |
| *CMBS B* | 0.963 | 1.099 | 0.665 | 0.816 | 2.851 | 0.233 |
| *CMBS High Yield Other* | 1.555 | 1.684 | 1.257 | 1.341 | 5.265 | 0.239 |
| Corporate Investment Grade (IG) | 0.514 | 0.615 | 0.216 | 0.325 | 1.358 | 0.159 |
| *Corporate AAA* | 0.521 | 0.619 | 0.223 | 0.291 | 1.370 | 0.163 |
| *Corporate AA* | 0.528 | 0.641 | 0.230 | 0.270 | 1.243 | 0.185 |
| *Corporate A* | 0.508 | 0.679 | 0.210 | 0.328 | 1.341 | 0.157 |
| *Corporate BBB* | 0.505 | 0.607 | 0.207 | 0.316 | 1.512 | 0.137 |
| Corporate High Yield (HY) | 0.513 | 0.730 | 0.215 | 0.472 | 2.190 | 0.098 |
| *Corporate BB* | 0.586 | 0.769 | 0.288 | 0.492 | 1.709 | 0.168 |
| *Corporate B* | 0.466 | 0.752 | 0.168 | 0.485 | 2.396 | 0.070 |
| *Corporate CCC* | 0.460 | 0.753 | 0.162 | 0.360 | 3.868 | 0.042 |
| *Corporate CC to D* | 0.828 | 0.610 | 0.530 | 0.296 | 5.748 | 0.092 |

Panel B. Standard CMBS sample period: May 2000 to June 2006

| | Mean Total Return | Median Total Return | Mean Excess Return | Median Excess Return | Std Dev of Excess Return | Sharpe Ratio |
|---|---|---|---|---|---|---|
| S&P 500 | 0.040 | 0.575 | -0.192 | 0.318 | 4.176 | -0.046 |
| U.S. Aggregate Bond Index | 0.506 | 0.662 | 0.274 | 0.442 | 1.096 | 0.250 |
| U.S. Universal Bond Index | 0.526 | 0.699 | 0.294 | 0.425 | 1.063 | 0.276 |
| Global Aggregate | 0.565 | 0.472 | 0.333 | 0.242 | 1.657 | 0.201 |
| U.S. Treasury Index | 0.472 | 0.603 | 0.240 | 0.393 | 1.437 | 0.167 |
| Asset-Backed Securities | 0.490 | 0.500 | 0.258 | 0.264 | 0.803 | 0.322 |
| Residential MBS | 0.485 | 0.603 | 0.253 | 0.328 | 0.776 | 0.326 |
| CMBS Investment Grade (IG) | 0.623 | 0.770 | 0.392 | 0.389 | 1.442 | 0.272 |
| *CMBS AAA* | 0.606 | 0.753 | 0.374 | 0.376 | 1.408 | 0.266 |
| *CMBS AA* | 0.671 | 0.762 | 0.439 | 0.449 | 1.609 | 0.273 |
| *CMBS A* | 0.692 | 0.777 | 0.460 | 0.425 | 1.624 | 0.283 |
| *CMBS BBB* | 0.771 | 0.846 | 0.539 | 0.614 | 1.645 | 0.328 |
| CMBS High Yield (HY) | 1.140 | 1.135 | 0.908 | 0.825 | 1.889 | 0.481 |
| *CMBS BB* | 1.105 | 0.978 | 0.873 | 0.677 | 2.067 | 0.422 |
| *CMBS B* | 1.098 | 1.099 | 0.866 | 0.816 | 1.792 | 0.483 |
| *CMBS High Yield Other* | 1.453 | 1.684 | 1.221 | 1.341 | 1.743 | 0.700 |
| Corporate Investment Grade (IG) | 0.564 | 0.728 | 0.332 | 0.495 | 1.427 | 0.233 |
| *Corporate AAA* | 0.558 | 0.688 | 0.326 | 0.427 | 1.381 | 0.236 |
| *Corporate AA* | 0.567 | 0.676 | 0.335 | 0.387 | 1.291 | 0.260 |
| *Corporate A* | 0.552 | 0.756 | 0.320 | 0.561 | 1.400 | 0.229 |
| *Corporate BBB* | 0.563 | 0.797 | 0.331 | 0.549 | 1.616 | 0.205 |
| Corporate High Yield (HY) | 0.594 | 1.091 | 0.362 | 0.904 | 2.455 | 0.148 |
| *Corporate BB* | 0.654 | 1.028 | 0.422 | 0.809 | 1.923 | 0.219 |
| *Corporate B* | 0.534 | 0.892 | 0.302 | 0.629 | 2.678 | 0.113 |
| *Corporate CCC* | 0.537 | 1.099 | 0.305 | 0.746 | 4.308 | 0.071 |
| *Corporate CC to D* | 1.403 | 1.467 | 1.171 | 1.280 | 6.492 | 0.180 |

## EXHIBIT 6

**Correlations of Total Returns**

| | Correlation with Total Return on S&P 500 Index | | Correlation with Total Return on Lehman Brothers U.S. Aggregate Bond Index | |
|---|---|---|---|---|
| | Whole Sample Period Jan 1997-June 2006 | Standard Sample Period May 2000-June 2006 | Whole Sample Period Jan 1997-June 2006 | Standard Sample Period May 2000-June 2006 |
| U.S. Aggregate Bond Index | -0.112 | **-0.302** | **1.000** | **1.000** |
| U.S. Universal Bond Index | 0.016 | ***-0.214*** | **0.977** | **0.990** |
| Global Aggregate | -0.055 | -0.147 | **0.674** | **0.681** |
| U.S. Treasury Index | **-0.227** | **-0.416** | **0.968** | **0.972** |
| Asset-Backed Securities | **-0.229** | **-0.422** | **0.946** | **0.944** |
| Residential MBS | -0.075 | **-0.286** | **0.925** | **0.932** |
| CMBS Investment Grade (IG) | -0.138 | **-0.351** | **0.962** | **0.976** |
| *CMBS AAA* | -0.134 | **-0.350** | **0.966** | **0.975** |
| *CMBS AA* | -0.137 | **-0.345** | **0.955** | **0.975** |
| *CMBS A* | -0.144 | **-0.343** | **0.946** | **0.970** |
| *CMBS BBB* | ***-0.163*** | **-0.347** | **0.834** | **0.939** |
| CMBS High Yield (HY) | -0.125 | **-0.342** | **0.554** | **0.847** |
| *CMBS BB* | -0.125 | **-0.361** | **0.598** | **0.847** |
| *CMBS B* | -0.107 | ***-0.223*** | **0.514** | **0.786** |
| *CMBS High Yield Other* | -0.097 | **-0.309** | **0.261** | **0.635** |
| Corporate Investment Grade (IG) | 0.051 | -0.109 | **0.933** | **0.930** |
| *Corporate AAA* | -0.062 | **-0.267** | **0.978** | **0.984** |
| *Corporate AA* | -0.060 | **-0.277** | **0.975** | **0.980** |
| *Corporate A* | 0.009 | -0.164 | **0.943** | **0.942** |
| *Corporate BBB* | 0.126 | 0.021 | **0.854** | **0.838** |
| Corporate High Yield (HY) | **0.492** | **0.536** | 0.112 | 0.082 |
| *Corporate BB* | **0.464** | **0.482** | **0.270** | 0.194 |
| *Corporate B* | **0.481** | **0.525** | 0.083 | 0.071 |
| *Corporate CCC* | **0.383** | **0.450** | -0.079 | -0.070 |
| *Corporate CC to D* | **0.226** | **0.286** | -0.050 | 0.007 |

**Bold**—*Significant at 5%.*
***Bold and Italic***—*Significant at 10%.*

amount and 62% in terms of number of issues (see Exhibits 2, 3, and 4). AAA-rated CMBS, in particular, account for a much higher percentage in CMBS than that in corporate bonds; 27% of CMBS are rated AAA and only 1.9% of corporate bonds are rated AAA, in terms of number of issues. In terms of outstanding amount, AAA-rated CMBS account for 83%, while AAA-rated corporate bonds account for only 3.3%.

The CMBS market is much smaller than the residential MBS market (about 14.5% of the size of the RMBS market). The average size of a CMBS issue is about 1.4% of the average size of an RMBS issue ($110 million for CMBS versus $7.566 billion for RMBS).

Exhibit 5 presents return and risk statistics on CMBS indexes, corporate bond indexes, and other major asset classes for the whole sample period (Panel A) and the standard CMBS sample period (Panel B). The mean returns and Sharpe ratios of CMBS IG and HY indexes dominate those on the respective corporate bond indexes for both the whole sample period and the standard CMBS sample. In both panels CMBS outperform RMBS and asset-backed securities (ABS) on a mean return basis, but underperform the asset classes on a total risk-adjusted basis (Sharpe ratio). Altogether the three securitized asset classes outperform all others in the entire sample period and the standard sample period.

As investors generally take a portfolio approach in investing, we should examine CMBS also on a correlation basis. Exhibit 6 presents the correlation of total returns on CMBS and other major Lehman fixed income indexes with the total return on the S&P 500 stock index and the total return on the Lehman U.S. Aggregate Bond Index (BI).

Investment-grade CMBS have correlations of 0.962 and 0.976 with the BI, over the whole sample period and the standard sample period. This is slightly higher than the IG corporate bond correlation with the BI, and much higher than the HY CMBS correlation with the BI. The

## EXHIBIT 7

**Descriptive Statistics for Endogenous Variables in VAR System**

| | Mean | Median | Maximum | Minimum | Std. Dev. | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| ERICM | 0.392 | 0.389 | 3.363 | -4.540 | 1.442 | -0.541 | 3.901 |
| ERHCM | 0.908 | 0.825 | 5.709 | -4.865 | 1.889 | 0.062 | 3.750 |
| IPSAG | 0.114 | 0.073 | 1.126 | -1.334 | 0.519 | -0.145 | 2.545 |
| INF | 0.227 | 0.217 | 1.208 | -0.657 | 0.275 | 0.055 | 5.083 |
| MR30D | -0.020 | -0.055 | 0.630 | -0.370 | 0.193 | 1.074 | 4.227 |
| TSD | 0.000 | -0.060 | 0.820 | -0.420 | 0.280 | 0.926 | 3.261 |
| DYSAD | -0.019 | -0.002 | 0.265 | -0.908 | 0.144 | -3.372 | 21.394 |
| DYSBD | -0.028 | -0.012 | 1.619 | -1.282 | 0.471 | 0.436 | 4.770 |
| ERSP | -0.192 | 0.318 | 8.666 | -11.008 | 4.176 | -0.336 | 3.106 |
| CMBSD | 1.076 | 1.145 | 1.680 | 0.500 | 0.381 | -0.067 | 1.572 |
| CMBSID | 0.331 | 0.950 | 17.000 | -23.000 | 7.188 | -0.338 | 4.498 |
| DSCRD | 0.002 | 0.000 | 0.030 | -0.030 | 0.009 | 0.005 | 6.007 |

*ERICM is excess return on investment-grade CMBS index. ERHCM is excess return on high-yield CMBS index. IPSAG is monthly growth rate in seasonally adjusted industrial production. INF is inflation rate (monthly percentage change in the seasonally adjusted CPI). MR30D is monthly change in 30-year mortgage rate. TSD is monthly change in term structure spread (between 10-year Treasury yield and 3-month Treasury yield). DYSAD is monthly change in investment-grade credit spread (yield spread between long-term AAA corporate bonds and long-term Treasury bonds). DYSBD is monthly change in high-yield credit spread (yield spread between long-term BB corporate bonds and long-term Treasury bonds). ERSP is excess return on S&P 500 stock index. CMBSD is monthly delinquency rate on CMBS. CMBSID is monthly change in amount of CMBS issuance. DSCRD is monthly change in average debt service coverage ratio (DSCR) of securitized commercial mortgages. Results are based on monthly data from May 2000-June 2006.*

HY CMBS correlation with the BI, however, is still much higher than the HY corporate bond correlation with the BI, as HY corporate bonds have a positive and highly significant correlation with the S&P.

In general, CMBS and most fixed-income classes have negative correlations with the S&P that are much more significant during the standard CMBS sample period, when the stock market experienced a major correction in the first three years. During the standard CMBS sample period, IG and HY CMBS have correlations of –0.351 and –0.342 with the S&P, demonstrating the strong potential for risk diversification when stocks and CMBS are combined in an investment portfolio.

### Drivers of Excess Return on CMBS

I use a structural vector autoregressive (VAR) model to determine the variables that drive the excess return on CMBS and how each variable does so.[6] The excess return on investment-grade CMBS (ERICM) is analyzed in the context of eight other economic and financial endogenous variables; 1) IPSAG (growth in industrial production); 2) INF (inflation rate); 3) MR30D (change in the 30-year mortgage rate); 4) TSD (change in term structure spread); 5) DYSAD (change in investment-grade credit spread); 6) ERSP (excess return on the S&P 500 stock index); 7) CMSID (change in the amount of CMBS issuance); and 8) DSCRD (change in the average debt service coverage ratio of securitized commercial mortgages).

To examine drivers of the excess return on high-yield CMBS (ERHCM), I include a similar list of economic and financial variables, with minor modifications. First, DYSAD (change in investment-grade credit spread) is replaced by DYSBD (change in high-yield credit spread). Second, an additional endogenous variable, CMBSD (delinquency rate on CMBS), is added to capture added credit risk not captured by DTSBD.

Exhibit 7 reports descriptive statistics on these potential drivers of the CMBS return dynamics. To ensure the availability of data on all endogenous variables, I use the standard CMBS sample period from May 2000 through June 2006 in the VAR modeling.[7]

In a reduced form of the VAR, each endogenous variable in the system is modeled as a function of the lagged values of all the endogenous variables in the system, and the error terms may be correlated with one another. In this structural form of the VAR, restrictions are placed on the contemporaneous relations among the endogenous variables to allow for identification of uncorrelated and independent structural shocks. Sims [1980] first introduced the impulse response analysis into VAR modeling as a descriptive device intended to represent the reaction of each variable to a shock (or innovation) in each equation of the VAR system over time. A meaningful impulse response analysis requires that shocks be uncorrelated. This orthogonal condition is fulfilled in this structural VAR framework.

Exhibit 8 reports the impulse response of CMBS excess returns to shocks in the two general economic variables (industrial production and inflation), four financial market variables (mortgage rate, term structure spread, credit spread, and stock market return), and three CMBS-specific variables (CMBS delinquency rate, CMBS

# EXHIBIT 8

## Impulse Response of CMBS Excess Return to One Standard Deviation Change in Variables—Standard Period

Panel A. Impulse Response for Investment-grade CMBS Excess Return

| Period | IPSAG | INF | MR30D | TSD | DYSAD | ERSP | CMBSID | DSCRD | ERICM |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -0.229 | -0.173 | **-1.006** | **-0.232** | 0.116 | **-0.306** | -0.110 | -0.043 | **0.724** |
| | (-1.48) | (-1.13) | **(-7.88)** | **(-2.43)** | (1.25) | **(-3.44)** | (-1.30) | (-0.51) | **(12.17)** |
| 1 | -0.041 | -0.138 | 0.085 | 0.026 | 0.010 | -0.169 | **-0.273** | 0.108 | 0.110 |
| | (-0.28) | (-0.88) | (0.63) | (0.21) | (0.08) | (-1.16) | **(-2.11)** | (0.76) | (1.05) |
| 2 | 0.056 | 0.008 | 0.146 | 0.100 | 0.095 | -0.039 | 0.121 | -0.056 | -0.106 |
| | (0.77) | (0.09) | (1.38) | (1.19) | (1.64) | (-0.57) | (1.45) | (-0.86) | (-1.41) |
| 3 | -0.065 | 0.008 | -0.034 | 0.045 | -0.029 | 0.012 | -0.030 | 0.003 | -0.007 |
| | (-1.37) | (0.18) | (-0.60) | (1.02) | (-0.95) | (0.29) | (-0.58) | (0.08) | (-0.14) |
| 4 | -0.015 | -0.014 | -0.049 | 0.023 | 0.009 | -0.028 | 0.018 | -0.004 | 0.043 |
| | (-0.53) | (-0.56) | (-1.34) | (0.76) | (0.48) | (-1.06) | (0.56) | (-0.18) | (1.48) |
| 5 | -0.021 | -0.017 | 0.002 | 0.018 | 0.004 | -0.013 | -0.030 | 0.012 | 0.007 |
| | (-1.02) | (-1.03) | (0.11) | (0.70) | (0.29) | (-0.67) | (-1.25) | (0.93) | (0.46) |
| 6 | -0.003 | -0.005 | 0.000 | 0.018 | 0.009 | -0.014 | 0.014 | -0.007 | 0.002 |
| | (-0.17) | (-0.41) | (0.00) | (0.88) | (0.97) | (-0.97) | (0.80) | (-0.82) | (0.18) |
| 7 | -0.012 | -0.004 | -0.004 | 0.012 | 0.000 | -0.004 | -0.010 | 0.003 | 0.003 |
| | (-1.05) | (-0.52) | (-0.54) | (0.77) | (0.05) | (-0.34) | (-0.76) | (0.53) | (0.36) |
| 8 | -0.004 | -0.004 | -0.005 | 0.009 | 0.003 | -0.007 | 0.004 | -0.002 | 0.005 |
| | (-0.44) | (-0.59) | (-0.97) | (0.71) | (0.64) | (-0.89) | (0.44) | (-0.40) | (1.03) |
| 9 | -0.006 | -0.003 | -0.001 | 0.006 | 0.001 | -0.003 | -0.005 | 0.002 | 0.002 |
| | (-0.82) | (-0.69) | (-0.35) | (0.64) | (0.38) | (-0.50) | (-0.78) | (0.63) | (0.50) |
| 10 | -0.002 | -0.002 | -0.002 | 0.005 | 0.002 | -0.004 | 0.002 | -0.001 | 0.002 |
| | (-0.40) | (-0.51) | (-0.54) | (0.65) | (0.68) | (-0.76) | (0.40) | (-0.47) | (0.64) |

Panel B. Impulse Response for High-Yield CMBS Excess Return

| Period | IPSAG | INF | MR30D | TSD | DYSBD | ERSP | CMBSD | CMBSID | DSCRD | ERHCM |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | **-0.452** | **-0.412** | **-0.912** | **-0.721** | **0.483** | ***-0.205*** | 0.092 | 0.042 | ***-0.218*** | **0.980** |
| | **(-2.26)** | **(-2.13)** | **(-5.22)** | **(-4.94)** | **(3.81)** | ***(-1.72)*** | (0.78) | (0.36) | ***(-1.87)*** | **(12.08)** |
| 1 | 0.038 | 0.103 | 0.065 | -0.072 | 0.219 | -0.091 | 0.000 | **-0.432** | 0.000 | ***0.280*** |
| | (0.19) | (0.50) | (0.37) | (-0.42) | (1.12) | (-0.48) | (0.00) | **(-2.54)** | (0.00) | ***(1.67)*** |
| 2 | 0.166 | 0.107 | **0.236** | 0.077 | -0.024 | -0.074 | 0.015 | ***0.183*** | -0.036 | ***-0.182*** |
| | (1.55) | (0.88) | **(1.94)** | (0.61) | (-0.25) | (-0.71) | (0.34) | ***(1.65)*** | (-0.46) | ***(-1.79)*** |
| 3 | -0.051 | 0.030 | -0.007 | 0.033 | -0.100 | 0.062 | 0.005 | -0.032 | 0.028 | -0.058 |
| | (-0.74) | (0.45) | (-0.10) | (0.44) | (-1.41) | (0.90) | (0.18) | (-0.47) | (0.51) | (-0.76) |
| 4 | 0.005 | -0.019 | -0.029 | 0.001 | 0.015 | 0.012 | 0.016 | 0.051 | -0.006 | 0.017 |
| | (0.13) | (-0.50) | (-0.64) | (0.02) | (0.37) | (0.29) | (0.66) | (1.17) | (-0.21) | (0.41) |
| 5 | -0.017 | -0.015 | -0.006 | -0.006 | 0.007 | 0.001 | 0.010 | -0.044 | 0.009 | 0.013 |
| | (-0.70) | (-0.67) | (-0.32) | (-0.19) | (0.30) | (0.05) | (0.39) | (-1.42) | (0.64) | (0.62) |
| 6 | 0.011 | -0.002 | 0.008 | 0.009 | 0.003 | -0.009 | 0.013 | 0.019 | -0.007 | -0.003 |
| | (0.58) | (-0.10) | (0.58) | (0.32) | (0.26) | (-0.65) | (0.55) | (0.91) | (-0.83) | (-0.29) |
| 7 | -0.011 | -0.003 | -0.001 | 0.011 | -0.005 | 0.006 | 0.011 | -0.011 | 0.004 | -0.001 |
| | (-0.66) | (-0.23) | (-0.17) | (0.43) | (-0.54) | (0.64) | (0.46) | (-0.71) | (0.69) | (-0.14) |
| 8 | -0.002 | -0.006 | -0.002 | 0.011 | 0.003 | -0.002 | 0.012 | 0.007 | -0.001 | 0.001 |
| | (-0.11) | (-0.46) | (-0.25) | (0.42) | (0.36) | (-0.25) | (0.53) | (0.64) | (-0.22) | (0.16) |
| 9 | -0.008 | -0.007 | -0.003 | 0.010 | 0.001 | 0.000 | 0.011 | -0.006 | 0.002 | 0.002 |
| | (-0.57) | (-0.48) | (-0.43) | (0.42) | (0.14) | (0.05) | (0.49) | (-0.78) | (0.58) | (0.42) |
| 10 | -0.004 | -0.006 | -0.002 | 0.012 | 0.002 | -0.002 | 0.012 | 0.002 | 0.000 | 0.001 |
| | (-0.31) | (-0.45) | (-0.27) | (0.47) | (0.41) | (-0.41) | (0.51) | (0.34) | (-0.12) | (0.32) |

**Bold**—*Significant at 5%.*

***Bold and Italic***—*Significant at 10%.*

## EXHIBIT 9

### Variance Decomposition of CMBS Excess Return—Standard period

Panel A. Variance Decomposition for Investment-Grade CMBS Excess Return

| Period | IPSAG | INF | MR30D | TSD | DYSAD | ERSP | CMBSID | DSCRD | ERICM |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 0 | 2.92 | 1.67 | 56.43 | 2.99 | 0.75 | 5.21 | 0.68 | 0.10 | 29.25 |
| 1 | 2.78 | 2.51 | 52.30 | 2.79 | 0.69 | 6.25 | 4.46 | 0.69 | 27.54 |
| 2 | 2.83 | 2.42 | 51.44 | 3.18 | 1.11 | 6.10 | 5.02 | 0.82 | 27.08 |
| 3 | 3.02 | 2.41 | 51.26 | 3.26 | 1.15 | 6.07 | 5.04 | 0.82 | 26.96 |
| 4 | 3.02 | 2.41 | 51.21 | 3.28 | 1.15 | 6.09 | 5.04 | 0.82 | 26.97 |
| 5 | 3.04 | 2.42 | 51.15 | 3.29 | 1.15 | 6.09 | 5.08 | 0.82 | 26.94 |
| 6 | 3.04 | 2.42 | 51.13 | 3.30 | 1.16 | 6.10 | 5.09 | 0.83 | 26.93 |
| 7 | 3.05 | 2.43 | 51.12 | 3.31 | 1.16 | 6.10 | 5.09 | 0.83 | 26.92 |
| 8 | 3.05 | 2.43 | 51.11 | 3.31 | 1.16 | 6.10 | 5.09 | 0.83 | 26.92 |
| 9 | 3.05 | 2.43 | 51.11 | 3.32 | 1.16 | 6.10 | 5.10 | 0.83 | 26.92 |
| 10 | 3.05 | 2.43 | 51.11 | 3.32 | 1.16 | 6.10 | 5.10 | 0.83 | 26.92 |

Panel B. Variance Decomposition for High Yield CMBS Excess Return

| Period | IPSAG | INF | MR30D | TSD | DYSBD | ERSP | CMBSD | CMBSID | DSCRD | ERHCM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| 0 | 6.76 | 5.62 | 27.55 | 17.21 | 7.74 | 1.39 | 0.28 | 0.06 | 1.57 | 31.81 |
| 1 | 6.11 | 5.36 | 24.87 | 15.61 | 8.38 | 1.49 | 0.25 | 5.61 | 1.41 | 30.90 |
| 2 | 6.59 | 5.42 | 25.21 | 15.01 | 7.98 | 1.57 | 0.25 | 6.28 | 1.38 | 30.31 |
| 3 | 6.62 | 5.41 | 25.04 | 14.94 | 8.21 | 1.67 | 0.25 | 6.27 | 1.39 | 30.20 |
| 4 | 6.61 | 5.41 | 25.03 | 14.92 | 8.21 | 1.68 | 0.25 | 6.33 | 1.39 | 30.17 |
| 5 | 6.62 | 5.42 | 25.01 | 14.91 | 8.20 | 1.67 | 0.25 | 6.38 | 1.39 | 30.15 |
| 6 | 6.62 | 5.41 | 25.01 | 14.91 | 8.20 | 1.68 | 0.26 | 6.39 | 1.39 | 30.14 |
| 7 | 6.62 | 5.41 | 25.00 | 14.91 | 8.20 | 1.68 | 0.26 | 6.39 | 1.39 | 30.14 |
| 8 | 6.62 | 5.41 | 25.00 | 14.91 | 8.20 | 1.68 | 0.27 | 6.39 | 1.39 | 30.13 |
| 9 | 6.62 | 5.41 | 25.00 | 14.91 | 8.20 | 1.68 | 0.27 | 6.39 | 1.39 | 30.13 |
| 10 | 6.62 | 5.42 | 25.00 | 14.91 | 8.20 | 1.68 | 0.27 | 6.39 | 1.39 | 30.13 |

issuance, and DSCR of commercial mortgages). Panel A presents the results for investment-grade CMBS, and Panel B the results for the high-yield CMBS.

Shocks in the economic variables, growth in industrial production and inflation rate both appear to have immediate negative effects on IG and HY CMBS excess returns. The effect, however, is stronger on HY CMBS than on IG CMBS.

The changes in the 30-year mortgage rate (MG30D) and the term structure spread (TSD) have highly significant and negative contemporaneous effects on ERICM and ERHCM. This result further demonstrates the importance of interest rate levels and term structure on debt securities in real estate. As interest rates and the term structure spread decline, the discount rate effect tends to drive up the excess returns on CMBS. Unlike residential MBS, commercial MBS are largely protected from prepayment risk through terms governing prepayment lockout, yield maintenance, defeasance, and prepayment penalties. As a result, the impacts of a higher mortgage rate and a higher yield curve spread on CMBS excess returns are highly significant and unambiguously negative.

The change in the high-yield credit spread (DYSBD) has a highly significant and positive contemporaneous effect on HY CMBS excess return, implying that investors are requiring a higher return on HY CMBS with an increase in credit risk premium. Although the change in the investment-grade credit spread (DYSAD) also has a positive effect on IG CMBS excess return, the effect is not significant. The CMBS delinquency rate does not appear to have any significant contemporaneous or lag effect on HY CMBS.

Inclusion of excess return on the S&P 500 (ERSP) in the structural VAR model sheds light on how the stock market affects CMBS returns. The contemporaneous ERSP appears to have negative impacts on both IG and HY CMBS excess returns, although the impact is stronger and more significant for the investment-grade securities. This is not surprising, given the substitution effect of stock and bond investing in portfolio allocation and the strong negative correlation between stocks and CMBS over the sample period.

The monthly change in the amount of CMBS issuance (CMBSID) appears to have a negative and highly significant lag effect on the HY CMBS excess return and a negative and marginally significant lag effect on the IG CMBS excess return. The negative lag impact of increase in CMBS issuance on CMBS excess returns is expected from a supply-demand perspective; an overwhelming increase in supply tends to depress prices and leads to a lower return as the securities are gradually absorbed by the market.

Finally, IG and HY CMBS excess returns are also strongly affected by their own shocks, as demonstrated by the highly significant and positive response to ERICM and ERHCM, respectively. The response of ERHCM to its own shock persists through three monthly periods, while the response of ERICM to its own shock is mainly contemporaneous.

The change in debt service coverage ratio, a primary indicator of the creditworthiness of securitized commercial mortgage portfolios, has an insignificant effect on

## EXHIBIT 10

**Comparison of Returns on Various Commercial Indexes**

Panel A. Descriptive Statistics

| | VACANT (Commercial Property Average Vacancy Rate in %) | NCREIF (NCREIF Commercial Property Index Return in %) | LEVY_CM (Giliberto-Levy Commercial Mortgage Index Return in %) | IG_CMBS (Lehman Brothers Investment-Grade CMBS Return) | HY_CMBS (Lehman Brothers High-Yield CMBS Return) |
|---|---|---|---|---|---|
| *Whole sample period from Q1 1997 to Q2 2006* | | | | | |
| Mean | 8.992 | 2.993 | 1.875 | 1.731 | 2.941 |
| Median | 8.800 | 2.855 | 1.090 | 1.461 | 2.159 |
| Maximum | 11.300 | 5.430 | 8.540 | 7.032 | 14.413 |
| Minimum | 6.900 | 0.670 | -2.180 | -3.369 | -16.477 |
| Std. Dev. | 1.437 | 1.097 | 2.221 | 2.411 | 4.956 |
| Skewness | 0.270 | 0.328 | 0.884 | 0.320 | -0.980 |
| Kurtosis | 1.637 | 2.725 | 3.761 | 2.438 | 8.205 |
| *Standard CMBS sample period from Q2 2000 to Q2 2006* | | | | | |
| Mean | 9.608 | 2.873 | 1.882 | 1.853 | 3.336 |
| Median | 9.900 | 2.760 | 1.030 | 1.334 | 1.747 |
| Maximum | 11.300 | 5.430 | 8.540 | 7.032 | 14.413 |
| Minimum | 6.900 | 0.670 | -2.180 | -3.369 | -1.648 |
| Std. Dev. | 1.406 | 1.236 | 2.554 | 2.638 | 3.572 |
| Skewness | -0.587 | 0.473 | 0.869 | 0.269 | 1.287 |
| Kurtosis | 2.212 | 2.535 | 3.280 | 2.325 | 4.696 |

Panel B. Correlation Matrix

| | VACANT | NCREIF | LEVY_CM | IG_CMBS | HY_CMBS |
|---|---|---|---|---|---|
| *Whole sample period from Q1 1997 to Q2 2006* | | | | | |
| VACANT | 1.00 | | | | |
| NCREIF | -0.33 | 1.00 | | | |
| LEVY_CM | -0.07 | -0.13 | 1.00 | | |
| IG_CMBS | -0.09 | -0.12 | 0.91 | 1.00 | |
| HY_CMBS | 0.04 | -0.09 | 0.62 | 0.54 | 1.00 |
| *Standard CMBS sample period from Q2 2000 to Q2 2006* | | | | | |
| VACANT | 1.00 | | | | |
| NCREIF | -0.33 | 1.00 | | | |
| LEVY_CM | -0.10 | -0.21 | 1.00 | | |
| IG_CMBS | -0.17 | -0.24 | 0.96 | 1.00 | |
| HY_CMBS | -0.12 | -0.01 | 0.84 | 0.80 | 1.00 |

the IG CMBS excess return but a marginally significant effect on HY CMBS excess return. This indicates the relatively stronger sensitivity of high-yield CMBS returns to changes in the creditworthiness of the underlying commercial mortgage portfolios.

While impulse response analysis is performed to illustrate how variables in the VAR system react over time to innovations or shocks in other variables, a variance decomposition technique allows us to compare the role that different variables play in causing such responses. Exhibit 9 reports two panels of results showing variance decomposition of excess returns on IG and HY CMBS.

Several results are worth noting. First, shocks to the excess return on CMBS consistently explain 26% to 32% of the variation of its own movement. Second, the change in mortgage rate (MG30D) and the term structure spread (TSD) together explain a sizable portion of the variation in CMBS excess returns (about 59% for IG CMBS and 45% for HY CMBS). This result implies that the changes in mortgage rates and yield curve dynamics are the critical driving forces for CMBS excess returns, especially IG CMBS.

Third, the growth in industrial production (IPSAG) and inflation (INF) explain 6.8% and 5.6% of HY CMBS excess return, but only 2.9% and 1.7% of IG CMBS excess return. Fourth, the high-yield credit spread (DYSBD) explains 7.7% of the HY CMBS excess return, while the investment-grade credit spread (DYSAD) explains only 0.8% of IG CMBS excess return, demonstrating more sensitivity to credit risk premium in the high-yield sector. Similarly, the change in debt service coverage ratio (DSCRD) explains a much higher percentage of the HY CMBS excess return than the IG CMBS excess return.

Finally, change in the monthly issuance of CMBS explains a much greater percentage of variation in CMBS excess returns in future periods than in the current period.

### Performance of CMBS, Commercial Mortgage, and Commercial Property

The structural VAR model does not include any factor on commercial property performance, as only quarterly data are available for such a performance index. Exhibit 10 provides some basic descriptive statistics, and Exhibit 11 illustrates the comparative performance of CMBS and commercial property or commercial mortgages, using quarterly data for the whole sample period and the standard CMBS sample period. Average vacancy rates on commercial properties are included in Exhibit 10.

The returns on investment-grade CMBS and the Giliberto-Levy commercial mortgage performance index

have a correlation of 0.91 for the whole sample period and a 0.96 correlation for the standard CMBS sample period. This is to be expected, given that CMBS are simply a securitization product of commercial mortgages. High-yield CMBS have a weaker correlation with the commercial mortgage performance index, but the correlation is still highly significant.

The returns on CMBS, which are basically debt securities on commercial property, are negatively but insignificantly correlated with return on the NCREIF Commercial Property Index and average vacancy rates on commercial properties, suggesting that the CMBS return is more likely to be driven by the economic, financial, and CMBS factors as identified by the structural VAR model than the commercial real property market.

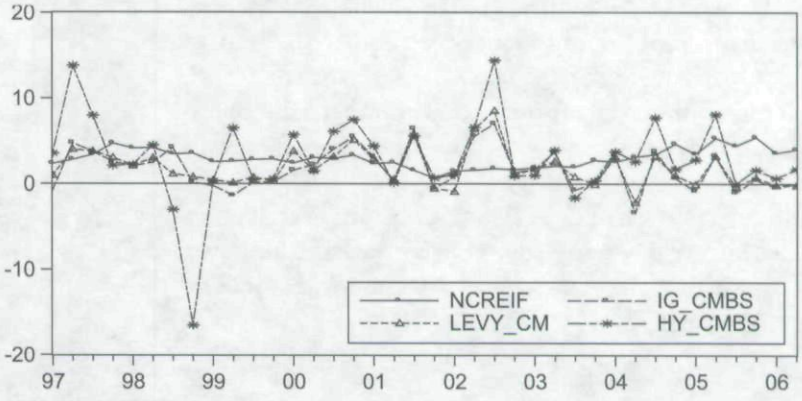
## SUMMARY

Sharpe ratios on investment-grade and high-yield commercial mortgage backed securities are found to clearly dominate those on investment-grade and high-yield corporate bonds, Treasuries, and stocks over January 1997-June 2006. Although CMBS outperform residential MBS and asset-backed securities on a mean return basis, they underperform residential MBS on a total risk-adjusted basis. Yet we should interpret those results, with caution, given the short history of available data and the relatively accommodating interest rate and real estate environment in the period.

Examination of the variables that drive the excess returns on CMBS, and how, includes the growth rate in industrial production; the inflation rate; change in mortgage rates; change in term structure spread, investment-grade credit spread, and high-yield credit spread; excess return on the S&P 500 stock index; delinquency rate on CMBS; and amount of CMBS issuance and change in the debt service coverage ratios of securitized commercial mortgages. Impulse response analysis and variance decomposition for a standard CMBS sample period indicate, first, that CMBS are most strongly affected by interest rate levels, the term structure of interest rate, and stock market returns. This is consistent with the empirical evidence to date on other fixed income instruments.

## EXHIBIT 11

**Return Performance on CMBS, Commercial Mortgages, and Commercial Property**




*NCREIF (NCREIF Commercial Property Index Return). LEVY CM (Giliberto-Levy Commercial Mortgage Index Return). IG CMBS (Lehman Brothers Investment-Grade CMBS Index Return) and HY CMBS (Lehman Brothers High-Yield CMBS Index Return).*

## APPENDIX A

**Justifications for VAR Model Variable Selection and Expected Relation with CMBS Return**

| Variable | Label | Justifications for Variable Selection and Expected Relationship with CMBS Return |
|---|---|---|
| IPSAG | Growth in industrial production | Economic growth should be positively related to market interest rates and negatively related to bond return |
| INF | Inflation rate | Inflation rate should be positively related to market interest rates and negatively related to bond return |
| MR30D | Change in mortgage rate | Prevailing mortgage rate should be negatively related to CMBS returns due to discount rate effect |
| TSD | Change in term structure spread | Term structure spread should be negatively related to CMBS returns since CMBS are exposed to term structure risk |
| DYSAD | Change in the investment-grade credit spread | Investment-grade credit spread should be positively related to the required return on investment-grade CMBS |
| DYSBD | Change in the high-yield credit spread | High-yield credit spread should be positively related to the required return on investment-grade CMBS |
| ERSP | Excess return on the stock market | Stock market return should be negatively related to CMBS return due to substitution effect in asset allocation between stocks and bonds. |
| CMSD | Delinquency rate on CMBS | Delinquency rate on CMBS should be positively related to the required return on high-yield CMBS |
| CMSID | Change in the amount of CMBS issuance | Change in CMBS issuance amount should have a lag negative effect on CMBS return based on the supply-demand principle |
| DSCRD | Change in the DSCR of commercial mortgages | Debt-to-Service Coverage Ratio (DSCR) of commercial mortgages should be negatively related to the credit worthiness of CMBS and positively related to the CMBS return |

Second, CMBS investors, especially high-yield CMBS investors, should be concerned as to the creditworthiness of the underlying commercial mortgages, the credit spread, and the overall CMBS market issuance. These CMBS-specific factors are also important drivers of CMBS returns.

Quarterly data on the return performance on CMBS indexes, commercial mortgage and commercial property indexes, and vacancy rates on commercial properties reveal that CMBS return performance is highly correlated with the return performance of non-traded commercial mortgages, but weakly correlated with real market indicators such as the return performance or vacancy rates of commercial properties.

## ENDNOTES

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[1]While the pricing and yield of CMBS have been researched in the literature, investors often find price return and yield to maturity to be unsatisfactory indicators of performance on their CMBS investments.

[2]I would like to have included three additional real market indicators in the model: commercial mortgage return index, commercial property return index, and commercial property vacancy rate. Unfortunately, these three variables are all available only on a quarterly basis, and not on a monthly basis.

[3]I focus on total return instead of yield to avoid the confounding problem of the reinvestment and prepayment. Total return, which is also called the holding-period return, measures what investors can earn from a security over a specified holding period. It is the most commonly used measure of return for all securities. Total return on CMBS is computed as the sum of price return, coupon return, and prepayment return for each monthly period.

[4]Data for monthly delinquency rates on CMBS are available only from May 2000, when CMBS underwriting became standardized.

[5]Only quarterly data are available for these two groups of indexes. Monthly data are not available.

[6]Excess return is computed as the total return on CMBS less the three-month Treasury bill rate.

[7]I conduct unit root tests to check whether the economic variables are stationary. For variables that are stationary, I compute the first differencing of these variables to induce stationarity.

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