An Analysis of Traditional Issue Specific and Macroeconomic Variables on US Commercial Mortgage Backed Securities

by

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Abstract

This paper examines the effects of traditional issue-specific commercial mortgage backed securities (CMBS) variables on US CMBS spreads. In addition, a decomposition of the Conference Board's US Leading Economic Indicators (LEI) Index will be examined for each of the ten component's explanatory power for US CMBS spreads. A qualitative examination of the history and setting of the US subprime crisis, features of US CMBS, and an outline of The Conference Board's US LEI components are provided. This is followed by an explanation of assumptions and the methodology used for the statistical analysis of the fourteen variables on CMBS spreads. In addition, the NA REIT Composite Index Dividend Yield is hypothesized to contribute to the CMBS spreads. A conclusion will contain results and proposals for an improved model, in contrast to Jadeja and Dorokov (Summer 2008). This paper closes with a discussion of possible sources of errors and guidance for future studies.

Keywords:

Commercial Mortgage Backed Securities, CMBS, CMBS spreads, CMBS ratings, percentage of subordinate debt, loan-to-value, debt-to-service-coverage, LTV, DSC, Leading Economic Indicators, LEI, US subprime, subprime crisis

Subject Terms:

Commercial Mortgage Backed Securities, CMBS, CMBS spreads, CMBS ratings, Leading Economic Indicators, LEI

Executive Summary

There is a multitude of variables that influence the spreads of Commercial Mortgage Backed Securities (CMBS). The three traditional issue-specific factors are the CMBS rating (RAT), the loan-to-value ratio (LTV), and the debt-to-service coverage ratio (DSC). Also, the percentage of subordinate debt of a CMBS issue (SUB) is widely considered an integral determinate of spreads. These four traditional issue-specific variables combined with various macroeconomic influences are hypothesized to significantly affect CMBS spreads.

Empirically, this paper finds CMBS ratings as the dominate driver of CMBS spreads. While LTV, DSC, and SUB are less sensitive than RAT, these variables are still statistically significant. This result is consistent with the findings of Jadeja and Dorokov (2008). Subsequently, the Conference Board's ten US Leading Economic Indicators (LEI) components are analyzed for their qualitative relevance and quantitative explanatory value in determining standardized CMBS spreads. Most of these individual component results are insignificant; however, as a group of indicators, they are significant and contribute to improving the explanatory power of the CMBS spreads model. Surprisingly, with the addition of the NA REIT Composite Index Dividend Yield, this model specification led to a lower coefficient of determination for standardized CMBS spreads in comparison to the proposed Ten Factor Hybrid Model.

The statistical test results of Jadeja and Dorokov (2008) are verified and differences are reconciled. Various model specifications are proposed, analyzed, and discussed in the context of statistical regressions. A comparison of the results from this paper's proposed Ten Factor Hybrid Model for CMBS spreads will demonstrate an improvement in the coefficient of determination, the F-statistic, and the Durbin Watson statistic over the Three Factor Model (RAT, SUB, and DSC) proposed by Jadeja and Dorokov (2008). The conclusion will yield an improved proposed model specification for CMBS pricing (the Ten Factor Hybrid Model), possible sources of errors, and guidance for future studies.

Dedication

I would like to dedicate this paper to two select individuals who have inspired me, challenged me, supported me, and mentored me in life.

I would like to dedicate this paper to Hui Qing (Cherry) Ou for her faith in my competence, morality, and adaptability. She continues to drive me to my best – possibly challenging me a bit too often at times. Cherry's absurd work ethic has constantly pressured me to match her efforts, and her dependability has always given me a sense of serenity and comfort in the most trying of times. I am indebted to her rational decision making abilities and complementing guidance as I would often be lost without it.

I wish to also dedicate this paper to my father, David T.K. Ho, for his unconditional love. His support for my decision to take the MBA program is greatly treasured. I wish us the best for all the years to come. He has been an early inspiration in my life as I aspire to reach my potential as a financier, business person, and family man during my post-graduate career.

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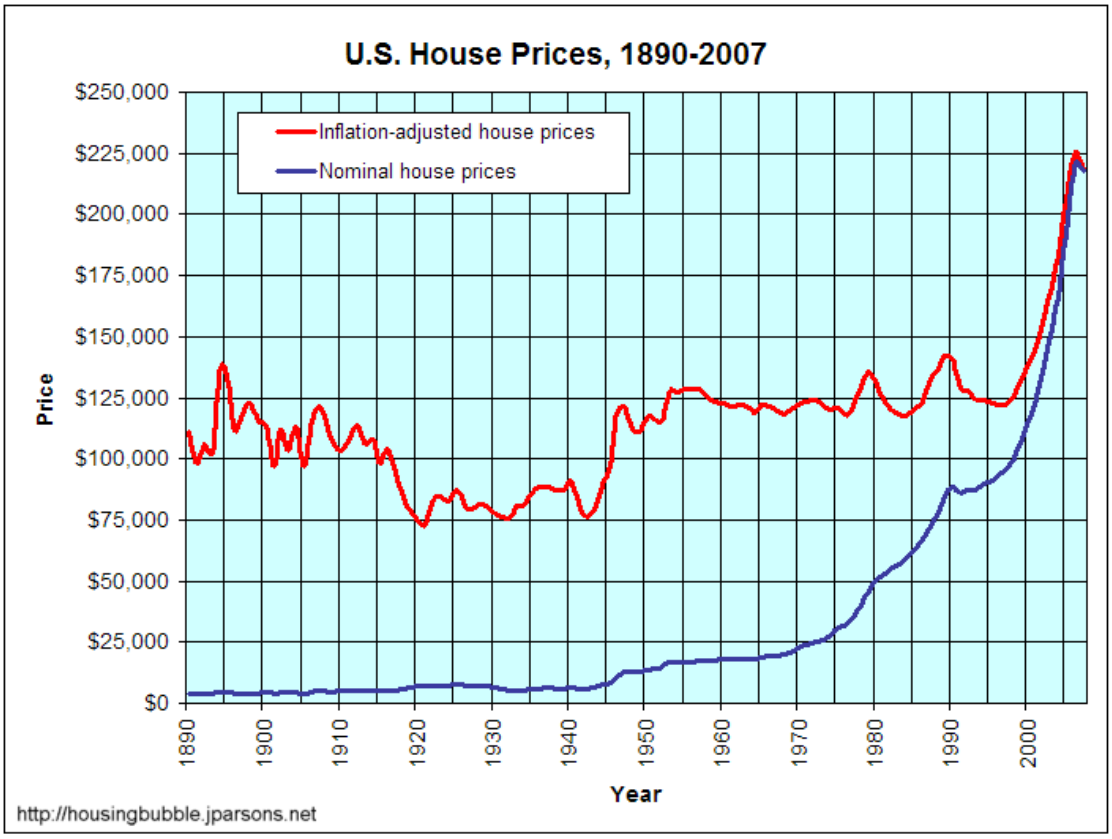

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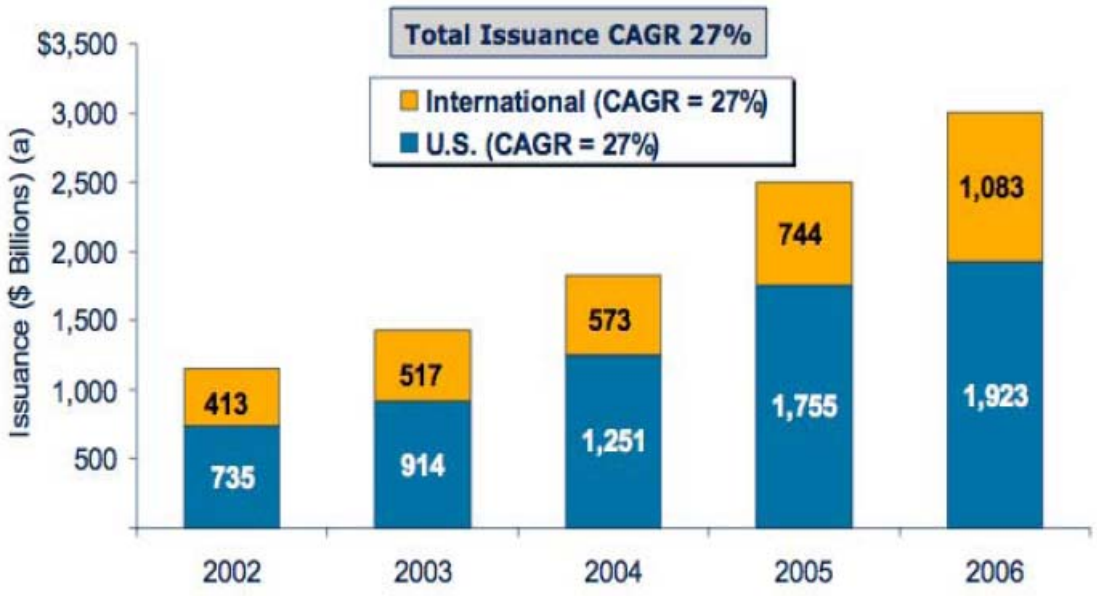

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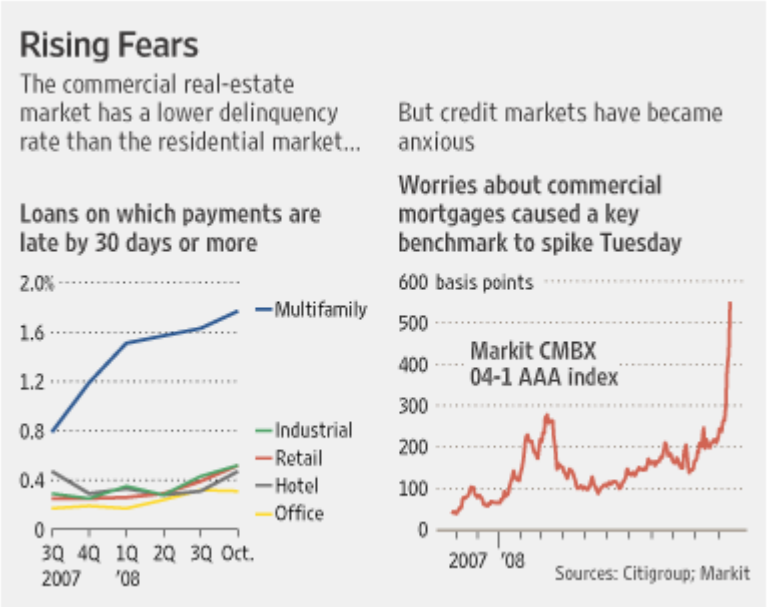

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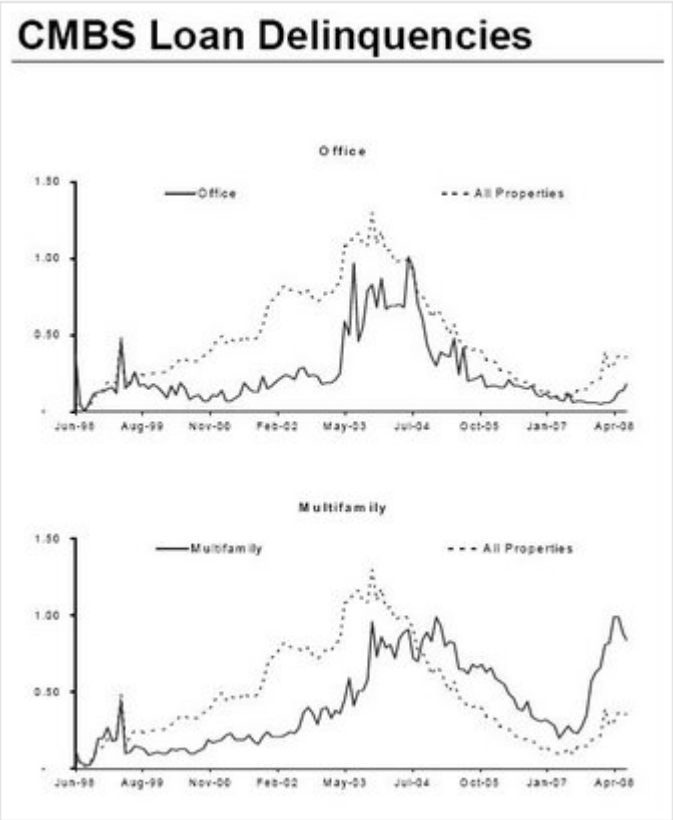

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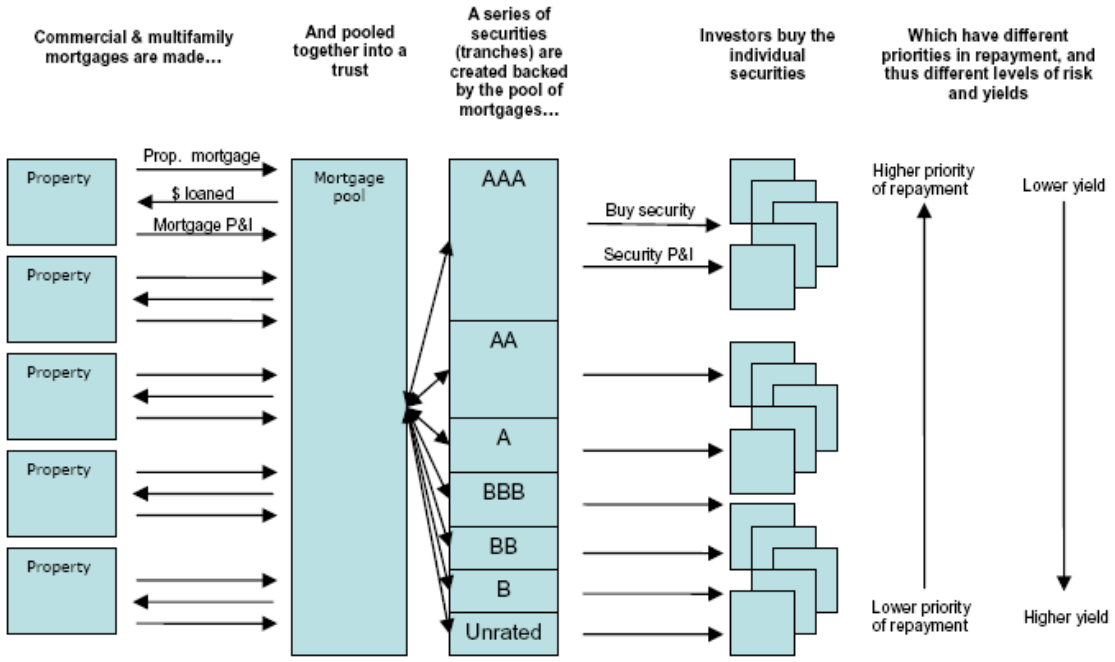

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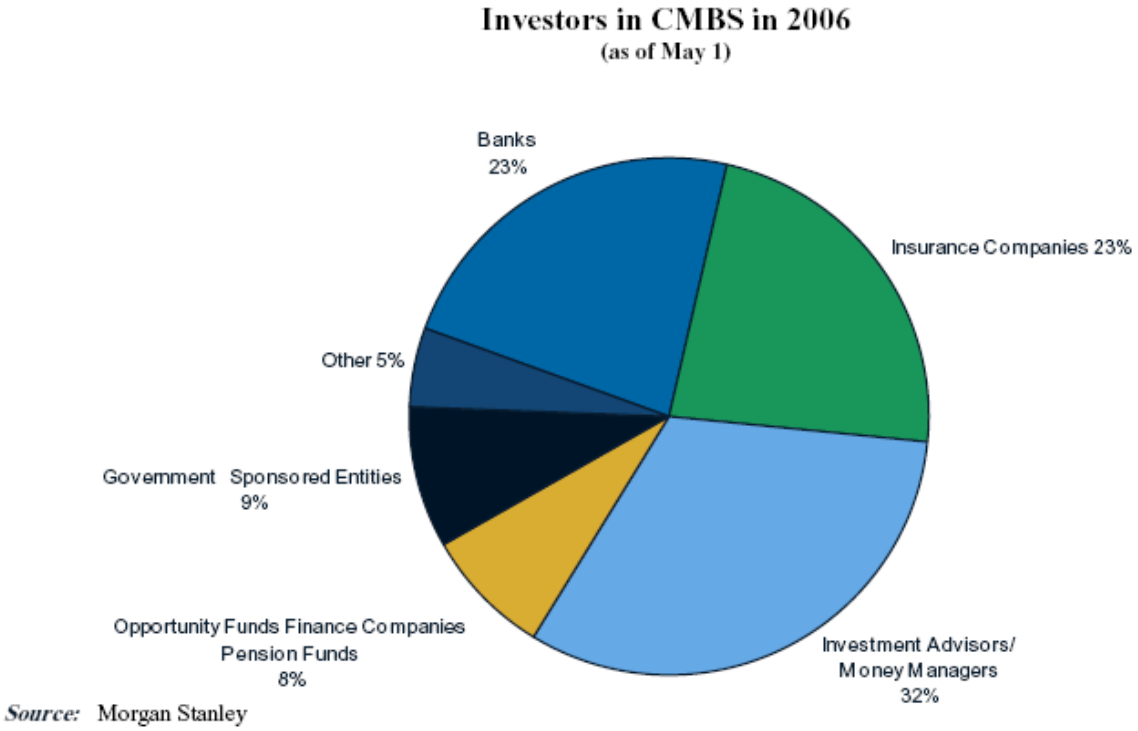

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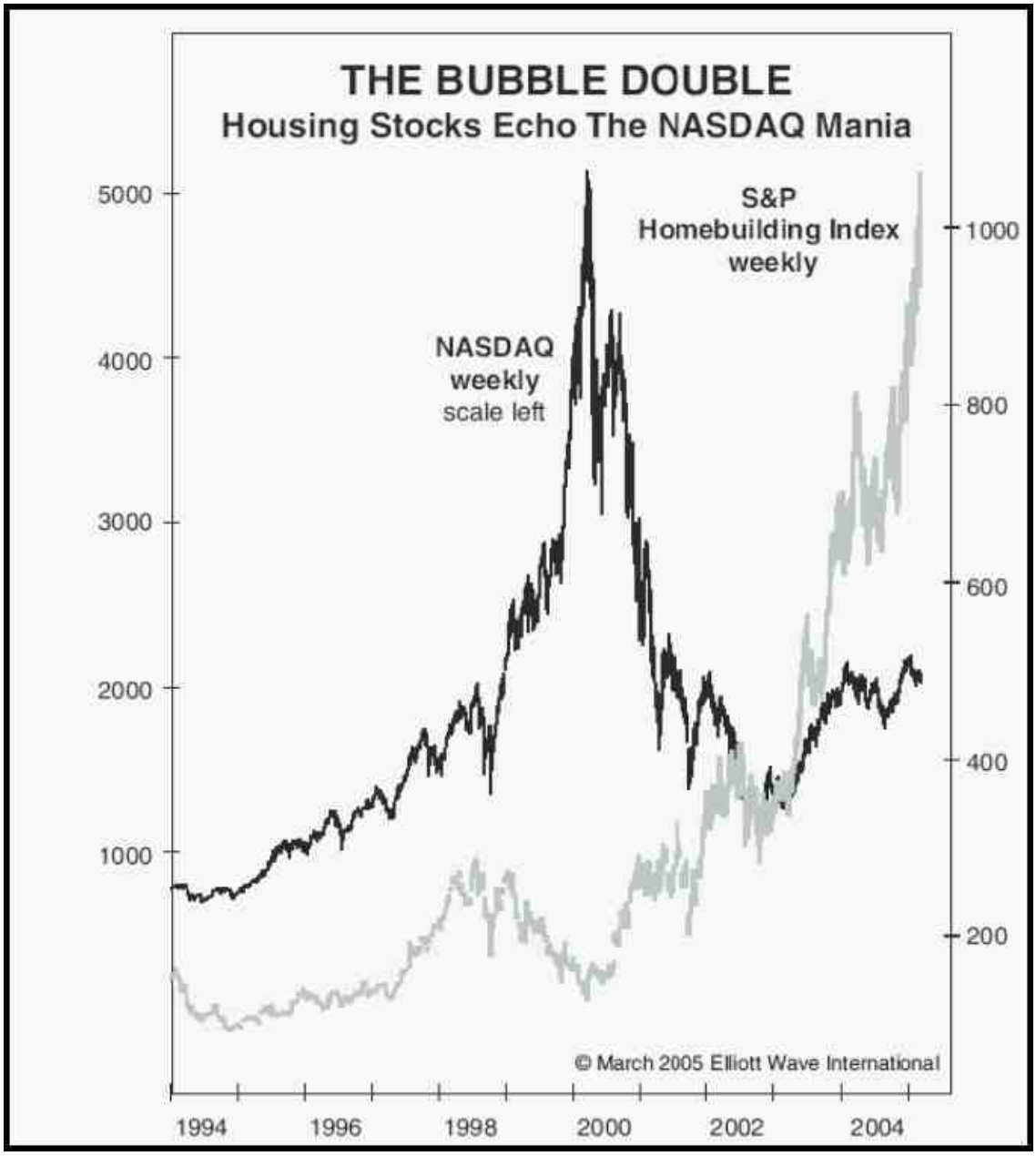

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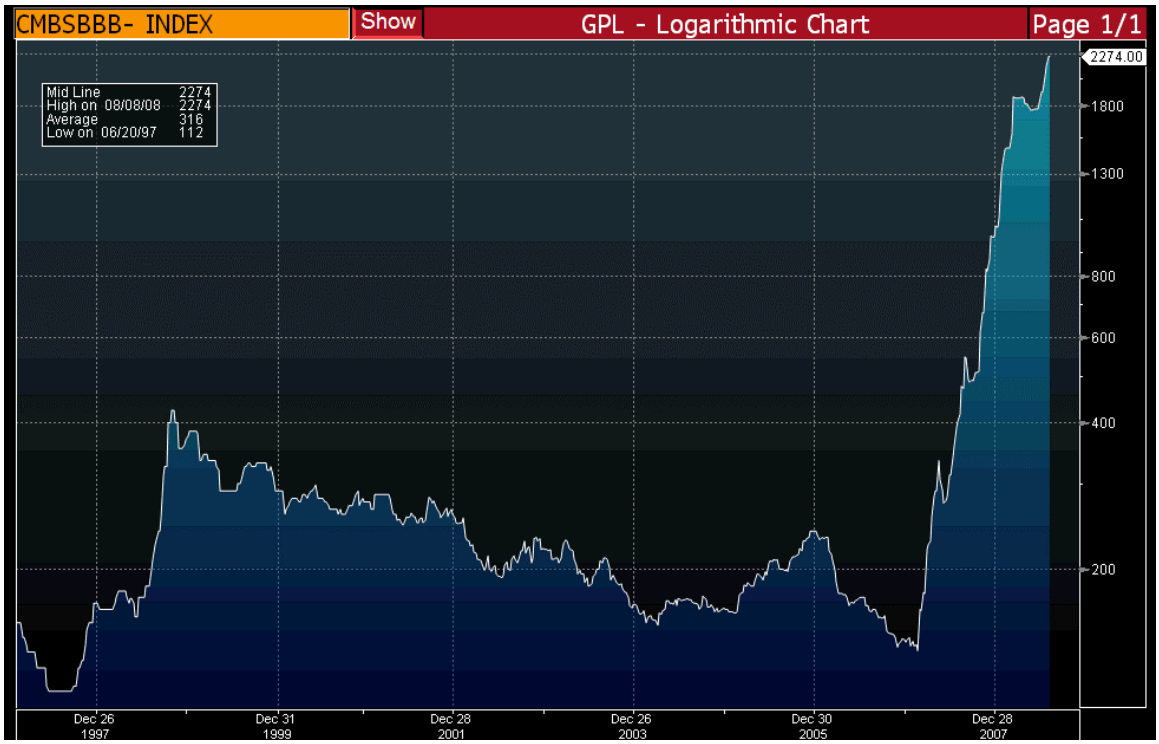

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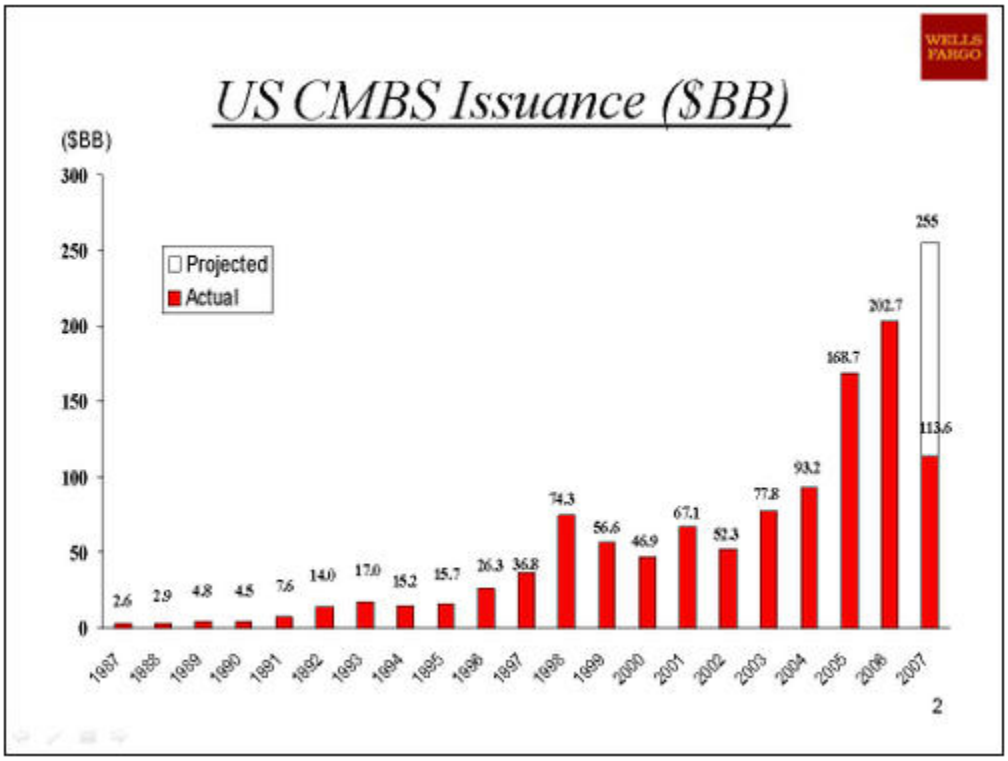

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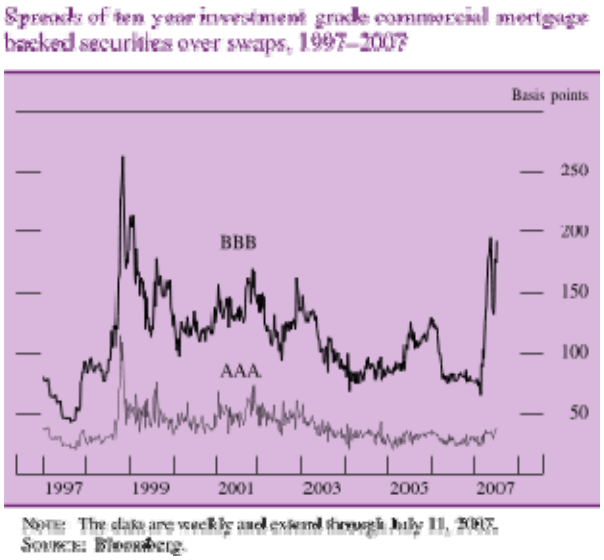

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Table 1: CMBS Unified Rating Valuation Scale

- Identical to the Jadeja and Dorokov (2008) Study

S&P	Moody's	Fitch	Unified Scale
Investment Grade			
AAA	Aaa	AAA	19
AA+	Aa1	AA+	18
AA	Aa2	AA	17
AA-	Aa3	AA-	16
A+	A1	A+	15
A	A2	A	14
A-	A3	A-	13
BBB+	Baa1	BBB+	12
BBB	Baa2	BBB	11
BBB-	Baa3	BBB-	10
Non-Investment Grade			
BB+	Ba1	BB+	9
BB	Ba2	BB	8
BB-	Ba3	BB-	7
B+	B1	B+	6
B	B2	B	5
B-	B3	B-	4
CCC+	Caa1	CCC+	3
CCC	Caa2	CCC	2
CCC-	Caa3	CCC-	1

Table 2: CMBS Rating Valuation Scale with Gap = 10

- Used as inputs for the Ten Factor Hybrid Model results

S&P	Moody's	Fitch	Unified Scale
Investment Grade			
AAA	Aaa	AAA	**29**
AA+	Aa1	AA+	**28**
AA	Aa2	AA	**27**
AA-	Aa3	AA-	**26**
A+	A1	A+	**25**
A	A2	A	**24**
A-	A3	A-	**23**
BBB+	Baa1	BBB+	**22**
BBB	Baa2	BBB	**21**
BBB-	Baa3	BBB-	**20**
Non-Investment Grade			
BB+	Ba1	BB+	9
BB	Ba2	BB	8
BB-	Ba3	BB-	7
B+	B1	B+	6
B	B2	B	5
B-	B3	B-	4
CCC+	Caa1	CCC+	3
CCC	Caa2	CCC	2
CCC-	Caa3	CCC-	1

Qualitative Fundamentals

History and Setting of the US Subprime and CMBS Crisis

The year 2008 will be characterized in history by the insolvencies of many iconic US financial institutions such as Bear Stearns, Lehman Brothers, AIG, Countrywide Financial, and Washington Mutual. However, the reasons for the demise of these US financial pillars were gradual and compounding, as opposed to sudden and overnight.

In March 2000, the Nasdaq Composite Index reached its pinnacle of 5,049; and in October 2002, the Nasdaq Composite Index troughed at 1,116. In about two and a half years, 77.9% of the Nasdaq Composite market capitalization was erased. Financiers felt a sense of resentment towards publically traded equities after the technology bubble burst, in conjunction with a drastically lowered risk appetite. A national portfolio rebalancing towards asset classes with low systematic risk and lower perceived risk quickly followed.

During the time period between December 2001 and November 2004, the US federal funds target interest rate remained below 2%. This expansive monetary policy stimulated investment and consumption with lower opportunity costs of capital. However, insurance companies, and to some extent pension funds, would unlikely be able to cover their fixed liabilities with low yielding US Treasuries. Thus, in efforts to avoid defaulting on these liabilities, firms of this nature commenced a search for higher yields for future viability. It is important to note that as US interest rates were declining, a global appreciation of housing and other asset prices materialized.[i] This set the stage for the US commercial and residential real estate bubbles.

Due to the resilience of US nominal and real housing prices from 1998, even before the technology bubble imploded, coupled with historically low interest rates, the confidence

in the US real estate asset class increased for investors.[ii] With this realization along with an increasing market demand for high yielding securities, investment banks commenced underwritings of financially engineered products. This led to the proliferation of the collateralized debt obligation (CDO) securities.

This new demand for CDO securities was unprecedented; but more importantly, it was an extraordinary event as opposed to a sustainable event. The CDO market itself was strong enough to drive demand for underlying mortgages in and of themselves.[iii] In turn, these mortgage originations further inflated housing prices. The investment banks and their structured finance vehicles drove demand for subprime mortgages from the mortgage-originating lenders. These lenders prospered from each incremental mortgage origination. Lending standards started to deteriorate as greed and potential for material abundance prevailed. Although this fact was a major factor for RMBS crisis, this was *the* primary factor for the CMBS crisis.

Investment banks and mortgage firms operate in the entrepreneurial worldview where material abundance is respected, the individual reigns supreme, and the velocity of decision-making is valued.[iv] Compliance becomes an impediment to velocity and that in itself, hinders a mortgage lending agent from heightened material compensation. Thus, it should be expected that lending standards fall in this setting, and indeed they did.

Assumptions that should be questioned remained unquestioned in the housing market bubble. Expectations of continued rising housing prices, refinancing mortgages at lower rates, and improving credit scores are not rational and sustainable assumptions. Also, traditional CDOs invested in unique pools of corporate loans and bonds. Systematic risks are determined by holding various proportions of cyclical and counter-cyclical industries within the pool. However, the Asset Backed (ABS) CDO securities are dictated by economic factors on a national level such as interest rates, housing prices, and the labor market; these systematic risks are non-diversifiable. A critical assumption that ABS CDO securities could diversify systematic risks like traditional CDO securities was a fallacy. Thus, in the event of a collapse in housing prices or national economic malaise, the erroneous low beta assumption of the CDO would have severe consequences as this economic assumption is critical in

structuring ABS CDOs.[v] However, one major assumption differs for the CMBS case: commercial real estate pricing *is* cyclical. In hindsight, the CMBS case is even tougher to digest with this historical fact in mind.

A seemingly more cohesive assumption is that the CDO ratings provided by the big three rating agencies, S&P, Moody's, and Fitch, are objective and justified. However, conflicts of interests between underwriters and rating agencies plague objectivity and justification for CDO issue ratings. The rating agencies become a consultant to the underwriters to achieve desired ratings. The compensation scheme in itself is a conflict of interest – the rating agencies are compensated *by* the underwriters. [vi] This is a typical example of agent capture.[vii] Less sophisticated and smaller financial institutions relied more on ratings provided by the big three credit rating agencies than larger and more sophisticated financial institutions.[viii] This factor was more significant for the RMBS crisis as opposed to the CMBS crisis. Commercial properties are more flexible and easier to transform for other functions; thus, the CMBS are less susceptible to precipitous price drops than RMBS, status quo.

A resilient US housing market from 1998 through 2006, unparalleled demand for high yielding securities in a low interest rate environment, fallacious low systematic risk CDO assumptions, and conflicts of interest between rating agencies and underwriters leading to artificially high CDO issue ratings, together, created the foundation for the subprime crisis to germinate, fester, and infect the global financial system. The story for the CMBS market has many parallel similarities with the subprime RMBS crisis: the low interest rate environment drove demand for higher yielding securities, the conflicts of interest between rating agencies and the underwriters leading to inflated CMBS ratings, and the widespread deteriorating lending standards of financial institutions.

On topic with the 2007 US Recession, the current subprime crisis outlined has affected the less affluent; however, easy credit was a widespread disease. Any loan to any borrower could be classified as subprime if there is inadequate down-payment or an exorbitant amount of debt. This is an issue of concern for the commercial real estate market. Commercial properties of various types enjoyed significant price appreciation since the

beginning of this century and delinquencies had fallen to record lows in early 2007. However, the possible implosion of the CMBS market will be markedly different than the RMBS precipitous fall: there are no targets of predatory lending and there were no failures by government regulators.[ix] The public does not have the less affluent US citizens to commiserate with for the CMBS scenario as opposed to the RMBS scenario. The corporate and institutional greed for incremental profit has led to a probably CMBS crisis.

The commercial real estate market crisis will yield less detrimental affects than the recent housing crisis. It is a smaller market in aggregate and the buildings have a diversified group of tenants with various sources of income. In 1995, $15.7 Billion of CMBS were issued; in the first three quarters of 2007, $196.9 Billion of CMBS were issued.[x] The market size for outstanding CMBS issues is $730 Billion. It is important to note that the supply of commercial real estate was proportionally much less than the residential market and commercial real estate is easily renovated for a multitude of uses and functions.

Falling lending standards, excessive levels of greed, lofty ratings granted per issue, and the amount of leverage applied have pushed the CMBS market into a state of irrational exuberance.[xi] The security underwriting rate was unsustainable, money supply is finite, and the market was further spurred with fallen lending standards and undeservingly high ratings. Commercial real estate is cyclical; Wall Street anticipated an inevitable market crash. The corporations and institutions that have created the CMBS disarray will be held accountable, slandered, and shown no mercy by the public media and societal factions.

The most recent US recession commenced in December 2007.[xii] This recession is largely attributed to the simultaneous collapse of the national housing bubble and the aggravating subprime mortgage crisis in 2006. In November 2008, there have been arising fears of probable widespread distress in the US commercial mortgage back securities (CMBS) market as indicated by record high risk premiums.[xiii] With this possible scenario becoming an economic reality, a study of issue specific and macroeconomic variables influencing CMBS spreads is pertinent and insightful to the persevering US economic environment.

US Commercial Mortgage Back Security Features

The US mortgage market is comprised of two divisions: the residential mortgage market typically includes properties with one to four single family units; and the commercial mortgage market includes income-producing properties such as apartment buildings, office buildings, industrial warehouse properties, shopping centers, hotels, and health care facilities for senior housing care and retirement homes.[xiv] The focus of this paper is strictly within the confines of the US commercial mortgage market.

Commercial mortgage loans are originated to finance a new purchase or refinance an existing commercial mortgage obligation. CMBS are non-recourse loans: there is no reliance on the capacity of the borrower to repay. Thus, the CMBS holder is only able to depend on the income-generating property backing the loan for interest and principal repayment. If the CMBS were to default partially or fully, there will be no recourse to the borrower for the outstanding unpaid balance; however, the holder of the CMBS has an option to consider selling the property for repayment proceeds.[xv]

A significant reason for the extraordinary market demand for ABS CDO securities was due to tranching. Although tranching does not reduce the absolute degree of risk associated with a pool of mortgages, it does distribute risk to various tranches in different degrees.[xvi] Each tranch is analyzed by its relevant expected cash flows for its respective property; thus, each tranch contains unique risks and is priced accordingly. Payouts from the ABS CDO pool were first allocated to the least risky senior tranches, then the mezzanine tranches and lastly to the most risky equity tranches. Consistent with each tranch's risk characterization, losses were first allocated to equity tranches, then to the mezzanines, and only lastly to the senior tranches.[xvii]

The four traditional key predictors of CMBS performance are the CMBS ratings (RAT), percentage of subordinate debt (SUB), loan-to-value ratio (LTV), and the debt-to-

service coverage ratio (DSC). The CMBS issue rating is provided by the big three credit rating agencies: Standard and Poor's, Moody's, and Fitch. The higher the SUB of a CMBS issue approximates the issues' higher sensitivities to riskier tranches and payment default, status quo. The LTV ratio for CMBS analysis is similar to a price-to-earnings metric for equity analysis. The numerator (loan) is defined as the outstanding loan amount, and the denominator (value) is defined as the present value of expected cash flows discounted at a specified capitalization rate. Thus, the value for the loan figure is the future net operating income (NOI), rental income subtracting cash operating expenses, discounted by a single capitalization rate. This is significantly different from a residential mortgage backed security (RMBS) as RMBS use a market or appraisal figure for value. Therefore, analysts are skeptical about the forecasting of expected cash flow generation and usage of a single, blunt capitalization rate for resulting LTV ratios reported. Lastly, the DSC ratio is defined as the NOI divided by debt service. A ratio greater than one suggests that the income generated from the property is sufficient to cover debt servicing. Thus, DSC ratio may vary due to NOI estimates, but to a significantly lesser extent than LTV ratio as discounting is a non-factor.

In general, CMBS are less exposed to prepayment risk than RMBS. On the loan level, CMBS usually entail prepayment penalty mechanisms in the form of prepayment penalty points, yield maintenance charges, or specific lockout periods. Defeasance is a popular mechanism used as funds intended for prepayment are then invested in US Treasury portfolios. In essence, defeasance mitigates proportional CMBS credit risk exposure since it is indirectly backed by prepayment funds invested in US Treasuries. There are also mechanisms on the CMBS structural level acting as call protections. Due to these loan and structural level CMBS call protections, CMBS trade more similarly to traditional corporate bonds in contrast to a non-agency RMBS.[xviii]

Stress tests with Monte Carlo and scenario analysis with varying assumptions of default risk, conditional default rate, timing of defaults, concentration of property geography, and percentage of loss severity are performed to understand sensitivities and risks associated with CMBS. General risks associated with mortgages include credit risk, liquidity risk, interest rate risk, and prepayment risk.

Comprehension of these general features of the commercial mortgage market and CMBS lead to a better understanding of the composition of ABS CDO securities. A portfolio or pool of various heterogeneous CMBS issues, in whole or in part, serves as the fundamental inputs comprising of CMBS CDO securities.

US Leading Economic Indicators Introduction

The Conference Board (CB) is a not-for-profit organization that amalgamates, analyzes, and disseminates information about economic-based forecasts and market trends for over the past 90 years.[xix] The CB US Leading Economic Indicators (LEI) and its ten components will be scrutinized in this paper. Although a dichotomous LEI index classified into periods of expansions for predicting peaks and periods of contractions for predicting troughs will lead to higher coefficients of determination, the focus will be on the individual LEI components.

The following is a discussion of each of the LEI components: (1) Manufacturer Average Work Week (MFG) measures the average work week in hours of manufacturing employees in the US. Theoretically, trends in MFG contribute to general economic forecasting not only on an absolute expansion or contraction level, but on a rate of change level as well. This statistic is recorded monthly. (2) Initial Jobless Claims (JOB) is a measure of the number of people filing first-time claims for state unemployment insurance.[xx] The higher this number results in a higher unemployment statistic and forebodes lesser economic activity. This statistic is recorded weekly. (3) Seasonally Unadjusted Durable Goods and Materials New Orders (ODR_CM) notes the amount of total $US for new orders received from more than 4,000 manufacturers in more than 85 industries of durable goods in the US. Growth in ODR_CM has usually occurred in advance of general economic expansion. This statistic is recorded monthly.[xxi] (4) Purchasing Manager's Index (PMI) is an indicator based on five major indicators: new orders, inventory levels, production, supplier deliveries and the employment environment. A measurement above 50 represents manufacturing sector expansion and below 50 signals manufacturer sector contraction.[xxii] The PMI is measured on a monthly basis. (5) Seasonally Unadjusted Manufacturing Excluding Defense New Orders (ODR_XD) is similar to ODR_CM as it is measured in total $US for new orders received from manufacturers subtracting defense industry related orders. ODR_XD is also recorded monthly. (6) New Privately Owned Housing Units Authorized by Building Permits

in Permit-Issuing Places (BLD) is a proxy measure for housing starts. This metric notes the number of residential building construction projects that have commenced during a given month. The more people buying new houses signal economic strength and confidence for future prospects.[xxiii] (7) The Standard and Poor's 500 Index (SPX) is the most commonly used index to gauge the US large capitalization stock market performance. It includes 500 stocks based on market capitalization, liquidity, and industry grouping among other factors. The S&P Index is market capitalization weighted and is measured daily.[xxiv] (8) Inflation Adjusted M2 (AM2) is a measure of US national money supply. M2 includes M1 plus all time-related deposits, savings deposits, and non-institutional money-market funds.[xxv] Money supply can predict inflationary and deflationary trends and is an important consideration for adjustments in interest rates. For this study, the CPI (January 1998 = 100, base year) is factored into the M2 figure in order to adjust for inflation. AM2 is reported on a monthly basis. (9) The Interest Rate Spread between the 10 Year US Treasury and the Federal Funds Rate (SPR_10FF) reflects how the market evaluates a longer term economic outlook. If the spreads widen and report a higher figure, the general expectation is that the economic outlook is weaker. Higher bond yields also attract investment funds from equity classes. This figure is recorded daily. And finally, (10) Expectations Portion of the University of Michigan's Consumer Sentiment Index (CSI) is a measure of expected consumer sentiment. This figure is a monthly final output from a formula.[xxvi] The higher the CSI reading for the month, the more comfortable consumers are about purchasing, thus, stimulating the economy. The CSI is measured monthly. Incorporating these ten measured variables through specified mathematical formulae, the CB produces a composite index with predictive implications on the US economy.

The methodology for computing the actual inputs into the statistical regression analysis will be discussed in the ensuing Quantitative Modeling and Results section.

Quantitative Modeling and Results

Generalizations and Assumptions

As with any model that attempts to model reality, this model is a drastic simplification of the real world. However, the findings and results do contribute to understanding how CMBS spreads vary with respect to traditional issue-specific and macroeconomic variables.

The ordinary least squares (OLS) model is utilized for the following analysis. OLS is only one of many possible methods which a curve can be fitted with data.[xxvii] This method assumes a linear relationship between the dependent variable, the standardized CMBS spreads, and the independent variables, the traditional issue-specific and macroeconomic factors. This assumption is quite possibly violated in a realistic context. The "line of best fit" is that which minimizes that sum of squared deviations of the points of the graph from the points of the straight line, distances measured vertically.[xxviii] Therefore, OLS regressions are very sensitive to outliers. In the spirit of retaining objectivity, no data points were discarded for all regressions in this paper. OLS assumes non-stochastic independent variables; and in addition, no exact linear relationship exists between two or more independent variables.[xxix] This assumption seems reasonable as inputs are from past recorded data. The error term for the regression has an expected value of zero. This could be a possible source of error as many indices are biased upward, even if not for the time periods relevant to this study (for example, S&P 500 index since inception). The error term of the OLS regression is assumed to have a constant variance for all observations. Volatility is unlikely constant throughout time and even doubtfully for the 1998 – 2008 time period of interest. The random variables are assumed statistically independent in OLS modeling. This is another possible violation since there are likely positive correlations among independent variables and negative correlations among other independent variables. In accordance with the Gauss-Markov

Theorem, given these assumptions, the estimators of alpha and beta are the most efficient linear unbiased estimators of alpha and beta in the sense that they have the minimum variance of all linear unbiased estimators.[xxx] Finally a more acceptable assumption for OLS modeling: the error terms are normally distributed in the OLS.

It would be possible to use autoregressive conditional heteroscedasticity (ARCH) models and generalized autoregressive conditional heteroscedasticity (GARCH) models for non-constant error term modeling. This application for CMBS spread modeling may give reason to support thy hypothesis that the variance of the error term is not a function of an independent variable, but instead varies over time depending on past magnitude of errors. As with inflation, interest rates, and stock market returns, there is often evidence of clusters of large and small errors.[xxxi] ARCH and GARCH models could lead to increased efficiency as Gauss-Markov Theorem may have been violated.

The source data used to compute the regression inputs were from Commercial Mortgage Alert (www.cmalert.com). From 22,581 possible data points, a subset of 1,589 data points was used. The discarding of 92.96% of the source data could have severe implications. This massive amount of discarded data was due to frequently omitted necessary inputs such as at least one CMBS issue rating from one of the big three credit rating agencies, date of origination and pricing, originating spread over the benchmark, and the benchmark itself from the original source data. However, in comparison to the 1,179 observations used in Jadeja and Dorokov (2008), this study has gathered 34.78% additional data. Thus, embedded in this study is an assumption that the results from this study's sample statistical analysis are consistent with the population's statistical analysis results. This assumption could possibly be violated; however, there is no definitive resolution as there is no relative data to compare the sample against the population results.

A pooled data set, cross-sectional and time-series, is used for this study. The source data from Commercial Mortgage Alert is a cross-sectional, as opposed to a time-series, measurement of various data at the CMBS origination date. The dependent variable in CMBS spreads and the four traditional issue-specific independent variables are classified as cross-sectional data; whereas, the ten CB LEI components are categorized as time-series data.

Thus, there is an implicit assumption that the methodology used to price of CMBS at origination is consistent throughout the 1998- 2008 period. This assumption is likely violated; however, time-series data for each CMBS issue would be sparse and intermittent due to the lack of liquidity and volume of trades on these securities. To the point, the CMBS spread at origination is assumed to be equivalent to an observed CMBS market spread.

As previously discussed, the two traditional issue-specific CMBS variables in LTV and DSC contain assumptions of an appropriate capitalization rate and predictions of incoming cash flows (NOI). The assumptions cannot be analyzed from the source data. Therefore, this is another possible source of error to consider.

The data set from 1998 – 2008 will be split into three time periods. Jadeja and Dorokov (2008) alleged that a four year cycle is sufficient time to draw conclusions regarding patterns and macroeconomic trends characteristic of the respective period. This explicit time period separation is also necessary to contrast the results from this study to those of Jadeja and Dorokov (2008). Results could vary widely depending on the time periods chosen; thus, careful judgment with economic intuition for separating periods of contraction and expansion is critical for this study's results. However, a full time period analysis could provide some perspective.

There are implicit lagging variables from the LEI components. Only the SPX and SPR_10FF are recorded daily; whereas, the other eight variables are recorded either monthly or weekly. This will certainly distort the regression line fit the further these variables are regressed from their recorded date. There is no solution for this issue as daily data does not exist for these eight variables. Thus, we need to keep in mind that the final coefficient of determination with any of these eight LEI components is likely understated.

There are many questionable assumptions explicit and implicit in the following statistical analysis. None of them by themselves or as a collective group is likely to render this study's statistical analysis in absolute futility. OLS modeling assumptions are frequently violated in practice still yielding significant implications. Possible model misspecification can have serious impacts; however, being aware at every step of modeling methodology can

mitigate undesired errors. A sample size of an absolute 1,589 observations should approximate results derived from a significantly larger population. The assumption of CMBS spreads at origination being equivalent to hypothetically observed CMBS market spreads is a concern. However, there may be no superior procedure available and it is approximately correct. The exact time period separations, LTV and DSC variance, and frequency of recorded data measurement concerns are important to recognize; however, these concerns cannot definitively defeat any conclusions drawn from this statistical study on standardized CMBS spreads.

Input Data Specification Methodology

From Commercial Mortgage Alert (www.cmalert.com), input data was filtered for completion of the following fields: date of origination, LTV, DSC, Country (Only $US denominated US CMBS issues are included in this study of variables affecting standardized CMBS spreads), rating (at least one valid rating from any of the big three rating agencies), percentage of subordinate debt, specified spread in addition to the CMBS benchmark, and the CMBS benchmark. In order to compute final values for the dependent variable, each CMBS specific spread is added to the respective CMBS benchmark for each CMBS issue and tranch. Then this set of absolute CMBS spreads were standardized by subtracting the 3 month US Treasury yield. This was the calculation for the standardized CMBS spread, dependent variable, for all the subsequent OLS regressions analyses in this paper.

With regards to ratings, S&P, Moody's, and Fitch all use similar ratings evaluation criteria for CMBS. The input data included in this study requires at least one rating from any of these big three rating agencies. For cases where a CMBS issue has multiple ratings, the priority is to use S&P, then Moody's, then Fitch. The justification for this priority is derived from the highest to lowest number of outstanding rated CMBS issues. This specification mirrors that of Jadeja and Dorokov (2008). Ratings are initially scaled with a unified rating system as specified in Jadeja and Dorokov (2008).[xxxii]

The remainder of the traditional issue-specific independent variables, SUB, LTV, and DSC, were not manipulated for the OLS regression inputs. However, a couple of the time-series independent variables in the LEI components required calibration. For inflation adjusted M2 (AM2), monthly non-adjusted M2 was taken and multiplied by a CPI figure scaled to a reading of 100 for base month and year, January 1998. Each month in the inspected time period from 1998 – 2008 is calculated in the same manner. The ten year US Treasury spread over the Federal Funds Rate was computed by the subtraction of the respective Federal Funds Target Rate from the daily ten year US Treasury spread for each

day for this study's time horizon, 1998 - 2008. The other eight indicators were sourced and their raw data was used as inputs for the various OLS regressions.

For the following Regression Model 5, the natural logarithm of the computed dependent variable CMBS spreads was used. The economic intuition for using this mathematical function is that there is a supposed non-linear relation between spreads. In reality, the spread difference between two identical securities with AAA and AA rating is far smaller than the spread difference between two identical securities with CCC and CC rating, although both these examples are an absolute one rating separation. Utilizing the natural logarithm, this transformed CMBS spreads data provides a drastically improved coefficient of determination.

On Regression Model 6, there is a gap distinguishing the investment grade CMBS issues and the non-investment grade CMBS issues. After multiple attempts of trial and error to narrow the possible intervals and find a specific value for this gap, a gap value of 10 appears to be a decent approximation. The purpose of this regression model is to test whether there is a higher deserved weighting for investment grade versus non-investment grade CMBS. Pension funds, insurance companies, and other large financial institutional investors often are restricted to holding only or a very large portion of their assets in investment grade securities.[xxxiii] An interesting discovery is that the gap value of 10 on this scale implies that the difference between investment grade and non-investment grade securities is approximately 10 grade steps, or more accurately between 5 and 15 grade steps![xxxiv]

Regression Model 7 assumes the gap value of 10 incorporated into the ratings independent variable. And one step further, Regression Model 7 takes the natural logarithm of this value for each of the outputs. Thus, instead of taking the natural logarithm of the CMBS spread dependent variable and having each of the independent variables plot against it, attempting to take the natural logarithm of an independent variable in ratings thought to have a non-linear relationship to the dependent variable should yield a more precise, fine-tuning method.

Regression Model 8 incorporates Regression Model 7's assumptions with the addition of adding the assumption in Regression Model 5, take the natural logarithm of the dependent CMBS spread variable.

Finally, for Regression Model 11, the dividend yield data for the NA REIT Composite Index was unchanged and used directly from the daily source data.

This explanation to the input data specification methodology has set the foundation for the succeeding statistical regression analysis discussion.

Regression Models: Report and Reconciliation of Results

The source of the originating CMBS structures from 1998 – 2008 with the additions of the macroeconomic LEI components data are jointly tested as possible determinants of CMBS spreads using OLS regression modeling. There are a number of hypotheses to consider for this study: (1) a natural hypothesis is that the key driver of CMBS spreads will be the credit rating agency issued CMBS rating; (2) traditional issue-specific variables in SUB, LTV, and DSC are significant, but their variation should affect the CMBS spreads to a lesser extent than ratings; (3) there should be some explanatory value in some of the ten components of US LEI. As a group of variables, they should be significant and increase the explanatory power of the CMBS spreads regression model, even if some of these macroeconomic variables are insignificant by themselves; and (4) the dividend yield of the NA REIT Composite Index should increase the explanatory power of a specified model used to explain the variances of standardized CMBS spreads. The following Regression Models, 1 to 11, take the full data set from 1998 – 2008.

Beginning with the Jadeja and Dorokov (JD) (2008) Three-Factor regression model, a comparison is made between their 1,179 observation data set and the more extensive 1,589 observation data set.

$$SPR_i = \alpha + \beta_1 RAT_i + \beta_2 SUB_i + \beta_3 DSC_i + \varepsilon_i$$

SPR = Standardized spread on CMBS
RAT = Rating issued for CMBS at date of origin
SUB = Percentage of subordinate debt for CMBS issue at origination
DSC = Debt-to-service coverage ratio for CMBS issue at origination

Table A: Beta and T-stat results from JD (2008) 3-factor model

Period	# of Obs.	β_i /(T-stat)			
		α	RAT	SUB	DSC
1998 – 2002	469	4.94	-0.20	0.00	-0.15
		(35.43)	**(-19.08)**	(0.92)	**(-4.58)**
2003 - 2006	529	2.96	-0.16	0.01	0.06
		(22.20)	**(-17.91)**	**(4.53)**	**(4.23)**
2007 - 2008	181	2.91	-0.12	0.02	0.01
		(4.94)	**(-3.88)**	**(2.47)**	(0.15)
1998 - 2008	*1179*	*4.48*	*-0.21*	*0.02*	*-0.15*
		(41.86)	***(-27.39)***	***(9.40)***	***(-9.11)***

Table B: Beta and T-stat results from Expanded Data Set with JD (2008) three-factor model specification

Period	# of Obs.	β_i /(T-stat)			
		α	Rating	SUB	DSC
1998 - 2002	990	487.97	-20.24	-0.74	-10.41
		(35.27)	**(-20.52)**	**(-2.75)**	**(-2.70)**
2003 - 2006	412	555.57	-33.05	2.98	7.79
		(22.92)	**(-17.99)**	**(6.20)**	**(3.01)**
2007 - 2008	187	415.21	-17.12	0.65	-9.28
		(13.74)	**(-8.71)**	(1.42)	(-1.59)
1998 – 2008	*1589*	*482.00*	*-22.43*	*0.31*	*-3.20*
		(45.60)	***(-28.12)***	*(1.46)*	*(-1.71)*

Due to the difference in scaling where JD (2008) used spreads in percentage terms, this regression used spreads measured in basis points; thus, there is a factor of 100 to adjust for. In contrasting the number of observations, this data set has more than twice the observations for the 1998 – 2002 period than that of JD (2008), 990 versus 469. However, for the period of 2003 – 2006, the JD (2008) data set is larger, 529 versus 412 observations. The difference for the 2007 – 2008 period is negligible.

As expected, the alpha terms for both sets of data are positive and significant for all time periods and for the full data set. However, there are noticeable absolute value differences for the 2003 – 2006 and the 2007 – 2008 periods. These differences disappear when comparing both data sets' full time horizon from 1998 – 2008.

Also hypothesized, the beta for RAT is negative as the higher the rating, the lesser the CMBS spread should be due to lower risks, status quo. Both data sets for all time period variations are negative and significant for the RAT beta.

However, the results for the SUB and DSC between both data sets are different. JD (2008) found that SUB and DSC are both significant; whereas, the extended data set concluded that SUB and DSC are both insignificant. A natural prediction would be for the SUB beta to be positive as the higher proportion of subordinate debt should increase the risk in the CMBS security; and thus, it should lead to a higher compensating spread for investors. For the full 1998 – 2008 time horizon, both data sets have positive SUB betas. However, for each of the three separate time periods, the results between both data sets are mixed for significance and sign. Similar to SUB, the null hypothesis is a negative DSC beta. The higher the DSC is, the less likely the CMBS issue is to default due to increased compensating cash flows from the property to service debt. In the full 1998 – 2008 time horizon, the DSC beta sign was confirmed negative for both data sets; however, again, there are discrepancies for significance and sign when comparing the three separate time periods.

Table C: R^2, F-stat, Critical F-stat, and DW-test from JD (2008) 3-factor model:

Period	R^2	F-stat	Critical F-Test	DW-stat
1998 – 2002	0.56	196.68	8.53	0.73
2003 – 2006	0.51	184.14	8.53	0.76
2007 – 2008	0.09	6.01	8.54	0.25
Full Data	*0.46*	*328.54*	*8.53*	*0.49*

Table D: Comparable R^2, F-stat, Critical F-stat, and DW-test results from the Expanded Data Set:

Period	R^2	F-stat	Critical F-Test	DW-stat
1998 – 2002	0.45	271.44	8.53	0.82
2003 – 2006	0.52	149.19	8.53	0.91
2007 – 2008	0.40	40.12	8.54	0.65
Full Data	*0.44*	*418.12*	*8.53*	*0.77*

From Table C and Table D, the coefficient of determination for 2007 – 2008 is dramatically different with a better result yielded from the expanded data set, R^2 equal 0.40 versus 0.09, respectively. However, the expanded data set results in a slightly poorer fit with the 1998 – 2002 data and also the full 1998 – 2002 time horizon (a difference of 0.11 and 0.02, respectively). F-stat were significant for all time periods in the expanded data set in contrasts to JD (2008) having an insignificant F-stat for the 2007 – 2008 time period. This

difference alone supports the added value of the expanded data set. Another premise to support the expanded data set is the higher DW-test statistics for each of the three time periods in conjunction with the full time horizon. Although, all computed DW-test statistics indicate the presence of positive correlation, the expanded data set yields higher DW-test statistics indicating a lesser likelihood for positive serial correlation.

With conflicting results for the three separated time periods, a more general focus is taken for the following Regression Models 1 to 11. The results appear more consistent and better with a larger sample observation size and longer time horizon. Also, the choice of the specific separation of time periods requires additional scrutiny as it should have very significant effects on the regression time period specific results.

Regression Model 1: Traditional Issues-Specific Independent Variables

$$SPR_i = \alpha + \beta_1 RAT_i + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \varepsilon_i$$

SPR = Standardized spread on CMBS
RAT = Rating issued for CMBS at date of origin
SUB = Percentage of subordinate debt for CMBS issue at origination
LTV = Loan-to-value ratio for CMBS issue at origination
DSC = Debt-to-service coverage ratio for CMBS issue at origination

Table E: Beta and T-stat results from Regression Model 1:

# of Obs.	β_i /(T-stat) α	RAT	SUB	LTV	DSC
1589	453.93	-22.39	0.28	0.37	-0.78
	(19.03)	**(-28.05)**	(1.33)	(1.31)	(-0.30)

Table F: Regression Model 1 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.44	314.16	5.63	0.78

This model specification is similar to the JD (2008) three factor model with the addition of LTV. The sign for each beta value is consistent for each with the pre-regression analyses theoretical hypotheses. However, only the ratings variable and the alpha are statistically significant. The coefficient of determination at 0.44 for this model is still marginally lower than the JD (2008) benchmark at 0.46. However, the DW-statistic is higher and indicates less presence of serial correlation.

Regression Model 2: Macroeconomic US LEI Component Independent Variables

$$SPR_i = \alpha + \beta_1 MFG_i + \beta_2 JOB_i + \beta_3 ODR\_CM_i + \beta_4 PMI_i + \beta_5 ODR\_XD_i + \beta_6 BLD_i + \beta_7 SPX_i + \beta_8 AM2_i + \beta_9 SPR\_10FF_i + \beta_{10} CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

MFG = Manufacturer average work week

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

PMI = Purchasing Manager's Index

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

AM2 = Inflation Adjusted M2

SPR_ 10FF = 10 year US Treasury and Federal Funds Rate Spread

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table G: Beta and T-stat results from Regression Model 2:

# of Obs.	β_i /(T-stat)					
	α	MFG	JOB	ORD_CM	PMI	ORD_XD
1589	2292.7	-39.6	0	0	0.7	0
	(3.39)	**(-2.47)**	**(-4.81)**	**(2.65)**	(0.49)	**(-3.68)**

β_i /(T-stat)				
BLD	SPX	AM2	SPR_10FF	CSI
-0.6	0.1	0	-0.7	-2.4
(-3.46)	**(4.86)**	(-0.04)	(-0.13)	**(-3.58)**

Table H: Regression Model 2 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.06	10.19	2.54	1.07

Due to the disparity of data recording frequency between each of the ten US LEI variables, a depressed coefficient of determination was expected. However, the results do state that the combination of all ten US LEI significantly contribute to the variation in standardized CMBS spreads, F-stat of 10.19 is greater than the Critical F-stat of 2.54. This model also exhibits lesser positive correlation than the JD (2008) benchmark, 1.07 versus 0.48 DW-stat, respectively. The JOB, ORD_CM, PMI, ODR_XD, and AM2 beta variables round to zero and thus, it is not possible to conclude any of their beta signs to confirm or refute the null hypotheses. The theoretical predictions for LEI beta signs are positive for JOB and SPR_10FF and negative for the other eight variables: MFG, ORD_CM, PMI, ODR_XD, BLD, SPX, AM2, and CSI. The results from Regression Model 2 appear weak as the resulting beta signs appear mixed, but seven of the individual betas have statistically

significant T-stats. With seven individual statistically significant T-stats of the ten and a significant F-statistic for the group of ten US LEI components, there is merit for further analysis in order to possibly specify a model better than JD (2008) incorporating the CB LEI indicators.

Regression Model 3: Traditional and Macroeconomic Independent Variables

$$SPR_i = \alpha + \beta_1 RAT_i + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 MFG_i + \beta_6 JOB_i + \beta_7 ODR\_CM_i + \beta_8 PMI_i + \beta_9 ODR\_XD_i + \beta_{10} BLD_i + \beta_{11} SPX_i + \beta_{12} AM2_i + \beta_{13} SPR\_10FF_i + \beta_{14} CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

RAT = Rating issued for CMBS at date of origin

SUB = Percentage of subordinate debt for CMBS issue at origination

LTV = Loan-to-value ratio for CMBS issue at origination

DSC = Debt-to-service coverage ratio for CMBS issue at origination

MFG = Manufacturer average work week

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

PMI – Purchasing Manager's Index

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

AM2 = Inflation Adjusted M2

SPR_ 10FF = 10 year US Treasury and Federal Funds Rate Spread

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table I: Beta and T-stats from Regression Model 3:

# of Obs.	β_i /(T-stat)				
	α	RAT	SUB	LTV	DSC
1589	1925	-21.4	0	0.5	4.4
	(3.85)	**(-27.01)**	(-0.14)	(1.68)	(1.37)

β_i /(T-stat)				
MFG	JOB	ORD_CM	PMI	ORD_XD
-24.2	0	0	0.3	0
(-2.04)	**(-5.81)**	**(3.03)**	(0.24)	**(-4.51)**

β_i /(T-stat)				
BLD	SPX	AM2	SPR_10FF	CSI
-0.6	0.1	0	-1	-2.6
(-4.30)	**(5.98)**	(0.40)	(-0.23)	**(-5.20)**

Table J: Regression Model 3 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.49	107.57	2.13	0.84

Regression Model 3 results for the traditional issue-specific variables are consistent with Regression Model 1. Only RAT is significant while SUB, LTV, and DSC were statistically insignificant at the 5% level. Also, Regression Model 2 results are similar to Regression Model 3; only PMI, AM2, and SPR_10FF are insignificant, while signs vary for US LEI components. However, with the fourteen-variable regression, the coefficient of determination is better than the benchmark of 0.46 and yields a DW-statistic that is again better than the JD (2008) benchmark indicating lesser evidence of serial correlation.

Although Regression Model 3 yield better results than the JD (2008) three-factor model, the additional eleven factors added only incremental explanatory value for standardized CMBS spread variation. The model specifications that follow will include economically and statistically intuitive transformations in attempt to yield a more reality conforming model than this cumbersome fourteen-variable model.

Regression Model 4: Statistically Significant Traditional and Macroeconomic Independent Variables

$$SPR_i = \alpha + \beta_1 RAT_i + \beta_2 MFG_i + \beta_3 JOB_i + \beta_4 ODR\_CM_i + \beta_5 ODR\_XD_i + \beta_6 BLD_i + \beta_7 SPX_i + \beta_8 CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

RAT = Rating issued for CMBS at date of origin

MFG = Manufacturer average work week

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table K: Beta and T-stats results from Regression Model 4:

# of Obs.	β_i /(T-stat)				
	α	RAT	MFG	JOB	ODR_CM
1589	2024.8	-21.5	-25	0	0
	(6.69)	**(-36.30)**	**(-3.35)**	**(-6.03)**	**(3.58)**

β_i /(T-stat)			
ODR_XD	BLD	SPX	CSI
0	-0.5	0.1	-2.6
(-6.84)	**(-4.60)**	**(5.95)**	**(-6.10)**

Table L: Regression Model 4 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.49	187.98	2.93	0.84

Only incorporating statistically significant variables from Regression Model 3, Regression Model 4 has an equivalent coefficient of determination of 0.49 and DW-statistic. This model yields another positive result including a higher F-stat, 187.98 versus 107.57 in Regression Model 3. Thus, this eight factor model including RAT, MFG, JOB, ORD_CM, ODR_XD, BLD, SPX, and CSI is a superior and more concise model than the cumbersome Regression Model 3. All eight independent variables are statistically significant.

Regression Model 5: $\ln(SPR_i)$ w/ Traditional and Macroeconomic Independent Variables

$$\ln(SPR_i) = \alpha + \beta_1 RAT_i + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 MFG_i + \beta_6 JOB_i + \beta_7 ODR\_CM_i + \beta_8 PMI_i + \beta_9 ODR\_XD_i + \beta_{10} BLD_i + \beta_{11} SPX_i + \beta_{12} AM2_i + \beta_{13} SPR\_10FF_i + \beta_{14} CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

RAT = Rating issued for CMBS at date of origin

SUB = Percentage of subordinate debt for CMBS issue at origination

LTV = Loan-to-value ratio for CMBS issue at origination

DSC = Debt-to-service coverage ratio for CMBS issue at origination

MFG = Manufacturer average work week

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

PMI = Purchasing Manager's Index

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

AM2 = Inflation Adjusted M2

SPR_ 10FF = 10 year US Treasury and Federal Funds Rate Spread

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table M: Beta and T-stats from Regression Model 5:

# of Obs.	β_i /(T-stat)				
	α	RAT	SUB	LTV	DSC
1589	8.04	-0.13	-0.01	0.01	0.06
	(2.65)	**(-27.27)**	**(-4.61)**	**(4.10)**	**(3.05)**

β_i /(T-stat)				
MFG	JOB	ORD_CM	PMI	ORD_XD
0.09	0.00	0.00	-0.01	0.00
(1.20)	**(-6.40)**	**(2.59)**	(-1.20)	**(-6.11)**

β_i /(T-stat)				
BLD	SPX	AM2	SPR_10FF	CSI
0.00	0.00	0.00	0.00	-0.03
(-5.36)	**(8.99)**	(0.36)	(-0.18)	**(-8.48)**

Table N: Regression Model 5 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.57	148.65	2.13	0.49

Regression Model 5 is a slight digression from Regression Model 4. There is economic intuition that standardized CMBS spreads do not have a linear relationship to many traditional issue-specific and macroeconomic variables. This model is a generalized test to uncover this premise. The results are interesting: all four traditional variables in RAT, SUB, LTV, and DSC are statistically significant; however, SUB and DSC have theoretically contradicting signs (although the absolute beta value is miniscule at -0.01 and 0.06). The previously insignificant US LEI variables in PMI, AM2, and SPR_10FF are still insignificant;

however, now MFG has also become insignificant. It is important to note that the already small absolute value of beta coefficients observed for Regression Model 3 is further minimized in Regression Model 5. However, it is tough to argue against the statistically significant and much higher coefficient of determination of 0.57 versus 0.49; however, this is at the expense of additional presence of serial correlation with a 0.49 DW-stat, in contrast to the 0.84 DW-statistic for Regression Model 3. Note that 0.49 DW-statistic is the reading for the JD (2008) three-factor model. From this model specification, there is probability that natural logarithm modeling could lead to improved model specification, thus, confirming economic rationale.

Regression Model 6: Traditional (incorporating an investment grade ratings gap of ten) and Macroeconomic Independent Variables

$$SPR_i = \alpha + \beta_1[RAT_i,(+10 \text{ if investment grade})] + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 MFG_i + \beta_6 JOB_i + \beta_7 ODR\_CM_i + \beta_8 PMI_i + \beta_9 ODR\_XD_i + \beta_{10} BLD_i + \beta_{11} SPX_i + \beta_{12} AM2_i + \beta_{13} SPR\_10FF_i + \beta_{14} CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

RAT = Rating issued for CMBS at date of origin

SUB = Percentage of subordinate debt for CMBS issue at origination

LTV = Loan-to-value ratio for CMBS issue at origination

DSC = Debt-to-service coverage ratio for CMBS issue at origination

MFG = Manufacturer average work week

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

PMI = Purchasing Manager's Index

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

AM2 = Inflation Adjusted M2

SPR_ 10FF = 10 year US Treasury and Federal Funds Rate Spread

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table O: Beta and T-stats from Regression Model 6:

# of Obs.	β_i /(T-stat)				
	α	RAT	SUB	LTV	DSC
1589	1872.1	-18.3	-0.2	0.6	5.9
	(4.02)	**(-32.73)**	(-1.01)	**(2.19)**	(1.95)

β_i /(T-stat)				
MFG	JOB	ORD_CM	PMI	ORD_XD
-19.5	0	0	0.7	0
(-1.76)	**(-6.30)**	**(4.16)**	(0.70)	**(-6.08)**

β_i /(T-stat)				
BLD	SPX	AM2	SPR_10FF	CSI
-0.5	0.1	0	-4.1	-3
(-4.06)	**(6.92)**	(1.03)	(-1.08)	**(-6.36)**

Table P: Regression Model 6 results for various Rating "gap" values:
(R^2, F-stat, critical F-stat, and DW-stat):

	R^2	F-stat	Critical F-stat	DW-stat
Gap = 1	0.50	113.63	2.13	0.84
Gap = 5	0.54	131.93	2.13	0.85
Gap = 10	0.56	140.20	2.13	0.90
Gap = 15	0.55	138.31	2.13	0.95
Gap = 20	0.54	132.82	2.13	0.98

For Regression Model 6, the basis is Regression Model 3 with the transformation of the RAT data to include a hypothetical "gap" between investment grade and non-investment grade CMBS issues. In the JD (2008) study, JD utilized a unified and linear scale for

assigning and quantifying CMBS ratings. However, in the investment world reality with established financial institutions, there are many constraints that often preclude non-investment grade securities. Thus, there is a "gap" in reality between these divisions.[xxxv]

The primary issue is to test if this theory of a ratings "gap" between investment grade and non-investment grade securities is confirmed by the regression models. The secondary issue is to approximate a decent "gap" value for subsequent regression models. From Table P, it is evident that the "gap" in fact *does* exist according to the result's implications. Each of the coefficients of determination for the various "gap" model values yields a statistically significant and higher R^2 than without the "gap" (Regression Model 3 yielded a 0.49 R^2).

For the beta coefficients, eight of them were significant: RAT, LTV, JOB, ODR_CM, ODR_XD, BLD, SPX, and CSI; however, the specific significant variables in this model are not exactly identical to Regression Model 3. LTV was statistically insignificant in Regression Model 3, while MFG was statistically significant. A "gap" value of 10 yielded the highest R^2 of 0.56 and is, therefore, a better predictor for standardized CMBS spreads than Regression Model 4 at 0.49.

Regression Model 7: Traditional (incorporating an investment grade ratings gap of ten, then taking the natural logarithm of the computed value) and Macroeconomic Independent Variables

$$SPR_i = \alpha + \beta_1 \ln[RAT_i,(+10 \text{ if investment grade})] + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 MFG_i + \beta_6 JOB_i + \beta_7 ODR\_CM_i + \beta_8 PMI_i + \beta_9 ODR\_XD_i + \beta_{10} BLD_i + \beta_{11} SPX_i + \beta_{12} AM2_i + \beta_{13} SPR\_10FF_i + \beta_{14} CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

RAT = Rating issued for CMBS at date of origin

SUB = Percentage of subordinate debt for CMBS issue at origination

LTV = Loan-to-value ratio for CMBS issue at origination

DSC = Debt-to-service coverage ratio for CMBS issue at origination

MFG = Manufacturer average work week

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

PMI = Purchasing Manager's Index

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

AM2 = Inflation Adjusted M2

SPR_ 10FF = 10 year US Treasury and Federal Funds Rate Spread

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table Q: Beta and T-stats from Regression Model 7:

# of Obs.	β_i /(T-stat)				
	α	RAT	SUB	LTV	DSC
1589	2304.8	-328.9	-0.8	0.7	6.6
	(5.22)	**(-37.05)**	**(-5.01)**	**(2.60)**	**(2.33)**

β_i /(T-stat)				
MFG	JOB	ORD_CM	PMI	ORD_XD
-14.3	0	0	0.9	0
(-1.36)	**(-6.46)**	**(5.16)**	(0.90)	**(-7.33)**

β_i /(T-stat)				
BLD	SPX	AM2	SPR_10FF	CSI
-0.5	0.1	0	-5.2	-3.3
(-3.92)	**(7.64)**	(1.18)	(-1.44)	**(-7.52)**

Table R: Regression Model 7 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.60	169.01	2.13	0.96

Regression Model 7 is an evolution of Regression Model 6. As previously discussed, there is economic and statistic reasons to assume non-linearity relationships between select variables. This non-linearity is incorporated by natural logarithmic modeling. Regression Model 5 yielded stellar relative results with natural logarithmic modeling of the standardized CMBS spread; however, it was too general and a logical hypothesis would be to evaluate each variable for a possible non-linear relationship with SPR. Thus, Regression Model 7

factors in a ratings "gap" value of ten for investment grade CMBS issues and transforms the data with a natural logarithm function.

The results for this model specification are encouraging. This iteration has ten statistically significant of the fourteen possible independent variables. This is the highest number of statistically significant independent variables for the SPR modeling sequence. Only MFG, PMI, AM2, and SPR_10FF are insignificant variables. Furthermore, the four traditional issue-specific variables in RAT, SUB, LTV, and DSC are each statistically significant. The 0.60 R^2 is the highest in all iterations thus far along with a high F-statistic of 169.01 and substantially better than the JD (2008) benchmark DW-statistic with 0.96. The fine-tuning and transformation of the RAT variable led to improved results.

Regression Model 8: $\ln(SPR_i)$ and Traditional (incorporating an investment grade ratings gap of ten, then taking the natural logarithm of the computed value) and Macroeconomic Independent Variables

$$\ln(SPR_i) = \alpha + \beta_1 \ln[RAT_i,(+10 \text{ if investment grade})] + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 MFG_i + \beta_6 JOB_i + \beta_7 ODR\_CM_i + \beta_8 PMI_i + \beta_9 ODR\_XD_i + \beta_{10} BLD_i + \beta_{11} SPX_i + \beta_{12} AM2_i + \beta_{13} SPR\_10FF_i + \beta_{14} CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

RAT = Rating issued for CMBS at date of origin

SUB = Percentage of subordinate debt for CMBS issue at origination

LTV = Loan-to-value ratio for CMBS issue at origination

DSC = Debt-to-service coverage ratio for CMBS issue at origination

MFG = Manufacturer average work week

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

PMI = Purchasing Manager's Index

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

AM2 = Inflation Adjusted M2

SPR_ 10FF = 10 year US Treasury and Federal Funds Rate Spread

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table S: Beta and T-stats from Regression Model 8:

# of Obs.	β_i /(T-stat)				
	α	RAT	SUB	LTV	DSC
1589	9.82	-1.42	-0.02	0.01	0.07
	(3.05)	**(-21.89)**	**(-13.73)**	**(4.10)**	**(3.17)**

β_i /(T-stat)				
MFG	JOB	ORD_CM	PMI	ORD_XD
0.12	0.00	0.00	-0.01	0.00
(1.63)	**(-6.02)**	**(3.86)**	(-0.97)	**(-7.26)**

β_i /(T-stat)				
BLD	SPX	AM2	SPR_10FF	CSI
0.00	0.00	0.00	-0.02	-0.03
(-4.88)	**(9.04)**	(0.32)	(-0.65)	**(-9.07)**

Table T: Regression Model 8 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.51	118.86	2.13	0.58

Not predictably, Regression Model 8 results are inferior to Regression Model 7 results. From improved regression results yielded by Regression Model 5 for $\ln(SPR_i)$ and Regression Model 7 for taking the natural logarithm of a "gap" adjusted RAT data, the natural hypothesis would be that a combination of these model specifications would lead to improved results again; however, this was not the case. The coefficient of determination dropped 0.09 or by 15%, the DW-statistic worsened significantly to 0.38, and the F-stat dropped. As likely as there are non-linear relationships, there are possible linear relationships.

By taking the natural logarithm of SPR and also of the RAT approximately cancels out the intention of non-linearity as yielded by Regression Model 7. Thus, Regression Model 7 with its ten statistically significant independent variables is the final model specification for modeling SP

Regression Model 9: Statistically Significant Traditional (incorporating an investment grade ratings gap of ten, then taking the natural logarithm of the computed value) and Macroeconomic Independent Variables

$$SPR_i = \alpha + \beta_1 \ln[RAT_i,(+10 \text{ if investment grade})] + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 JOB_i + \beta_6 ODR\_CM_i + \beta_7 ODR\_XD_i + \beta_8 BLD_i + \beta_9 SPX_i + \beta_{10} CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS
RAT = Rating issued for CMBS at date of origin
SUB = Percentage of subordinate debt for CMBS issue at origination
LTV = Loan-to-value ratio for CMBS issue at origination
DSC = Debt-to-service coverage ratio for CMBS issue at origination
JOB = Initial jobless claims
ODR_CM = Seasonally unadjusted durable goods and materials new orders
ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders
BLD = New privately owned housing units authorized by building permits
SPX = Standard and Poor's 500 Index
CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table U: Beta and T-stats from Regression Model 9:

# of Obs.	β_i /(T-stat)				
	α	RAT	SUB	LTV	DSC
1589	1777.6	-328.2	-0.9	0.7	7.7
	(27.20)	**(-37.20)**	**(-5.27)**	**(2.70)**	**(2.89)**

β_i /(T-stat)					
JOB	ORD_CM	ORD_XD	BLD	SPX	CSI
0	0	0	-0.4	0.1	-3.6
(-6.32)	**(5.31)**	**(-10.03)**	**(-4.13)**	**(8.29)**	**(-10.44)**

Table V: Regression Model 9 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	Critical F-stat	DW-stat
0.60	235.67	2.54	0.96

Regression Model 9 is the final model specification for the analysis of SPR. With ten statistically significant independent variables, all four traditional issue-specific variables and six of the ten US LEI components as variables, this model has achieved an R^2 of 0.60, and high F-statistics and DW-statistics in contrast to the three-factor model from JD (2008). Regression Model 9 is the Ten Factor Hybrid Model specification.

Regression Model 10: Statistically Significant Traditional (without RAT) and Macroeconomic Independent Variables

$$SPR_i = \alpha + \beta_1 SUB_i + \beta_2 LTV_i + \beta_3 DSC_i + \beta_4 JOB_i + \beta_5 ODR\_CM_i + \beta_6 ODR\_XD_i + \beta_7 BLD_i + \beta_8 SPX_i + \beta_9 CSI_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

SUB = Percentage of subordinate debt for CMBS issue at origination

LTV = Loan-to-value ratio for CMBS issue at origination

DSC = Debt-to-service coverage ratio for CMBS issue at origination

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

Table W: Beta and T-stats from Regression Model 10:

# of Obs.	β_i /T-stat			
	α	SUB	LTV	DSC
1589	901.51	-3.85	0.30	1.91
	(-10.80)	**(-20.11)**	(-0.81)	(0.52)

β_i /T-stat					
JOB	ORD_CM	ORD_XD	BLD	SPX	CSI
-0.00	0.00	-0.00	-0.60	0.13	-3.39
(-5.33)	**(5.64)**	**(-8.94)**	**(-4.71)**	**(5.50)**	**(-7.28)**

Table X: Regression Model 10 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	critical F-stat	DW-stat
0.25	51.85	2.54	0.91

The specification this regression formula and its analysis focus on the importance of the RAT variable as a determinant for standardized spreads on the CMBS issues. From Regression Model 10, the fall of 0.35 in the coefficient of determination is more significant than hypothesized leading to a final figure of 0.25 for Regression Model 10. This is a 58% drop in the explanatory power of the model omitting the RAT variable. Although there is no quantification of the degree of importance of the RAT, it is surprising that its effects outweigh the explanatory power of the other nine variables by 40%! The F-statistic also falls dramatically to 51.85 from a figure of 235.67 in Regression Model 9. These results have fascinating real world implications. There is evidence to support the fact that investment managers depend disproportionately high on the ratings of an issue in contrast to other considered variables. This fact alone supports the higher than expected amount of

devastation that the ratings agencies have on the CMBS markets, status quo. The conflicts of interest that plague the underwriting and ratings issued from the perspective of S&P, Moody's, and Fitch were understated. This is derived from the analysis of the importance of the RAT variable.

Regression Model 11: Statistically Significant Traditional (incorporating an investment grade ratings gap of ten, then taking the natural logarithm of the computed value) and Macroeconomic Independent Variables and US REIT Composite Index dividend yield

$$SPR_i = \alpha + \beta_1 \ln[RAT_i,(+10 \text{ if investment grade})] + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 JOB_i + \beta_6 ODR\_CM_i + \beta_7 ODR\_XD_i + \beta_8 BLD_i + \beta_9 SPX_i + \beta_{10} CSI_i + \beta_{11} REIT_i + \varepsilon_i$$

SPR = Standardized spread on CMBS

RAT = Rating issued for CMBS at date of origin

SUB = Percentage of subordinate debt for CMBS issue at origination

LTV = Loan-to-value ratio for CMBS issue at origination

DSC = Debt-to-service coverage ratio for CMBS issue at origination

JOB = Initial jobless claims

ODR_CM = Seasonally unadjusted durable goods and materials new orders

ODR_XD = Seasonally unadjusted manufacturing excluding defense new orders

BLD = New privately owned housing units authorized by building permits

SPX = Standard and Poor's 500 Index

CSI = Expectations portion of the University of Michigan's Consumer Sentiment Index

REIT = NA REIT Composite Index dividend yield

Table Y: Beta and T-stats from Regression Model 11:

# of Obs.	β_i /T-stat				
	α	RAT	SUB	LTV	DSC
1589	8.53	-0.13	-0.01	0.01	0.06
	(-16.59)	**(-28.33)**	**(-4.47)**	**(5.52)**	**(3.12)**

β_i /T-stat						
JOB	ORD_CM	ORD_XD	BLD	SPX	CSI	REIT
0.00	0.00	0.00	-0.01	0.00	-0.02	0.17
(-7.04)	**(-3.19)**	(0.21)	**(-8.95)**	**(3.05)**	**(-8.06)**	**(9.73)**

Table Z: Regression Model 11 results (R^2, F-stat, critical F-stat, and DW-stat):

R^2	F-stat	critical F-stat	DW-stat
0.59	229.54	2.54	0.51

Even with the addition of the North American Real Estate Investment Trusts Composite Index Dividend Yield factored into Regression Model 9, the ten factor hybrid model from Regression Model 9 yielded a slightly higher R^2. Thus, the null hypothesis that the NA REIT Composite Index Dividend Yield contributes significantly to the explanatory power of the standardized CMBS spreads is rejected. With the frequent daily recorded closing prices of the index and the associated dividend yield acting as a proxy for the standardized CMBS yield spreads, it was a natural hypothesis to believe that the NA REIT Composite Index Dividend Yield would contribute to a higher R^2 for this model specification. However, this is not the case and the Ten-Factor Hybrid Model still yields the highest coefficient of determination. It is interesting to note that the T-stat is significant for the REIT variable at the 5% significance level.

JD (2008) Three-Factor Model versus Ten-Factor Hybrid Model with Expanded Data Set:

For the following results these models share the same equation as Regression Model 9, the Ten-Factor Hybrid Model; however, each of these following regression models is separated into time three periods: 1998 – 2002, 2003 – 2006, and 2007 – 2008, respectively. This is necessary in order to compare and contrast the original JD (2008) Three-Factor Model.

Table AA: JD (2008) Three-Factor Model results

	R^2	F-stat	Critical F-stat	DW-stat
1998 - 2002	0.56	196.68	8.53	0.73
2003 - 2006	0.51	184.14	8.53	0.76
2007 - 2008	0.09	6.01	8.54	0.25
1998 - 2008	0.46	328.54	8.53	0.49

Table BB: The Ten-Factor Hybrid Model results

	R^2	F-stat	Critical F-stat	DW-stat
1998 - 2002	0.65	185.17	2.54	1.06
2003 - 2006	0.68	85.37	2.55	1.29
2007 - 2008	0.70	41.03	2.57	1.10
1998 - 2008	0.60	235.67	2.54	0.96

From each time period's coefficient of determination and DW-statistic, The Ten-Factor Hybrid Model is superior to the Three-Factor JD (2008) Model. In addition, all F-statistics are significant.

Conclusion

Deteriorating lending standards, inflated ratings issued by rating agencies, and excessive greed on behalf of financial institutions involved were the fundamental causes for the CMBS market bubble. There are advocates warning of the CMBS crisis and its encompassing deep roots; however, it is unlikely that its adverse effects will rival that of the RMBS crisis due to the significantly larger US residential market, lesser relative supply of commercial real estate, and the flexibility of functions for commercial real estate.

The quantitative analysis in this paper has found many of The Conference Board's Ten Leading Economic Indicators to be significant to the determination of standardized CMBS spreads through various models. The final proposed model is the Ten-Factor Hybrid Model outlined in Regression Model 9. This specification includes all four traditional issue-specific variables and six of the ten possible macroeconomic variables: initial jobless claims, seasonally unadjusted durable goods and materials new orders, seasonally unadjusted manufacturing excluding defense new orders, new privately owned housing units authorized by building permits, S&P 500 index, and the expectations portion of the University of Michigan's Consumer Sentiment Index. Successfully incorporating a ratings gap between investment and non-investment grade CMBS and a natural logarithm transformation of this independent variable led to the specification for the *Ten-Factor Hybrid Model*:

$$SPR_i = \alpha + \beta_1 \ln[RAT_i,(+10 \text{ if investment grade})] + \beta_2 SUB_i + \beta_3 LTV_i + \beta_4 DSC_i + \beta_5 JOB_i + \beta_6 ODR\_CM_i + \beta_7 ODR\_XD_i + \beta_8 BLD_i + \beta_9 SPX_i + \beta_{10} CSI_i + \varepsilon_i$$

This model is superior to the JD (2008) Three-Factor Model for all JD's separate time periods and for the full time period of 1998 – 2008 with respect to their metrics. Using the expanded data set for both models and for the full 1998 – 2008 time period, the Ten-

Factor Hybrid Model yielded a coefficient of determination of 0.60, a significant F-statistic, and a 0.96 Durbin Watson statistic compared to the JD (2008) Three-Factor Model of 0.46 R-square, a significant F-statistic, and a 0.49 Durbin Watson statistic.

Critical points to note: (1) Quantifying the ratings gap to approximately ten steps gives perspective on the impressive magnitude of investment grade versus non-investment grade CMBS; (2) The importance of the ratings variable is overwhelming as it contributes more explanatory power by itself than the nine other variables together in the Ten-Factor Hybrid Model; and (3) The inclusion of the daily dividend yield from the NA REIT Composite Index surprisingly did not improve the results and specifications of the standardized CMBS spreads model, though the variable itself was significant at the 5% level.

There are interesting results and implications derived from this study. There is motive for the CMBS underwriters to collude with the ratings agencies to attain an inflated investment grade rating. Conversely, there are significant penalties, in form of higher yields, for not having investment grade status. In practical terms, it is more likely that underwriters create a CMBS security that is marginally below investment grade and via agency capture, coerce the ratings agency to grant the CMBS issue at least a minimum of an investment grade rating. This hypothetical strategy would reap the underwriters the maximum gain at the expense of its naïve buyers, various financial institutions. Continuing with the ratings variable, there is evidence to support the premise that many buyers of CMBS issues depend excessively, almost to a fault, on the rating given to a specific CMBS issue from S&P, Moody's, or Fitch. Thus, instead of spending time, effort, and resources to manipulate and justify subjective loan-to-value ratios and debt-to-service coverage ratios, it would be more efficient and effective to focus efforts on the ratings agency. Therefore, in order to have an unbiased and objective rating, conflicts of interests and agency capture must cease to exist.

And finally, the finance industry continues to operate within the confines of an Entrepreneurial Worldview. Status quo, it would be reasonable to consistently predict that regulation and compliance will be regarded as an impediment to material abundance in the next boom market. Unless there is incentive for real structural and or philosophical changes for finance firms, history will repeat itself in some other shape or form.

Sources of Errors and Future Studies

This paper utilizes the Ordinary Least Squares (OLS) regression model. Inherit in any model employed are assumptions and simplifications of reality. The OLS model is very sensitive to outliers. It is a conscious choice not to discard any outliers for this study, although JD (2008) have subjectively omitted outliers (Thus, the results in this paper are understated and conservative!). Discarding outliers with a filter will certainly lead to better results, specifically a higher coefficient of determination. However, there are some assumptions that are likely violated, such as a homoskedasticity throughout the 1998 – 2008 period.

A sample of 1,589 data points were taken from a population of 22,581 observations. The discarding of 92.96% of the comprehensive data should lead to a less convincing model. However, unless there is an updated data source, it would take an eternity to manually search for each swap benchmark for each CMBS issue from the Commercial Mortgage Alert (www.cmalert.com) source data. Another issue of concern is regarding the frequency of recorded values of each indicator. For example, there are daily observations for the S&P 500 Index, weekly observations for initial jobless claims, and monthly observations for the Purchasing Manager's Index. The further time elapsed from an observation point, the more erroneous the value becomes. Thus, it would be ideal to find daily records or possibly better proxies will be found or created.

However, the largest leap of faith is the assumption that the standardized CMBS spreads at origination would be identical to an observed traded CMBS market spread. This implicit assumption is questionable; however, this cross-sectional data is likely the most complete data available. If a time series data for CMBS spreads for each issue and tranch were to be analyzed, the regressions would be exponentially more complex and there will be issues for data completion. Unfortunately, the liquidity and trading volume of these CMBS issues are sparse and intermittent. Thus, a pure time series data set would unlikely yield

interesting insights as opposed to the pooled, combination of cross-sectional and time-series, data series used in this paper.

Future studies can build on the findings of this paper in many directions. Creating a filter rule and analyzing outlying data points individually would make for insightful findings (How much of an effect do outliers really have on the regression model?). Other models such as autoregressive conditional heteroscedasticity and its general form, ARCH and GARCH, could be employed and specified to negate non-constant variance throughout the full period data. It could also be possible to separate time periods based on economic reasoning for differing periods of variance, as it is common to find clusters of high and low variances through time series. In addition, finding better proxies with more frequent observations or using countless other macroeconomic factors hypothesized to affect CMBS spreads may yield interesting results. Finally, due to the significance of the NA REIT Composite Index dividend yield, there are likely other REIT proxies that can be discovered to contribute significantly and simultaneously improve the R-square of the standardized CMBS spreads model.

References List

1. Rating Issues of CMBS Structures, *Dmitry Dorokhov and Sandeep Jadeja*, Summer 2008.

2. Subprime Lending and Real Estate Markets – Working Paper, *Prof. Andrey Pavlov,* 2008.

3. The Sub-prime mortgage crisis: a synopsis, *Karen Weaver – Deutsche Bank,* Global Securitisation and Structured Finance 2008.

4. What Drives the Return on Commercial Mortgage-Backed Securities? *Xiaoqing Eleanor Xu Ph.D CFA,* The Real Estate Research Institute January 2007.

5. Where did the Risk go? How Misapplied Bond Ratings Cause Mortgage Backed Securities and Collateralized Debt Obligation Market Disruptions, *Joseph R. Mason and Joshua Rosner*, May 2007.

6. Bond Markets, Analysis, and Strategies, *Frank J. Fabozzi*, Sixth Edition, Pearson Prentice Hall, 2007.

7. CMBS E-Primer, *A Publication of The Commercial Mortgage Securities Association,* Annemarie DiCola Editor in Chief, March 2007.

8. Synthetic CMBS Primer, *Nomura Fixed Income Research,* September 2006.

9. Commercial Mortgage Backed Securities: How Much Subordination is Enough?, *Chris T. Downing and Nancy E. Wallace*, January 2005.

10. The Role of Ratings in Structured Finance: Issues and Implications, *Bank for International Settlements*, Committee on the Global Financial System, January 2005.

11. The Role of Ratings in Structured Finance: Issues and Implications, *Bank for International Settlements*, Committee on the Global Financial System, January 2005.

12. Commercial Mortgage-Backed Securities: An Exploration into Agency, Innovation, Information, and Learning in Financial Markets, Timothy J. Riddiough and Risharng Chiang, 2003.

13. A Proportional Hazards Model of Commercial Mortgage Default with Originator Bias, *Brian A. Ciochetti, Yongheng Deng, Gail Lee, James D. Shilling, and Rui Yao,* Journal of Real Estate Finance and Economics, 2003.

14. Commercial Mortgage-Backed Securities: Prepayment and Default, *Brent W. Ambrose and Anthony B. Sanders*, Journal of Real Estate Finance and Economics, 2003.

15. Transforming Real Estate Finance – A CMBS Primer, *Morgan Stanley, Editors: Howard Esaki, Marielle Jan De Beur, and Masumi Pearl,* Second Edition Spring 2002.

16. Pricing Commercial Mortgage Backed Securities, *Clark Maxam and Jeffrey Fisher*, Journal of Property Investment and Finance, Vol. 19 No. 6, 2001.

17. Analysis of Yield Spreads on Commercial Mortgage-Backed Securities, Brian A. Maris and William Segal, Journal of Real Estate Research, 2002.

18. Econometric Models and Economic Forecasts, *Robert S. Pindyck and Daniel L. Rubinfeld*, Fourth Edition, Irwin/McGraw-Hill, 1998.

19. The Pricing of Multiclass Commercial Mortgage-Backed Securities, *Paul D. Childs, Steven H. Ott, and Timothy J Riddiough*, The Journal of Financial and Quantitative Analysis, Vol. 31, No. 4, December 1996.

20. Predicting Commercial Mortgage Foreclosure Experience, *Kerry D. Vandell*, Journal of the American Real Estate and Urban Economics Association, Vol. 20, 1992.

21. Pricing Commerical Mortgages and Their Mortgage-Backed Securities, *James Kau, Donald Keenan, Walter Muller, and James Epperson,* Journal of Real Estate Finance and Economics, 1990.

22. Scoring the Leading Indicators, *Francis X. Diebold and Glenn D. Rudebusch*, The Journal of Business, Vol. 62, No. 3, July 1989.

23. Mortgage Credit Availability and Residential Construction, *Dwight M. Jaffee, Kenneth T. Rosen, Benjamin M. Friedman, Lawrence R. Klein*, Brookings Papers on Economic Activity, Vol. 1979, No. 2, 1979.

End Notes

[i] Pavlov, Andrey, "Subprime Lending and Real Estate Markets", working paper, 2008

[ii] Nominal and Real Housing Prices have been appreciating since 1998 until 2006. http://www.irrationalexuberance.com/ (data from Robert J. Shiller of Yale University Economics Professor)

[iii] Pavlov, Andrey, "Subprime Lending and Real Estate Markets", working paper, 2008, page 6

[iv] Wexler, Mark, "GAWM Bus 813 Ethics in the Wealth Management and Securities Industry," September 26th and October 10th, 2008

[v] This paragraph borrows extensively from Pavlov, Andrey, "Subprime Lending and Real Estate Markets", working paper, 2008, page 8

[vi] Mason, Joseph R., and Rosner, Joshua, "Where did the Risk go? How Misapplied Bond Ratings Cause Mortgage Backed Securities and Collateralized Debt Obligation Market Disruptions," May 2007

[vii] Wexler, Mark, "GAWM Bus 813 Ethics in the Wealth Management and Securities Industry," September 22nd, 26th, and October 10th, 2008 – GAWM Case on page 9: "John Coffee's Views on "Why the Watchdog Did Not Bark!"

[viii] Bank for International Settlements, "The Role of Ratings in Structured Finance: Issues and Implications," Committee on the Global Financial System, January 2005

[ix] http://www.portfolio.com/views/columns/wall-street/2007/12/17/Commercial-Real-Estate-Crisis

[x] www.cmalert.com

[xi] http://en.wikipedia.org/wiki/Irrational_exuberance

[xii] According to the National Bureau of Economic Research http://money.cnn.com/2008/12/01/news/economy/recession/index.htm

[xiii] http://online.wsj.com/article/SB122703851606838297.html

[xiv] Fabozzi, Frank J., "Bond Markets, Analysis, and Strategies," Sixth Edition, Pearson Prentice Hall, 2007, page 305

[xv] http://en.wikipedia.org/wiki/Nonrecourse_debt

[xvi] Pavlov, Andrey, "Subprime Lending and Real Estate Markets", working paper, 2008, page 10

[xvii] Pavlov, Andrey, "Subprime Lending and Real Estate Markets", working paper, 2008, page 4

[xviii] Fabozzi, Frank J., "Bond Markets, Analysis, and Strategies," Sixth Edition, Pearson Prentice Hall, 2007, page 306-307

[xix] Manufacturer Average Workweek: Series Id: CES3000000007; Data Type: AVERAGE WEEKLY HOURS OF PRODUCTION WORKERS (http://www.conference-board.org/aboutus/about.cfm)

[xx] http://www.thestreet.com/tsc/basics/tscglossary/initialjoblessclaims.html

[xxi] http://www.investopedia.com/university/releases/durablegoods.asp

[xxii] http://www.investopedia.com/terms/p/pmi.asp?viewed=1

[xxiii] http://www.investopedia.com/terms/h/housingstarts.asp

[xxiv] http://www.investopedia.com/terms/s/sp500.asp

[xxv] http://www.investopedia.com/terms/m/m2.asp

[xxvi] http://www.sca.isr.umich.edu/documents.php?c=i

[xxvii] Pindyck, Robert S., and Rubinfeld, Daniel L., "Econometric Models and Economic Forecasts," Fourth Edition, Irwin/McGraw-Hill, 1998, page 57

[xxviii] Pindyck, Robert S., and Rubinfeld, Daniel L., "Econometric Models and Economic Forecasts," Fourth Edition, Irwin/McGraw-Hill, 1998, page 5

[xxix] Pindyck, Robert S., and Rubinfeld, Daniel L., "Econometric Models and Economic Forecasts," Fourth Edition, Irwin/McGraw-Hill, 1998, page 86

[xxx] Pindyck, Robert S., and Rubinfeld, Daniel L., "Econometric Models and Economic Forecasts," Fourth Edition, Irwin/McGraw-Hill, 1998, page 62

[xxxi] Pindyck, Robert S., and Rubinfeld, Daniel L., "Econometric Models and Economic Forecasts," Fourth Edition, Irwin/McGraw-Hill, 1998, page 285

[xxxii] See Table 1 in Appendix

[xxxiii] The Rating Scale for the Gap Valuation is found in Table 2 in the Appendix

[xxxiv] For Regression Model 6, there were many iterations varying the size of the gap between investment grade and non-investment grade CMBS securities. The R^2 for the gap value equals to 10 is higher than the R^2 values for gap of 15 and a gap of 5, 0.555 > 0.5516 or 0.5399.

[xxxv] Tables 1 and 2 in the Appendix contain the actual figures used in the regression for the respective Regression Models