Commercial Mortgage Delinquency, Foreclosure and Reinstatement

Cynthia Holmes

University of British Columbia, Faculty of Commerce

cynthia_holmes@hotmail.com

This draft: January 21, 2003

Abstract: Commercial mortgage default is modeled in two stages. First, a mortgage becomes delinquent, when the borrower stops making payments. Second, the delinquency is either reinstated (payments are resumed) or the lender forecloses. The results of the empirical estimations have implications for lenders' monitoring functions. Lenders should use the critical variables of loan-to-value ratio, debt coverage ratio and guarantee to identify expected delinquent loans. Within this pool of delinquent loans, these same characteristics can be used to predict the outcome, which could be reinstatement or foreclosure. An important contribution of this paper is to demonstrate that the loan-to-value ratio, debt coverage ratio and guarantee differ in a statistically significant way across these outcomes.

Thank you to my doctoral committee members Tsur Somerville, Adlai Fisher and Stan Hamilton. Enormous thanks are also due to the anonymous lender who provided the database. Generous funding from the Real Estate Research Institute is gratefully acknowledged. Any errors are mine.

1. Introduction

An important source of risk for commercial mortgage lenders and investors is default. When a borrower misses regularly scheduled payments, becoming delinquent, they interrupt the lender's cash flow and reduce the reinvestment income. When delinquency persists, lenders may initiate foreclosure proceedings, where they assume ownership of the secured property and release the mortgage obligation. Foreclosure is a costly event, with loss percentages estimated to be 30% (Ciochetti 1997).

Due to the importance of default risk, it has received considerable attention from the academic literature, particularly in the residential context. However, most existing models equate missed payments with foreclosure. In reality, a missed payment does not lead inexorably to foreclosure. Some borrowers enter delinquency with the intention of exercising their default option; they intend for the lender to foreclose on the secured property and release them from the mortgage obligation. Since foreclosure takes a considerable amount of time, it's conceivable that economic conditions could change favorably for the delinquent borrower, so that they decide instead to reinstate the mortgage. But other delinquent borrowers may always have the intention of reinstating the mortgage. These borrowers are effectively making a new short-term loan equal in value to the amount of the missed payments. In the database used in this paper, of the 174 loans that were delinquent and had a resolved outcome, 103 were reinstated and 71 were foreclosed or the equivalent. The high proportion of reinstated loans reinforces that these two states, delinquency and foreclosure, are not synonymous, and should be modeled separately.

Another reason that this distinction between delinquency and foreclosure is important is that models that consider only foreclosure will neglect the cash flow volatility that arises from missed payments. This is particularly important in the context of commercial mortgage-backed securities where the lowest level tranches absorb all the pool's volatility. Appropriate delinquency models are therefore a necessity.

Perhaps the most compelling reason why the distinction between delinquency and foreclosure is relevant is within the context of loan monitoring and servicing. A better understanding of the characteristics that distinguish the two outcomes of delinquency (reinstatement or foreclosure) will assist lenders and servicers in developing strategies and allocating resources to minimize their losses.

A large Canadian commercial mortgage lender provided the database used for the empirical estimations. Two features of the database are particularly interesting. First, the lender performs periodic appraisals of the underlying property as part of their monitoring procedures. The result is a more accurate assessment of the loan-to-value ratio relative to other empirical work that observes the value only at initiation, and then appreciates the property value forward in time using return indices. The debt coverage ratio is also evaluated periodically and is therefore also well measured. The second interesting feature of the database is that the lender's records indicate whether the loan is non-recourse. In this database, non-recourse lending accounts for only 12% of loans, while the remainder has either a personal or corporate guarantee, or both.

If a guarantee is viewed as a transaction cost within the options-based default model, then it should be negatively related to the incidence of delinquency since the borrower's trigger point for default would be higher. On the other hand, the guarantee or lack thereof is set at the time of mortgage initiation. Therefore, it can be viewed as endogenous since the lender can manipulate various terms of the mortgage, such as the loan amount and the guarantee, in order to mitigate risk. A final consideration related to guarantee is that in practice, it can be difficult to realize upon it. For example, the value of personal guarantees may be compromised since valuable assets such as the principal residence can be in the name of the guarantor's spouse. Corporate guarantees may be offered from borrowing firms where the only asset is the secured property. Due to the issue of endogeneity and the difficulty in realization, one might predict that the guarantee variable was insignificant. In fact, guarantee was consistently negative in the estimations performed in this paper, favoring the transaction cost perspective.

In this paper, the empirical estimations are performed in two stages that correspond to the process that actually occurs as a loan moves from delinquency to resolution. In this first stage, a model to predict delinquency from within the pool of all loans is estimated. Variables related to the property equity level (loan-to-value ratio) and cash flow (debt coverage ratio) were significant, with the signs predicted by option-based theories. This implies that these variables are useful for lenders' monitoring functions, in the prediction of delinquency.

In the second stage, the outcome of delinquent loans is modeled as either reinstatement or foreclosure. The loan-to-value ratio was positively significant for the foreclosure outcome, relative to reinstatement. The coefficients for the debt coverage ratio and the guarantee were both negative and significant. This implies that lenders can distinguish between these two outcomes of delinquent.

In section 2, a review of the related literature is performed. Section 3 discusses the data while section 4 presents the methodology and results. Section 5 concludes.

2. Literature Review

The theory providing a foundation for the empirical estimations in this paper is the options-based model for the value of a mortgage. This model incorporates two sources of uncertainty, term structure risk and default risk. Starting with Foster and Van Order (1984,1985), the default aspect of a mortgage has been modeled a put option, where the underlying asset is the secured property. Kau et al. (1987,1990) extend this model to the commercial mortgage framework.

The earliest empirical testing of this model for commercial mortgages on disaggregate data is Vandell et al. (1993). The dataset in this study consists of multiple commercial property types originated by a single lender. The methodology is proportional hazards estimation, where failure is defined as the time when the mortgage is foreclosed upon. He found that the contemporaneous loan-to-value ratio and the interest rate were positive and significant. The debt coverage ratio was not significant, but the value at loan origination was used, not the contemporary value. The property type and the borrower type also had significant effects. Vandell argues that the significance of the borrower type is evidence that transaction costs have an influence on default.

There has been a recent explosion in work on the empirical estimation of commercial mortgage default, including Ciochetti et al (2002), Ambrose and Sanders (2001), Archer et al. (2002), Chun and Deng (2002) and Goldberg and Capone (2002). These studies differ in their data sources, estimation technologies, set of independent variables and definition of default.

The current study uses data from a single large commercial mortgage lender, as does Ciochetti et al. (2002), although they use a different, American firm. Other studies use commercial mortgage backed securities data (Ambrose and Sanders (2001) and Chun and Deng (2002)) or multifamily mortgages (Archer et al. (2002) and Goldberg and Capone (2002)).

The critical independent variable suggested by option theory is a measurement of the borrower's equity, the loan-to-value ratio. Goldberg and Capone's (2002) findings suggest that cash flow considerations, measured as the debt coverage ratio, also play a role in default. Archer et al. (2002) and Ambrose and Sanders (2001) both confirm the lack of a relationship between initial loan-to-value ratio and default, while Ciochetti et al. (2002) find that contemporaneous loan-to-value ratio and debt coverage ratio are significantly positive and negative, respectively. Other variables used as independent variables in these studies include borrower characteristics, property location and market conditions. This research is the first to consider the presence of a guarantee.

In most of these studies, a mortgage is considered to be in default at the time when the loan terminates through foreclosure.[1] But work by Ambrose and co-authors explicitly recognize that default and foreclosure are not synonymous. In Ambrose and Capone (1996), costs and

[1] An exception is Archer et al. (2002) who define default as 90-days delinquent.

benefits to various alternatives to foreclosure on residential mortgages are modeled and parameterized. They find that multiple alternatives can be optimal, including foreclosure and restructuring, depending on factors such as the interest-rate environment and movement of house prices. Ambrose and Buttimer (2000) modify the boundary conditions of the mortgage pricing model to include the value of the right to reinstate a mortgage in delinquency, and Ambrose and Capone (1998) empirically examine the effect of the loan, property and borrower characteristics on the eventual outcome of a residential mortgage in default. Gardner and Mills (1989) and Springer and Waller (1993) are other papers that recognize and study the distinction between delinquency and foreclosure.

Chun and Deng (2002) examine the workout strategy decisions of commercial mortgage backed securities special servicers on loans that are 60-days delinquent. They find that cash flow considerations are relevant. This study differs from the present one in that they are not concerned with the eventual outcome of the mortgage, but with whether or not the loan receives a restructuring modification.

3. Data

A major Canadian commercial mortgage lender provided the dataset used in the empirical estimation. Observations are monthly, from November 1996 to May 2001, with three months of missing data, for a total of 52 months. In the first observation, there were 1,126 active loans, and each month new loans were added and some loans terminated. A total of 1,637 loans are present for at least one month during the observation window.

Every loan is secured by commercial property in Canada. The differences between the American and Canadian commercial mortgage systems and regulations are not substantial. In Canada, the incidence of a personal or corporate guarantee may be higher. The competitive market structure is different in that the Canadian market is dominated by a small number of large, national lenders, of which the data supplier is one. But most importantly, foreclosure laws, prepayment clauses and rules governing delinquency are comparable across the two countries.

All the loans by this lender are fixed-rate mortgages with a fixed term that usually ranges between 1 year and 30 years, with the most common terms being 5 years, 10 years and 20 years. Most loans have a term shorter than the amortization period, so a balloon payment is usually due at maturity. Approximately 95% of the loans are amortizing with monthly payments of principal and interest, with the remainder making interest-only payments either monthly or annually.

The lender has a standard clause in the mortgage contract prohibiting early repayment[2]. However, the company policy is to accept early repayment when it is accompanied with a penalty large enough so that the lender can maintain the contract yield by substituting Canadian government bonds. This is identical to yield maintenance penalties observed in the U.S. except that the discount rate is the Canadian government bond yield, not the current mortgage rate. This penalty is sufficiently severe so that the economic incentive to refinance through prepayment is removed. There were 190 loans that prepaid during the observation window, of which 181 were classified as never delinquent and 9 of which were delinquent but then reinstated/prepaid.

The key variables of interest are the loan's delinquency status, and the eventual outcome of the delinquency. A loan is classified as "delinquent" if a payment is 90-days past due at least once during the observation window. Of the 1637 loans observed, 214 were delinquent. Table 1 provides a diagram of the default process, and the number of loans with each outcome. Of the 214 delinquent loans, 103 were not delinquent at the end of the observation window. These are classified as "reinstated". 71 loans were foreclosed or the equivalent.[3] The remaining 40 loans are unresolved at the end of the observation window – no foreclosure or equivalent has been

[2] Some loans originated before the mid-1970s may have a clause in their contract specifying some other prepayment penalty, such as 6 months interest.
[3] Any outcome where the lender becomes the legal owner of the secured property is classified as a foreclosure equivalent. The most common alternative is the voluntary transfer of title ("deed-in-lieu").

initiated and the payment is still at least 90-days past due.[4] These unresolved loans include loans where the lender has deliberately decided to delay or avoid foreclosure. But in addition, this unresolved category includes loans that have just entered 90-day delinquency, so the lender has not yet had the opportunity to initiate foreclosure.

Descriptive statistics for the independent variables are in Table 2, broken down by delinquency status.[5] The independent variables are measured at the first observation for each particular loan. For most loans, this is November 1996, but for new loans, the variables are measured at the time of the mortgage initiation.

The loan-to-value ratio is calculated as the outstanding balance divided by the property value, both measured at the first observation. An advantage of this database is that there are multiple property appraisals available for each mortgage, including historical values. The lender periodically re-appraises the underlying property for loan monitoring purposes. These re-appraisals are done at irregular intervals, which vary based on the size of the mortgage and the lender's discretion. To measure the property value at the time of the first observation, the appraisal closest in time, either forward or backward, is appreciated or depreciated based on returns from the Russell Canada Property Index for that property type and region.[6] In this way, the resulting property value that is quite accurate relative to other empirical studies that appreciate the property value from loan initiation.

The loan-to-value ratio averages 70.3% in the database. Delinquent loans have a higher value, at 93.4% versus 66.9% for never-delinquent loans. Foreclosed loans have the highest loan-to-value ratio of all the categories, at 118.4%.

---

[4] The lender may negotiate a restructuring agreement with a borrower. Some delinquent loans with these agreements were reinstated and some were foreclosed. More precisely, 9 of the 71 foreclosed loans were restructured, 7 of the 103 reinstated loans were restructured, and 7 of the 40 unresolved loans were restructured. Of the 1423 loans that were never delinquent within the observation window, 29 were restructured.

[5] The independent variables are not highly correlated. The highest (absolute value) correlation is between the loan-to-value ratio and the debt coverage ratio at –0.37.

[6] This index doesn't report values for all property type/region combinations. If a combination is unavailable, the appreciation rates for the region is applied.

Whenever a property appraisal is performed, the lender calculates and records the debt-coverage ratio. The one closest in time to the first observation is selected.[7] The average debt-coverage ratio was 149%. Never-delinquent loans have a higher debt-coverage ratio than delinquent loans, and reinstated loans are higher than foreclosed loans.

Non-recourse loans are relatively rare in Canada. In fact, 87.6% of the loans in the database had either a personal or a corporate guarantee, or both. The indicator variable measuring the guarantee is 0 if the loan is non-recourse and 1 if there is any type of guarantee. Unfortunately, the breakdown to the type of guarantee (personal or corporate or both) and the subjective evaluation of the quality of the guarantee were not consistent in the lender's records and were therefore not usable in the empirical work.

Of the 1637 loans in the database, the guarantee data is only available for 898. In order to avoid discarding the observations with missing data, a dummy variable indicating whether the guarantee variable was missing was created, and the guarantee variable itself was coded 0 for missing data. In the estimations, the coefficient on the dummy variable will capture the average incremental value for the loans with missing guarantee data. This value is not reported in the estimation tables. The coefficient on the guarantee represents the marginal effect for the non-missing cases. This technique is exactly analogous to Archer et al. (2002).

The lender diversifies their portfolio across property type and geographic region. The largest category of property types is retail, which includes shopping centers, strip malls, restaurants, auto dealerships, stand-alone fast food restaurants and other retail properties. Besides retail, the major categories are offices, apartments and industrial/warehouse. The remaining other category includes vacant land, hotels, motels, airport properties, medical buildings, government properties, nursing homes and schools.

[7] I am unaware of a Canadian rental index across property types, so I am unable to adjust the debt-coverage ratio for the passage of time. The average number of days between the date of the debt coverage ratio used and the first observation is 337.

The six geographic regions are Quebec, Ontario, Alberta, British Columbia, Atlantic (which includes the provinces of Newfoundland, Nova Scotia, Prince Edward Island and New Brunswick) and Prairie (which includes the provinces of Saskatchewan and Manitoba). The region with the highest proportion of loans is Ontario, followed by Quebec.

The size of the mortgage is measured as the outstanding balance at the time of the first observation; the average was $4.1 million (Canadian). The average contract interest rate, measured as a percentage, was 9.7. The spread was calculated as the difference between the contract rate and the prime market rate, divided by the prime market rate. The lender-supplied market rate is based on a prime mortgage with a matching term. Therefore, high spreads would be observed under several circumstances. If rates have fallen since loan initiation, then high spreads would be observed. But in addition, loans that were initiated at a high contract rate due to elevated risk will also have higher spreads. Further, loans that were initiated with long terms that are now reaching maturity will have higher spreads even if rates have not fallen, if the usual yield curve slope is assumed.

Other variables were considered but not used. The seasoning of the loan was not available since the lender's records sometimes report date since initiation and sometimes date since the last renewal. Since the proportion of insured mortgages was less than 2.5% (only small apartment buildings), it was not usable. Similarly, mortgage priority is not used since only 2.2% of loans were second mortgages. Property vacancy rates were not used due to data unavailability. The property income return and income return volatility over the previous 5 years was calculated for each loan's property type and region. These variables were included in initial specifications but were never significant.

The descriptive statistics broken down by loan status provide some interesting insights when the values for never delinquent loans are compared to delinquent but reinstated loans and foreclosed loans. The average loan-to-value ratio monotonically increases across the three categories, with the lowest value for never delinquent loans, the next lowest value for reinstated loans and the highest value for foreclosed loans; the values are 67%, 80% and 118%. The debt coverage ratio also shows the same monotonic pattern, with the values for the three categories equal to 154%, 134% and 85%. For both variables, the foreclosed loans have the "worst" average values, while the never delinquent loans are "best" and the reinstated loans are in-between.

The same pattern also holds for the interest rate, the outstanding balance and the spread. For all three variables, the foreclosed loans have the highest average value and never delinquent loans have the lowest. Among the property types and locations, only Ontario shows a pattern, with 35% of the never delinquent loans in Ontario, 45% of the reinstated loans and 54% of the foreclosed loans. For the guarantee variable, the never delinquent loans and the reinstated loans have the same proportion, about 88%. But only 67% of foreclosed loans have a guarantee. While these patterns are suggestive, multivariate analysis is necessary to determine whether these relationships are significant.

4. Methodology and Results

The first estimation models delinquency status and uses the probit methodology. The single-failure proportional hazards estimation method has been used by other authors, such as Vandell et al. (1993), but it is not appropriate for use in this paper since the timeframe is too short. This was confirmed by tests using failure defined as the first time delinquency was observed for the loan. The log hazard ratio function was not constant over time, indicating that proportional hazard methodology is not appropriate.

Instead, the probit methodology was employed, which estimates

$$probability\ (90\text{-}day\ delinquency_i = 1) = F(X_i\beta),$$

where $F(.)$ is the standard normal distribution and X_i are the independent variables that include the loan-to-value ratio, the debt-coverage ratio and the incidence of a guarantee.

In this estimation method, the values of the independent variables are taken at the time of the first observation, which is either November 1996 or the initiation date for loans initiated after November 1996. The dependent variable is determined by looking forward to the end of the observation window. Therefore, this estimation is analogous to that which the lender would perform in the course of monitoring their portfolio. They use information available at the present point in time in order to predict future default.

The results of the estimation are in table 3. As predicted by the option-theoretic model of default, the loan-to-value ratio is positive and significant. This has been a consistent finding in empirical studies that use the contemporary loan-to-value ratio (as opposed to the initial value). The debt coverage ratio is also negative and significant, confirming the findings of Goldberg and Capone (2002) and others that use contemporary debt coverage ratios. In addition, the spread between the current market rate and the contract rate is positively and significantly related to the likelihood of delinquency. This is the first study to examine whether the non-recourse status of the loan is related to delinquency. The result is that the guarantee variable is significantly negative, meaning that the presence of a guarantee reduces the likelihood of delinquency. Region-level variables for Ontario and Quebec were added in the second specification, with all other regions serving as the excluded outcome. The Ontario region was found to be significantly positive. In the final specification, property type dummies for retail, industrial/warehouse and office were included but were not significant. In this case, the excluded types were multifamily and other. In summary, the loan-to-value ratio, debt coverage ratio, spread and guarantee are important variables related to commercial mortgage loan delinquency, which is the first stage of the default process, and includes borrowers who are both exercising their default option and those who are short-term payment amount borrowers.

Since it is more common for empirical researchers to use foreclosure as the measure of default, the same set of estimations are repeated with the binary dependent variable set to 1 if the loan was foreclosed instead of if the loan was delinquent. The key variables of loan-to-value ratio, debt coverage ratio and guarantee have the same sign and significance. However, the coefficients in the foreclosure case are larger, in an absolute value sense. The implication of this result is that if a lender is attempting to discern which loans will become delinquent and which will become foreclosed, it is largely a matter of degree, since the same variables are involved in the two cases. Loans with more extreme values (in the worst direction) would be those more likely to be foreclosed. This idea is tested more rigorously in the next set of estimations.

The second goal of this paper is to distinguish among the potential outcomes of delinquent loans. Since there are multiple potential outcomes, a multinomial logit model is employed. Loan *i* can have one of *k* outcomes. For each mortgage loan

$$\Pr(i \in j) = \frac{e^{X\beta_j}}{\sum_{j=1}^{k} e^{X\beta_k}}$$

for all *k* outcomes. *X* is the vector of independent variables and β_j are the coefficients reported in the table.

The three possible outcomes for a delinquent loan are foreclosure, reinstatement or the outcome can be unresolved at the end of the observation window. The results that are reported in table 4a are relative to reinstatement, which is the excluded outcome. Only delinquent loans are used in this estimation, so the results are conditional on the loan being delinquent. In order to address a selection bias that may arise from the exclusion of the never delinquent loans, table 4b reports another set of estimations performed based on all loans and four potential outcomes: never delinquent, foreclosed, reinstated and unresolved. Again, the excluded outcome is reinstatement. The results are similar in the three-outcome and four-outcome estimations.

Relative to the likelihood of being reinstated, the probability of a delinquent loan being foreclosed is positively related to the loan-to-value ratio and negatively related to the debt coverage ratio and the guarantee. For all three variables, these signs correspond to those predicted by option-theory with the presence of a guarantee viewed as a transaction cost. These finding suggests that it is possible for commercial mortgage loan servicers to distinguish among the potential outcomes of delinquent loans.

5. Conclusion and Extensions

An innovation in this paper is to consider the models for delinquency and delinquency outcome separately. This is justified since the outcome of delinquency is not foregone – reinstatement is a more frequent resolution than foreclosure. The empirical models are estimated using a database from a single lender, with particularly accurate values for the loan-to-value ratio and the debt coverage ratio.

The results of the empirical estimations have implications for lenders' monitoring functions. Lenders should use the critical variables of loan-to-value ratio, debt coverage ratio and guarantee to identify expected delinquent loans. Within this pool of delinquent loans, these same characteristics can be used to predict the outcome, which could be reinstatement or foreclosure. An important contribution of this paper is to demonstrate that the loan-to-value ratio, debt coverage ratio and guarantee differ in a statistically significant way across these outcomes.

This paper is also the first to examine the guarantee variable, and despite issues related to endogeneity and difficulty in realization on the guarantee, it was found to be consistently statistically significant, both in prediction of delinquency and in distinguishing among the reinstatement and foreclosure outcomes of delinquency.

Planned extensions of this paper include the formalization of the two-stage conceptual model of the default process, as well as robustness checks for the results in light of restructuring modifications, post-renewal defaults and prepayments.

References

Ambrose, Brent W., Buttimer, Richard J., Embedded Options in the Mortgage Contract, Journal of Real Estate Finance and Economics, 21(2), 2000, pages 95-111.

Ambrose, Brent, Capone, Charles, Modeling the Conditional Probability of Foreclosure in the Context of Single-Family Mortgage Default Resolutions, Real Estate Economics, 1998, 26(3), pages 391-429.

Ambrose, Brent, Capone, Charles, Cost-Benefit Analysis of Single Family Foreclosure Alternatives, Journal of Real Estate Finance and Economics, 13, 1996, pages 105-120.

Ambrose, Brent; Sanders, Anthony, Commercial Mortgage-backed Securities: Prepayment and Default, working paper, 2001.

Archer, Wayne et al., Determinants of Multifamily Mortgage Default. Real Estate Economics, 30(3), 2002, pages 445-473.

Childs, Paul D.; Ott, Steven H.; Riddiough, Timothy J., The Pricing of Multi-Class Commercial Mortgage Backed Securities, Journal of Financial and Quantitative Analysis; 31(4), December 1996, pages 581-603.

Chun, Jun; Deng, Yongheng, Commercial Mortgage Workout Strategy and Conditional Default Probability: Evidence from Special Serviced CMBS Loans, working paper, 2002.

Ciochetti, Brian A., Loss Characteristics of Commercial Mortgage Foreclosures, Real Estate Finance, Spring 1997, pages 53-69.

Ciochetti, Brian A. et al., The Termination of Commercial Mortgage Contracts through prepayment and Default: A Proportional Hazard Approach with Competing Risks, Real Estate Economics, 30(4), 2002, pages 595-633.

Foster, C., Van Order, R.; FHA Terminations,: A Prelude to Rational Mortgage Pricing, Journal of the American Real Estate and Urban Economics Association, 1985, 13(3), pages 292-316.

Foster, C., Van Order, R.; An Option-Based Model of Mortgage Default, Housing Finance Review, 1984, 3, pages 351-372.

Gardner, Mona, Mills, Dixie, Evaluating the Likelihood of Default on Delinquent Loans, Financial Management, 18(4), Winter 1989, pages 55-63.

Goldberg, Lawrence and Capone, Charles A, A Dynamic Double-Trigger Model of Multifamilty Mortgage Default, Real Estate Economics, 30(1), Spring 2002, pages 85-114.

Kau J.B., Keenan, D.C., An Overview of the Option-Theoretic Pricing of Mortgages, Journal of Housing Research, 6(2), 1995, pages 217-244.

Kau, J.B., Keenan, D.C., Muller, W.S., Epperson, J.F., Pricing Commercial Mortgages and their Mortgage-backed Securities, Journal of Real Estate Finance and Economics, 1990, pages 333-356.

Kau, J.B., Keenan, D.C., Muller, W.S., Epperson, J.F., Valuation and Securitization of Commercial and Multi-family Mortgages, Journal of Banking and Finance, 11, 1987, pages 525-546.

Kau, J.B., Kim, T,; Waiting to Default: The Value of Delay, Journal of the American Real Estate and Urban Economics Association, 1994, 22(3), pages 539-551.

Riddiough, Timothy J.; Thompson, Howard E., Commercial Mortgage Pricing with Unobservable Borrower Default Costs, American Real Estate and Urban Economics Association Journal; 21(3), Fall 1993, pages 265-91.

Riddiough, Timothy J.; Wyatt, Steve B., Strategic Default, Workout, and Commercial Mortgage Valuation, Journal of Real Estate Finance and Economics; 9(1), July 1994, pages 5-22.

Schwartz, Torous, Prepayment and the Valuation of Mortgage-Backed Securities, Journal of Finance, June 1989, 44(2), pages 375-392.

Springer, Thomas M., Waller, Neil G., Lender Forbearance: Evidence from Mortgage Delinquency Patterns, Journal of the American Real Estate and Urban Economics Association, 21(1), 1993, pages 27-46.

Titman, Sheridan D.; Torous, Walter N., Valuing Commercial Mortgages: An Empirical Investigation of the Contingent Claims Approach to Pricing Risky Debt, Journal of Finance; 44(2), June 1989, pages 345-73.

Vandell, Kerry D., How Ruthless is Mortgage Default? A Review and Synthesis of the Evidence, Journal of Housing Research, 6(2), 1995, pages 245-264.

Vandell, Kerry D., Handing over the Keys: A Perspective on Mortgage Default Research, American Real Estate and Urban Economics Association Journal; 21(3), Fall 1993, pages 211-46.

Vandell, Kerry D. et al., Commercial Mortgage Defaults: Proportional Hazards Estimation Using Individual Loan Histories, American Real Estate and Urban Economics Association Journal; 21(4), Winter 1993, pages 451-80.

Table 1 - Number of Loans by Delinquency Status

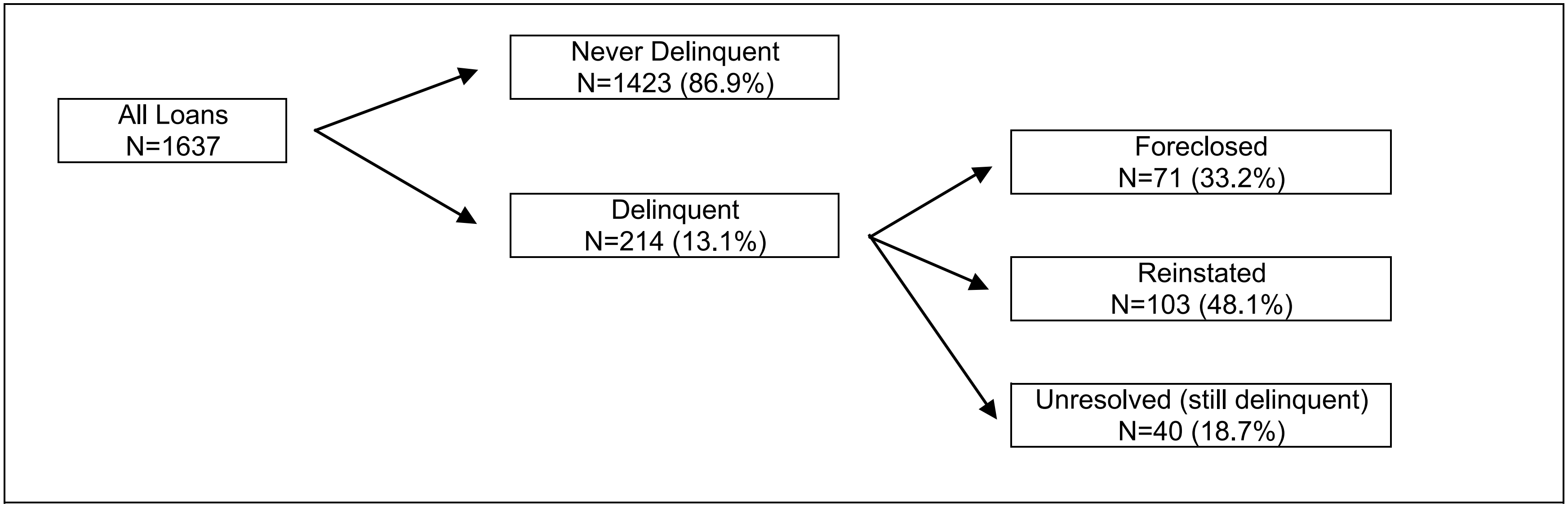


Table 2 - Descriptive Statistics

	All Loans			Never delinquent			Delinquent			Foreclosed			Reinstated		
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev
LTV	1526	0.703	0.441	1329	0.669	0.402	197	0.934	0.599	66	1.184	0.812	97	0.795	0.406
DCR	1441	149.124	74.272	1248	154.352	75.033	193	115.321	59.002	55	85.364	46.849	98	134.000	63.282
Rate	1637	9.723	1.924	1423	9.680	1.889	214	10.011	2.126	71	10.549	2.196	103	9.725	2.015
OSB	1637	4.059	7.884	1423	3.880	7.886	214	5.252	7.783	71	5.667	8.062	103	4.817	8.221
Guarantee	898	0.876	0.329	774	0.888	0.316	124	0.806	0.397	30	0.667	0.479	60	0.883	0.324
Spread	1637	0.563	0.356	1423	0.553	0.353	214	0.628	0.373	71	0.702	0.433	103	0.618	0.343
Ontario	1637	0.368	0.483	1423	0.351	0.477	214	0.486	0.501	71	0.535	0.502	103	0.447	0.500
Quebec	1637	0.274	0.446	1423	0.275	0.447	214	0.271	0.446	71	0.268	0.446	103	0.282	0.452
Retail	1637	0.373	0.484	1423	0.368	0.482	214	0.402	0.491	71	0.451	0.501	103	0.369	0.485
Industrial	1637	0.220	0.414	1423	0.225	0.418	214	0.187	0.391	71	0.155	0.364	103	0.223	0.418
Office	1637	0.213	0.410	1423	0.214	0.411	214	0.206	0.405	71	0.254	0.438	103	0.184	0.390

Table 3

	Independent Variable: Ever Delinquent			Independent Variable: Foreclosed		
	(1)	(2)	(3)	(1)	(2)	(3)
LTV	0.5714 ***	0.5636 ***	0.5914 ***	0.7144 ***	0.7131 ***	0.7033 ***
	(0.110)	(0.112)	(0.111)	(0.138)	(0.141)	(0.141)
DCR	-0.0042 ***	-0.0041 ***	-0.0042 ***	-0.0093 ***	-0.0087 ***	-0.0096 ***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Rate	-0.0326	-0.0500	-0.0343	0.0234	0.0154	0.0216
	(0.032)	(0.032)	(0.032)	(0.050)	(0.051)	(0.051)
OSB	0.0040	0.0042	0.0052	0.0058	0.0054	0.0063
	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)
Spread	0.6031 **	0.6493 ***	0.6086 ***	0.3539	0.3735	0.3607
	(0.174)	(0.176)	(0.175)	(0.270)	(0.273)	(0.274)
Guarantee	-0.4066 **	-0.3545 **	-0.4035 **	-0.7612 **	-0.7334 **	-0.7589 **
	(0.157)	(0.160)	(0.158)	(0.233)	(0.235)	(0.234)
Ontario		0.3969 ***			0.3369 *	
		(0.110)			(0.188)	
Quebec		0.1338			0.0967	
		(0.121)			(0.212)	
Retail			-0.0639			0.6236 **
			(0.138)			(0.309)
Industrial			-0.0053			0.5432
			(0.152)			(0.333)
Office			-0.1608			0.5464 *
			(0.153)			(0.320)
Constant	-0.6638 *	-0.7684 **	-0.6057	-1.2787 **	-1.4875 **	-1.7800 **
	(0.382)	(0.390)	(0.396)	(0.595)	(0.624)	(0.655)

Notes:
*The estimation method is probit and the sample includes all loans. N=1394, of which 180 have the dependent variable "ever delinquent" equal to 1and 52 have the dependent variable "foreclosed" equal to 1. The independent variables are measured as of November 1996 (the first date in the observation window) or as of the initiation date for loans initiated after November 1996. The independent dummy variable indicating missing guarantee is omitted.Standard errors are in brackets below the coefficients and the significance levels of 10%, 5% and 1% are indicated by *,**and ***.*

Table 4a - Delinquent Loan Outcome

	Foreclosed	Unresolved
LTV	1.2509 **	0.3028
	(0.447)	(0.533)
DCR	-0.0136 **	-0.0062
	(0.005)	(0.005)
Rate	0.1118	0.1025
	(0.128)	(0.128)
OSB	-0.0139	-0.0305
	(0.024)	(0.030)
Spread	-0.1031	-0.9435
	(0.723)	(0.780)
Guarantee	-1.5787 **	-0.8055
	(0.635)	(0.638)
Constant	-0.2850	0.1122
	(1.547)	(1.500)
Pseudo R-squared	14.79%	

Notes:
*The estimation method is multinomial logit, where the dependent variable is the delinquent loan'soutcome. Possible outcomes are foreclosed, unresolved or reinstated. The excluded outcome is reinstated, so reported values are relative to that alternative.The independent variables are measured as of November 1996 (the first date in the observation window) or as of the initiation date for loans initiated after November 1996. The sample includes delinquent loans. The number of observations is 180, of which 52 are foreclosed, 34 areunresolved and 94 are reinstated.The independent dummy variable indicating missing guarantee is omitted. Standard errors are in brackets below the coefficients and the significance levels of 10%, 5% and 1% are indicated by *,** and ***.*

Table 4b - Loan Outcome

	Never Delinquent	Foreclosed	Unresolved
LTV	-0.6440 **	0.9353 **	0.0104
	(0.282)	(0.344)	(0.441)
DCR	0.0422 *	-0.0169 ***	-0.0097 **
	(0.022)	(0.004)	(0.005)
Rate	0.1416 *	0.2258 *	0.0592
	(0.080)	(0.131)	(0.140)
OSB	-0.0109	0.0069	-0.0187
	(0.012)	(0.019)	(0.025)
Spread	-1.3979 **	-0.3599	-0.7912
	(0.407)	(0.683)	(0.771)
Guarantee	0.1410	-1.6399 **	-0.7999
	(0.425)	(0.609)	(0.618)
Constant	1.6983 *	-0.8153	1.0641
	(0.977)	(1.561)	(1.664)
Pseudo R-squared	12.09%		

Notes:
*The estimation method is multinomial logit, where the dependent variable is the loan's outcome. Possible outcomesare never delinquent, foreclosed, unresolved or reinstated. The excluded outcome is reinstated, so reported values are relative to that alternative. The independent variables are measured as of November 1996 (the first date in the observation window) or as of the initiation date for loans initiated after November 1996. Sample includes all loans. The number of observations is 1394, of which 1214 are never delinquent, 52 are foreclosed, 34 are unresolved and 94 are reinstated. Standard errors are in brackets below the coefficients and the significance levels of 10%, 5% and 1% are indicated by *,** and ***.*

A Multiple Factor Asset-Pricing Model for Commercial Mortgages

Cynthia Holmes

University of British Columbia, Faculty of Commerce

cynthia_holmes@hotmail.com

This draft: July 23, 2002

Abstract:

This paper contributes to the commercial mortgage literature and the multiple factor asset-pricing literature by creating a model for commercial mortgage returns. The result of an initial analysis using the five Fama and French (1993) factors is that the sensitivities of commercial mortgage returns and corporate bond returns to each factor are statistically indistinguishable. However, further analysis was performed using factors associated with real estate returns, and the result is that unlike stocks and corporate bonds, commercial mortgage returns are sensitive to the factor that measures growth in personal consumption.

Thank you to my committee members, Tsur Somerville, Stan Hamilton and Adlai Fisher for their advice and comments. In addition, thanks to Kenneth French for making his portfolio returns and factors available to all researchers on his data library website and to Michael Giliberto for supplying the values of the Giliberto-Levy Commercial Mortgage Return Index. Any errors or omissions are mine.

1 Introduction

Commercial mortgages are a large asset class. The size of the U.S. market was about $1.2 trillion[1] at the end of 2000, about a quarter of the size of the market for corporate bonds. But despite the large size of the market, the size of the body of academic literature about commercial mortgages is small. This is most likely due to the difficulty in obtaining access to data[2], since most commercial mortgages are held by the originating lender and are not traded on any secondary market. However, as the secondary market grows through the issuance of commercial mortgage backed securities, so does the need for research that addresses questions about this asset class[3].

Commercial mortgages have term structure risk, like corporate bonds. But while the source of cash flow to service corporate bonds is from the general operation of the firm, the source of cash flow for commercial mortgages is the rental income of the specific property secured by the mortgage. Therefore, the structure of default risk is different. This is an important factor that distinguishes the two asset classes. In addition, commercial mortgages are less liquid and less divisible than corporate bonds, and have a different payment structure. Commercial mortgages typically have amortizing payments of interest and principal, while corporate bonds typically have only interest coupons. In this paper, I examine how the differences in the asset classes are manifested in the returns using multiple factor asset pricing models.

The development and testing of asset pricing models is one of the central research areas in finance dating back to the 1960s with the work of Sharpe (1964) and Lintner (1965) on the capital asset pricing model. But most of research attention is turned to stock market returns, with little attention to bonds and real estate, and no work at all on commercial mortgages.

---

[1] Federal Reserve Board, Flow of Funds Accounts of the United States, September 18, 2001.
[2] In this paper, I overcome this problem by using an index created by Giliberto-Levy Inc. Further details are in the data description in section 4.
[3] The amount of CMBS issued grew from less than $10 billion in 1990 to over $90 billion in 2001. (Source: John B. Levy, The Ground Floor, Barron's, January 1991 and January 2001).

In this paper, I test the five-factor asset-pricing model of Fama and French (1993) on a broad set of assets that includes stocks, bonds, real estate[4] and commercial mortgages. This allows me to compare the sensitivity of different assets to the factors. The result is that the Fama and French five factors describe stock, real estate investment trust (REIT), bond and commercial mortgage returns. In fact, the sensitivity of bonds and commercial mortgages to each of the five factors is statistically indistinguishable. That specification, however, does not include the factor that measures growth in personal consumption.

The second specification, developed in the real estate literature by Ling and Naranjo (1997), describes whole, appraised real estate returns and includes the consumption factor. There is a strong theoretical justification for including consumption as a factor to describe asset returns dating back to the formulation of the consumption capital asset pricing model of Breeden (1979). But the empirical evidence linking stock and bond returns to consumption has been mixed.[5]

The empirical test based on a multiple factor model from the real estate literature demonstrates that commercial mortgage returns are sensitive to the factor that measures growth in personal consumption, while the stock and bond returns are not. This finding is one of the key contributions of this paper, because it distinguishes the underlying factors driving commercial mortgages and corporate bonds. This finding justifies the examination of commercial mortgages as an asset class distinct from corporate bonds, because it shows that the returns have different characteristics. And in particular, the characteristic distinguishing commercial mortgages from corporate bonds is the same one that links commercial mortgages and appraised real estate, since appraised real estate is also sensitive to the factor growth in personal consumption.

---

[4] Real estate returns are measured two ways in this paper. The first is an index of real estate investment trusts (REIT) and the second is based on appraisals of whole real estate. More detail is in the data description in section 4.

[5] For example, Mankiw and Shapiro (1986) find that the CAPM performs better than a consumption-based model, while Breeden, Gibbons and Litzenberger (1989) find that the performance of the CAPM and a consumption-based model are similar. More recently, Cochrane (1996) finds that the CAPM outperforms a consumption model and Lettau and Ludvigson (2001) have shown that a conditional consumption CAPM works just as well as the Fama-French three-factor model in explaining stock returns.

Based on the results from the first two estimations, I create a third specification that consists of the five Fama and French factors along with the consumption factor. The consumption factor is still significant for commercial mortgages and insignificant for corporate bonds. In fact, this six-factor specification is the best model (in terms of adjusted R^2 and the root mean squared error) for commercial mortgages.

In section 2 of this paper, I will provide an introduction to commercial mortgages. Section 3 will review the related literature, section 4 will discuss the data, section 5 will present the results and section 6 will conclude.

2 Commercial Mortgages

Commercial mortgages are distinguished from residential mortgages by the nature of the underlying security as well as regulatory and institutional factors. Commercial mortgages are secured by a specific commercial property, such as an office building, retail property or apartment complex, as opposed to a residential mortgage which is secured by a single-family home. There is no mortgage insurer for commercial mortgages as there is for residential mortgages, so default risk falls to the lender, not any government agencies. As a consequence of this, the maximum loan-to-value ratios for commercial mortgages are usually lower than those for residential mortgages. There is less interest rate risk for investors due to the presence (usually) of a yield maintenance prepayment penalty. So the incidence of prepayment is lower for commercial mortgages relative to residential mortgages. (See Clauretie and Sirmans (1999), page 399, for a textbook description of the characteristics of commercial mortgages.)

Commercial mortgages and corporate bonds are similar in that they both have term structure risk and default risk. But the default risk for mortgages is based on the value of the underlying real estate asset, while for corporate bonds, it is based on the value of the firm.

Another key difference between commercial mortgages and corporate bond investments is that commercial mortgages are less liquid and less divisible.

Commercial mortgages require specialized knowledge by investors, who perform underwriting based on property appraisals of the real estate that forms the collateral. Along with the lack of liquidity and the indivisibility, this implies that the potential investor pool is largely limited to major financial institutions. The cash flow structure of a commercial mortgage is comparable to a corporate bond in that they are usually fixed-rate, although for commercial mortgages, interest and principal is paid on an amortizing basis.

3 Literature Review

Ciochetti and Vandell (1999) investigate the characteristics of the returns from investment in commercial mortgage loans. Ciochetti and Vandell's data comes from a single insurance firm, which they use to construct a return series for the period 1974 to 1990. They compare the mean and variance of their return series with those of various stock and bond indices, and find that commercial mortgages are quite similar to bonds. The returns on commercial mortgages were found to have an important positive correlation of 0.95 with bond series, a small positive correlation of 0.30 with stocks and a small negative correlation of –0.27 with real estate series. Other work investigating the returns of commercial mortgages includes Snyderman (1990) and Giliberto (1996), both of whom create a performance index based on American Council of Life Insurance submissions by life insurers who are commercial mortgage lenders.

While my paper contributes to the small literature on commercial mortgage returns, it also contributes to the asset pricing literature by applying the existing multiple factor models to a new asset return series.

An early paper about the empirical testing of multiple factor asset-pricing models is Chen, Roll and Ross (1986). Motivated by the Arbitrage Pricing Theory of Ross (1976), they identify a set of macroeconomic factors and create a model to describe stock market returns. The five factors that are identified and tested are the term spread between long and short interest rates, the default spread between high and low risk bonds, growth in industrial production, change in expected inflation and unexpected inflation. In addition, Chen, Roll and Ross use a value-weighted stock market index.

Fama and French (1993) (FF) differ from Chen, Roll and Ross in two ways relevant to my work. First, they expand the set of asset returns to include corporate and government bonds, which I will expand further to include commercial mortgages and real estate. Second, they employ a time-series regression approach that originated with Black, Jensen and Scholes (1972). The equation being estimated is

$$r_{it} - r_{ft} = \alpha_i + \sum_{k=1}^{K} \beta_{ik} F_{kt} + e_{it} \tag{1}$$

where F_{kt} are various macroeconomic factors at time t and the dependent variable is an excess return (r_{it} is the return for asset i at time t and r_{ft} is the risk-free rate of return at time t).

FF designated three factors as stock market-related: an overall market factor, a factor related to firm size and a factor related to the ratio of book equity to market equity[6]. Two factors were designated bond market factors: the term spread and the default spread.

Several papers have used the multiple factor model framework to examine real estate returns (although none have yet considered commercial mortgage returns). Chan, Hendershott and Sanders (1990) analyze real estate returns using the method and factors from by Chen, Roll and Ross. A difficulty in analyzing real estate is that there are two potential sources of return information, REIT returns and appraisal-based returns, neither which is believed to be a perfect measure of the true nature of real estate volatility, as discussed in Corgel and deRoos (1999) and

[6] See Table 1 for more detail about the factors.

others[7]. Although Chan, Hendershott and Sanders appreciate that REIT data may be "too" volatile, they prefer this to appraisal-based returns because they feel that REIT returns are more representative of transaction prices. Thirty-eight REITs are combined to create portfolios, and excess returns are used in the estimations. Their key finding is that REITs are consistently sensitive to the term spread and the default spread.

While Chan, Hendershott and Sanders use the factors and methods of Chen, Roll and Ross, Peterson and Hsieh (1997) use those of FF. Peterson and Hsieh explore REIT returns (both equity REITs and mortgage REITs) using the time-series approach and factors identified by FF. They found significant relationships between equity REIT returns and the market factors.

Ling and Naranjo (1997) use both REITs and appraisal-based returns to generate real-estate portfolios. They applied nonlinear seemingly unrelated regression techniques in their estimation and identified a set of economic factors relevant to real estate. Their factors are the real t-bill return, the growth in personal consumption and unexpected inflation, along with the term spread.

While there is evidence that the consumption factor is related to real estate returns, researchers (for example, Cochrane (1996) and Mankiw and Shapiro (1989)) have failed to find strong empirical evidence that the consumption factor plays an important role in describing stock and bond returns. This raises the important question of whether commercial mortgage returns, which are positively correlated to corporate bond returns, but are linked to appraised real estate (since it is the underlying security for the commercial mortgage cash flow), will be sensitive to the consumption factor. The finding is that commercial mortgage returns are sensitive to the bond factors and to the consumption factor.

[7] The explanation for this phenomenon, where the volatility of real estate returns is understated, is usually attributed to the systematic behavior of property appraisers during the valuation process. Several methods have been developed to adjust the returns to account for this smoothing process. Appendix 1 provides details about how the appraisal-based returns used in this paper were unsmoothed.

4 Data

In order to test the multiple factor asset pricing models, I use an index of commercial mortgage returns prepared by Giliberto-Levy Inc (GLI)[8]. This index is the only commercial mortgage index in existence, and is widely used as a benchmark by industry practitioners.

The index is created by constructing a model portfolio that mimics the holdings of life insurance companies that hold commercial mortgages. Using data provided by the life insurers to the American Council of Life Insurers[9] (ACLI), the model portfolio has mortgages added to it every quarter based on the characteristics of the new loans done by the life insurers. Loans that terminate, either through maturation or foreclosure, are removed from the index. The cash flows in quarter t, CF_t, are the interest and principal payments plus recoveries from foreclosures. The market value in quarter t, MV_t, is the present value of all future contracted cash flows, discounted using the current market mortgage rate. The returns for quarter t, r_t, are then:

$$r_t = \frac{MV_t - MV_{t-1} + CF_t}{MV_{t-1}} \qquad (2)$$

This return calculation in (2) is analogous to the one used for bond indices. However, for bonds, MV_t is usually based on the price observed in the market, and CF_t are the coupon payments. The specific instruments that are included in bond indices are selected based on criteria such as the size and the rating. Periodically, the set of bonds included in the index are re-determined. This implies, for example, that any AAA bonds with ratings downgrades will be removed from the AAA index. So a key difference between the ratings-based bond indices used in this paper and the GLI is that the GLI bears the costs of default and foreclosure, while the bond indices may not if there are ratings downgrades. But this difference is consistent with the

[8] Giliberto (1997) and www.jblevyco.com/giliberto.html describe the methods of constructing the index in detail.
[9] Giliberto (1997) estimates that the included lenders represent more than two-thirds of the total industry commercial mortgage assets.

experience of investors. Since corporate bonds are liquid, then if there is a ratings downgrade, then the investor can divest of his holdings. Since commercial mortgages are not liquid, when a loan goes into default, the investor must bear the losses resulting from foreclosure.

One limitation of the GLI index is that the returns are only available quarterly, as opposed to stock and bond return data that is observed more frequently. For this reason, all the return series used in this paper will be on a quarterly basis.

The GLI incorporates several (reasonable) assumptions, making it an imperfect proxy for the true commercial mortgage returns. First, only fixed rate and fixed term mortgages are included in this index[10], there are no development loans and all loans are assumed to be non-recourse and closed to prepayment. In addition, assumptions are made about the lag between the commitment and funding dates, the amortization period length, the periodicity of payments (monthly) and credit losses.

The credit loss model used in the generation of the GLI warrants further explanation. ACLI data gives the proportion of the lenders' portfolio (based on book value) that is delinquent and that has been foreclosed. GLI allocates this percentage across its model portfolio based on an algorithm that takes into account the current loan-to-value ratio of each model loan. A range of loan to value ratios will exist in the model portfolio since as loans age, principal is repaid and the underlying real estate appreciates (or depreciates). Once the algorithm has selected which of the model loans to make delinquent and which to foreclose upon, it generates a cash loss. Based on evidence from Ciochetti (1997), the GLI charges a loss equal to 30% of the loan's book value on average (with variation across property type) for foreclosed loans. For delinquent loans, the loss is assessed as 0.5% of the book value per month. This figure is based on evidence from Snyderman (1991).

[10] This assumption excludes less than 10% of all the life insurer's submissions. Giliberto (1997) also reports that most lending done outside the life insurance industry is also based on a fixed-rate, fixed-term structure.

To derive the excess returns, the return on a 1-month T-bill is deducted from the GLI. The resulting excess commercial mortgage series is plotted in Figure 1, against the excess returns on a BAA-rated, intermediate-term corporate bond. Note that the duration for the commercial mortgage series varies between 3.5 and 7.0 years (based on the true holdings of the ACLI submitting lenders), so it is comparable to an intermediate term bond in terms of duration.

The macroeconomic variables used in the multiple factor model estimation are summarized in Table 1. The factors correspond to the factors used by FF and Ling and Naranjo (1997). The size factor and the book equity to market equity factor were obtained from Kenneth French's online data library, along with the returns on 25 stock portfolios, sorted by size and book-to-market equity[11]. Bond return series were obtained through DataStream from Lehman Brothers. These 8 series include indices for different ratings classes of corporate bonds (AAA, AA, A and BAA) and for two maturity lengths, long and intermediate. The REIT return series is an index compiled by the National Association of Real Estate Trusts and the index for whole, appraised real estate is from the National Council of Real Estate Investment Fiduciaries.

Table 2 lists the descriptive statistics (quarterly) for selected return series, unsmoothed real estate return series and all the factors. All return series shown are the excess form, where the one-month t-bill rate (quarterly) has been subtracted from the raw returns. The highest quarterly excess return of 4.40% is for the stock portfolio shown, which is the 13th FF portfolio, which is of medium size and medium book equity to market equity. The lowest return of 0.47% is for the appraised real estate series. Note that this series, being appraisal based, is smooth and autocorrelated. Two methods have been used to unsmooth the real estate series, with details

[11] The French website elaborates on the construction of the 25 portfolios: "The portfolios, which are constructed at the end of each June, are the intersections of 5 portfolios formed on size (market equity) and 5 portfolios formed on the ratio of book equity to market equity. The size breakpoints for year t are the NYSE market equity quintiles at the end of June of t. Book-equity to market-equity for June of year t is the book equity for the last fiscal year end in t-1 divided by the market equity for December of t-1. The ratio book-equity to market-equity breakpoints are NYSE quintiles. The portfolios for July of year t to June of year t+1 include all NYSE, AMEX and NASDAQ stocks for which we have market equity data for December of t-1 and June of t, and positive book equity data for t-1."

provided in Appendix 1. The commercial mortgage returns are higher than the BAA corporate bond returns (0.98% versus 0.64%) but the standard deviation is also higher (3.32% versus 3.04%). Figure 1 plots the excess commercial mortgage and BAA corporate bond returns.

Table 3 shows the correlations across selected return series and factors. Commercial mortgage returns have the highest correlation with BAA corporate bond returns at 0.63 and the lowest correlation with appraised real estate at 0.00. REITs and stocks have the highest correlation shown, at 0.76. This is consistent with the prior results in the real estate literature that identifies the shared characteristics of stock and REIT returns, for example Ling and Naranjo (1999).

5 Results

The testing of the multiple factor models is done using the time-series approach originated by Black, Jensen and Scholes and employed by FF, based on equation (1). This method is used to facilitate comparison to the FF results. The alternative method used by Chen, Roll and Ross (1986) and Ling and Naranjo (1997) is the two-stage cross-sectional approach originated by Fama and MacBeth (1972). In this method, the first stage is a series of rolling time-series regressions to generate a series of time-variant factor sensitivities. In the second stage, a regression is performed for every time period where the dependent variable is the returns across the portfolios and the independent variables are the coefficients from the first stage. The results from the second stage are the risk premiums, which do not vary across assets.

There are several reasons why this cross-sectional method is not appropriate for my study. First, I am not able to separate my single commercial mortgage return series into a set of portfolios due to data limitations. In any case, it is not logical to sort commercial mortgage returns on a size factor and a book-equity to market-equity factor since these factors have no meaning for commercial mortgages. This is the reason that FF used the time-series method when examining bond returns. Second, since N is only 83 (since the data is quarterly), there are simply not enough observations to create a meaningful set of rolling factor coefficients. Third, the purpose of my study is to compare a model for commercial mortgages against other assets, especially corporate bonds. The second stage results from a cross-sectional approach, the risk premiums, do not vary across assets, and so do not provide information to distinguish assets. For these reasons, the time-series method is preferable.

The results from the regressions of the excess returns of the selected return series on factor variables are in Table 4. Standard errors are adjusted based on the Huber-White method for robustness. Three specifications are shown, where the first one is based on the FF factors and the second on the Ling-Naranjo real estate factors. The third specification is the FF factors with the addition of the factor of growth in personal consumption.

In the first specification, where the FF factors are used, I confirm that the 3 factors, stock market return, size factor and book-to-market equity factor describe returns on the selected stock portfolio very well. All three factors are significant at 1% and the R^2 is 88%. In addition, I confirm FF's findings for corporate bonds, where the two factors, term spread and default spread are significant. REITs are also well described by the FF factors, but appraised real estate is not (R^2 is only 5% and only the term spread is significant).

Since commercial mortgages have similar coefficients to corporate bonds on all factors under this specification, a test is performed to determine whether the sensitivity of commercial mortgage returns and corporate bond returns are statistically different. A dummy variable is created and is set to 0 if the returns are corporate bonds and 1 if commercial mortgages. To create a fully interacted model, each factor is multiplied by this dummy variable. The estimation is performed with the returns (both commercial mortgage and corporate bonds) on the factors and the dummy-interacted factors. The coefficients on the factors will be identical to those obtained for corporate bonds alone, and the coefficients on the dummy-interacted factors will be equal to the difference between the corporate bond sensitivity and the commercial mortgage sensitivity.

So if the coefficient on the dummy-interacted factor is significant, then the sensitivity of commercial mortgages and corporate bonds to that factor is significantly different. Under the FF specification, none of the dummy-interacted terms are significant, indicating that the sensitivities of commercial mortgages and corporate bonds are indistinguishable. At this point, one is tempted to conclude that commercial mortgages are simply corporate bonds renamed, and that the real estate underlying the commercial mortgages plays no role in the movement of returns. In order to investigate this, I test commercial mortgage returns against a set of factors identified by Ling and Naranjo (1997) to explain real estate.

Using the real estate factors improves the performance of the model for appraised real estate as shown in the middle panel of Table 4. The new factors are the real T-bill return, unexpected inflation and growth in consumption, while the term spread is retained from the FF set of factors. But while this specification works better for appraised real estate, it is not as good at describing corporate bond, REIT or stock returns. Interestingly, this set of factors is approximately equally good at describing commercial mortgage returns, with the adjusted R^2 of 74% for both specifications. The factors that are significant for commercial mortgages in this second specification are the term spread and the growth in personal consumption.

The final specification is the five FF factors plus the growth in personal consumption. The result is that for commercial mortgages, the consumption factor is still significant, and the term spread, default spread and stock market return from the FF specification remain significant. The new, six-factor specification increases the adjusted R^2 from 74% to 76% and improves the root mean squared error from 1.643% to 1.575% for commercial mortgages. In addition, the tests for equality across coefficients in Table 5 show that the sensitivity of commercial mortgages and corporate bonds to the factor growth in personal consumption is significantly different.

In the six factor specification, the term spread is significant for 4 of the 5 series, while the default spread, the stock market return, the size factor and the book-to-market equity factor are significant for 3 series. The growth in consumption is significant for 2 series, commercial mortgages and appraised real estate.

Table 4 reports the results across only selected return series. For stocks, the medium size and medium book-to-market equity portfolio was shown. The results of the estimations across all 25 size and book-equity to market-equity sorted portfolios are shown in Table 6a, 6b and 6c. Similarly, Table 7 has the estimation results for the 8 bond series. The key findings are unchanged. Stocks are consistently sensitive to the FF stock-market factors and bonds are consistently sensitive to the FF bond market factors.

The appraised real estate series was unsmoothed two different ways as described in Appendix 1. The selected real estate series used in Table 4 was the smooth series, and so the question arises whether the unsmoothed series would have the same sensitivities. Results are in Table 8. While the results are not identical across the smooth series and the unsmoothed series, all the appraised real estate series are sensitive to the consumption factor.

6 Conclusion

This paper contributes to the commercial mortgage literature and the asset pricing literature by creating a multiple factor model to price commercial mortgages. Commercial mortgage returns are measured using the ACLI-based Giliberto-Levy Index. In order to compare results across different types of assets, I also include 25 size and book-equity to market-equity ratio sorted stock portfolios, 8 corporate bond return series and 4 real estate return series. The real estate series are REITs, appraised real estate, appraised real estate unsmoothed using the variance method and appraised real estate unsmoothed using the mean method.

Three specifications of a multiple factor asset-pricing model are tested using the time-series method. The first is the Fama and French (1993) specification, which includes the term, spread, the default spread, the size factor and the book-equity to market-equity factor. The main finding is that commercial mortgage returns and corporate bond returns are identically sensitive to these factors.

Using a specification derived from the real estate literature, I find that commercial mortgages are also sensitive to the factor that measures growth in personal consumption. When a six-factor specification is tested, using the five FF factors with the growth in personal consumption factor, I find that commercial mortgages are still sensitive to the consumption factor. Commercial mortgages and corporate bonds are not identically sensitive to the consumption factor.

The implication is that while commercial mortgages are highly correlated to corporate bonds and share the same risk factors, there is more to commercial mortgages. The sensitivity to the growth in personal consumption is a characteristic shared with appraised real estate, which underlies commercial mortgages as security.

References

Black, Fischer; Jenson, Michael C.; Scholes, Myron, The Capital Asset Pricing Model: Some Empirical Tests, in Studies in the Theory of Capital Markets, New York, Praeger, 1972.

Breeden, Douglas T., An intertemporal asset pricing model with stochastic consumption and investment opportunities, Journal of Financial Economics, 1979, 7, pages 265-296.

Breeden, Douglas T.; Gibbons, Michael R.; Litzenberger, Robert H., Empirical Tests of the Consumption-Oriented CAPM, Journal of Finance, XLIV (2), June 1989, pages 231-262.

Campbell, John Y., Consumption and the Stock Market, NBER Working Paper Series 5610, 1996.

Campbell, John Y., Understanding Risk and Return, Journal of Political Economy, Journal of Political Economy, 1996, 104(2), pages 298-345.

Campbell, John Y; Cochrane, John H., Explaining the Poor Performance of Consumption-based Asset Pricing Models, Journal of Finance, 55(6), December 2000, pages 2863-2878.

Campbell, John Y.; Lo, Andrew W.; MacKinlay, A. Craig, The Econometrics of Financial Markets, Princeton University Press, New Jersey, 1997.

Chan, K.C.; Hendershott, Patric H. ; Sanders, Anthony B., Risk and Return on Real Estate: Evidence from Equity REITs, AREUEA Journal, 18(4), 1990, pages 431-452.

Chen, Nai-fu; Roll, Richard; Ross, Stephen A., Economic forces and the stock market, Journal of Business, 1986, 59(3), pp. 383-403.

Ciochetti, Brian A., Loss Characteristics of Commercial Mortgage Foreclosures, Journal of Real Estate Finance, 1997, 14, pages 53-69.

Ciochetti, Brian A.; Vandell, Kerry D., The Performance of Commercial Mortgages, Real Estate Economics; 27(1), Spring 1999, pages 27-61.

Clauretie, Terence M.; Sirmans, G. Stacy, Real Estate Finance Theory and Practice, Third Edition, prentice-Hall, New Jersey, 1999.

Cochrane, John H., A Cross-Sectional Test of an Investment-Based Asset Pricing Model, Journal of Political Economy, 1996, 104(3), pages 572-621.

Corgel, John B.; deRoos, Jan A., Recovery of Real Estate Returns for Portfolio Allocation, Journal of Real Estate Finance and Economics, 18(3), 1999, pages 279-296.

Fama, Eugene F.; French, Kenneth R., Common risk factors in the returns on stocks and bonds, Journal of Financial Economics, 31, 1993, pages 3-56.

Fama, Eugene F.; Gibbons, Michael R., A Comparison of Inflation Forecasts, Journal of Monetary Economics, 13 (1984), pages 327-348.

Fama, Eugene F.; MacBeth, James D., Risk, Return and Equilibrium: Empirical Tests, Journal of Political Economy, (1972), pages 607-636.

Federal Reserve Board, Flow of Funds Accounts for the United States, Flows and Outstanding, Second Quarter, 2001, Board of Governors of the Federal Reserve System, Washington, D.C.

Ferson, Wayne E.; Harvey, Campbell R., The Variation of Economic Risk Premiums, Journal of Political Economy, 99 (1991), pages 385-415.

Fisher, Jeffrey D.; Geltner, David M.; Webb, R. Brian, Value Indices of Commercial Real Estate: A Comparison of Index Construction Methods, Journal of Real Estate Finance and Economics, 9, 1994, pages 137-164.

Geltner, David, Estimating Real Estate's Systematic Risk from Aggregate Level Appraisal-Based Returns, Real Estate Economics, 17(4), 1989, pages 463-481.

Giliberto, S.M., A Performance Benchmark for Commercial Mortgages, Journal of Real Estate Finance, 1996, 13, pages 68-75.

Hamilton, Stanley W.; Heinkel, Robert L., The Role of Real Estate in a Pension Portfolio, Bureau of Asset Management, University of British Columbia, 1994.

Hsieh, Chengho; Peterson, James, Book Assets, Real Estate and Returns on Common Stock, Journal of Real Estate Finance and Economics, 21(3), 2000, pages 221-233.

Ibbotson, R. G.; Siegel, L. B.; Real Estate Returns: A Comparison with Other Investments, AREUEA Journal, 1984, 12(3), pp 219-242.

Jagannathan, Ravi; Wang, Zhenyu, The Conditional CAPM and the Cross-Section of Expected Returns, Journal of Finance, 51(1), March 1996, pages 3-51.

Karolyi, G. Andrew; Sanders, Anthony B., The Variation of Economic Risk Premiums in Real Estate Returns, Journal of Real Estate Finance and Economics, 17(3), 1998, pages 245-262.

Kullman, Cornelia, Real Estate and its Role in Asset Pricing, January 2002, unpublished manuscript.

Lettau, Martin; Ludvigson, Sydney, Resurrecting the (C)CAPM: A Cross-Sectional Test When Risk Premia Are Time-Varying, Journal of Political Economy, 109(6), 2001, pages 1238-1287.

Levy, John B., Loan Issues Set Record, Barron's, January 2002.

Ling, David C.; Naranjo, Andy, The Integration of Commercial Real Estate Markets and Stock Markets, Real Estate Economics, 1999, 27(3), pages 483-515.

Ling, David C.; Naranjo, Andy, Economic Risk Factors and Commercial Real Estate Returns, Journal of Real Estate Finance and Economics, 1997, 14(3), pages 283-307.

Liu, Crocker H.; Mei, Jianping, The Predictability of International Real Estate Markets, Exchange Rate Risks and Diversification Consequences, Real Estate Economics, 1998, 26, 1, pages 3-39.

Liu, Crocker H.; Mei, Jianping, The Predictability of Returns on Equity REITs and Their Co-movement with Other Assets, Journal of Real Estate Finance and Economics, 1992, 5, pages 401-418.

Mankiw, N. Gregory; Shapiro, Matthew D., Risk and Return: Consumption Beta Versus Market Beta, Review of Economics and Statistics, 1990, 3, pages 431-467.

Merton, Robert C., An Intertemporal Capital Asset Pricing Model, Econometrica, 1973 41(5), pages 867-887.

Myer, F.C. Neil; Webb, James R., Statistical Properties of Returns: Financial Assets Versus Commercial Real Estate, Journal of Real Estate Finance and Economics, 1994, 8, pages 267-282.

Peterson, James D.; Hsieh, Cheng-Ho, Do Common Risk Factors in the Returns on Stocks and Bonds Explain Returns on REITs? Real Estate Economics, 1997, 25(2), pages 321-345.

Ross, Stephen A., The arbitrage theory of capital asset pricing, Journal of Economic Theory, 1976, 13, pages 341-360.

Ross, Stephen A.; Zisler, Randall C., Risk and Return in Real Estate, Journal of Real Estate Finance and Economics, 1991, 4, pages 175-190.

Snyderman, Mark P., A Commercial Mortgage Performance Index, Journal of Portfolio Management; 16(3), Spring 1990, pages 70-73.

Snyderman, Mark P., Commercial mortgages: Default occurrence and estimated yield impact, Journal of Portfolio Management, Fall 1991, pages 82-87

Appendix 1 – Unsmoothing Real Estate Returns

Problems with the measurement of real estate returns arise because of the nature of property appraisals. There is a behavioral aspect to the valuation that reduces variation, a process known as appraisal smoothing.

For this reason, real estate researchers have developed methods to recover unsmoothed returns. The most common method is to model the effects of prior observations on current returns as

$$r_t^* = \sum_{i=1}^{N} \theta_i r_{t-i}^* + e_t$$

where r^*_t is the smooth return for time t, and r^*_{t-i} are lagged smooth returns. Further, if the error term is modeled as $e_t = r_t w$, where r_t is the unsmoothed return and w is a smoothing factor, then

$$r_t = \frac{1}{w}\left[r_t^* - \sum_{i=1}^{N} \theta_i r_{t-i}^* \right]$$

What remains is to determine w and the lag structure. In this paper, two unsmoothing methods are applied. In the first, called the variance method, w is set so that the standard deviation of the unsmoothed series is equal to one half of the standard deviation of stocks. In the second, called the mean method, w is set so that the mean of the unsmoothed series is equal to the mean of the smoothed series. Both methods are described in Fisher, Geltner and Webb (1994). In both the variance method and the mean method, the lag structure is an AR(1,4) with no constant.

$$r_t = \frac{1}{w}\left[r_t^* - \theta_1 r_{t-1}^* - \theta_4 r_{t-4}^* \right]$$

The lag model is estimated only on the observed capital return, and the resulting unsmoothed capital return is added to the observed income return to generate the total unsmoothed return.

The result is that θ_1 = 0.5207 ($p<0.01$) and θ_4 = 0.4099 ($p<0.01$). The smoothing factor *w* is 0.2416 for method 1 and 0.6937 for method 2.

The descriptive statistics for the two unsmoothed real estate return series are shown in Table 2, and graphs are in Figure 2.

Figure 1
Commercial Mortgage Returns and BAA Corporate Bonds
Quarterly 1980 Q2 to 2000 Q4

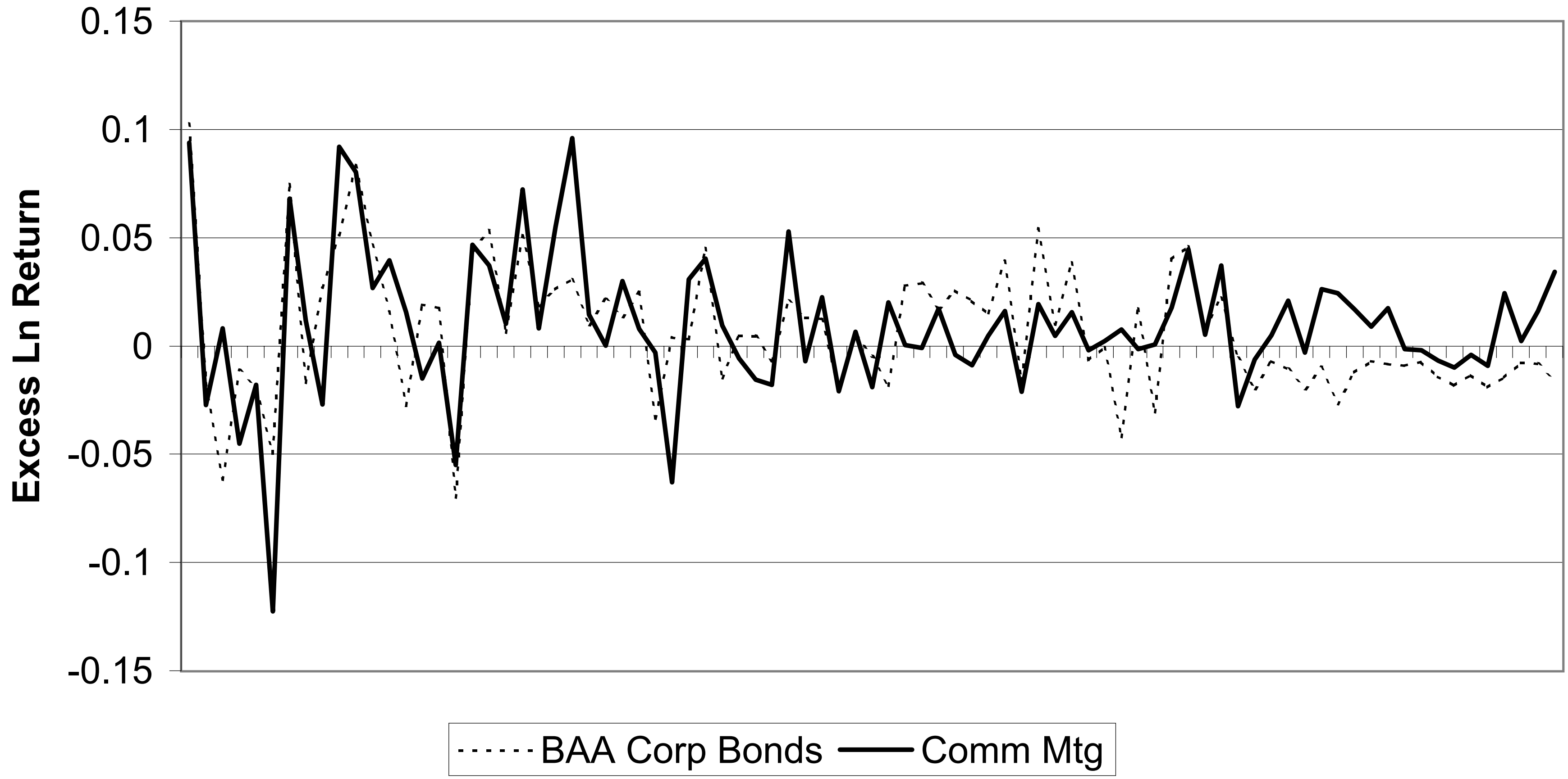
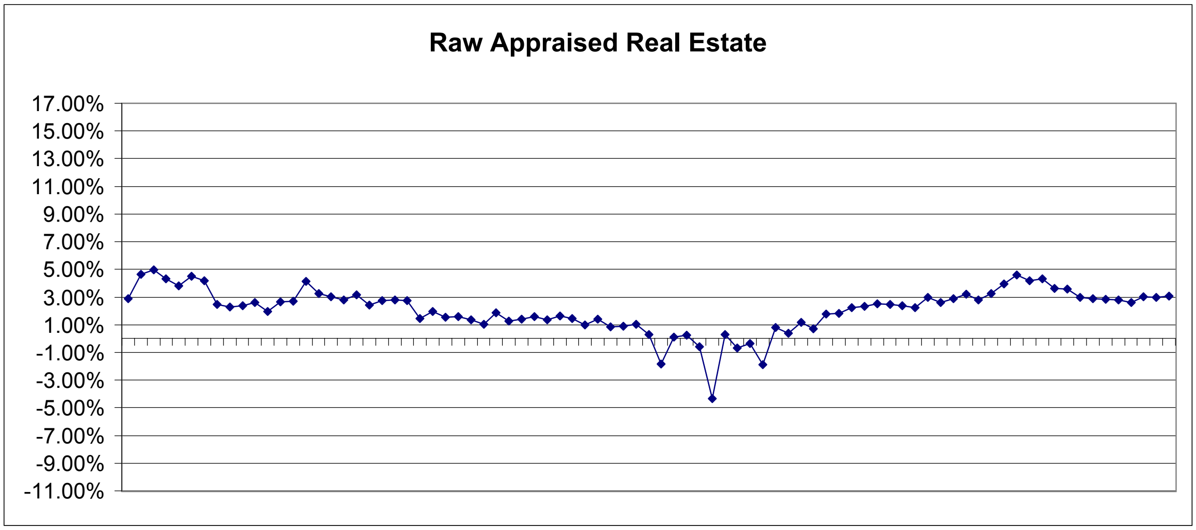
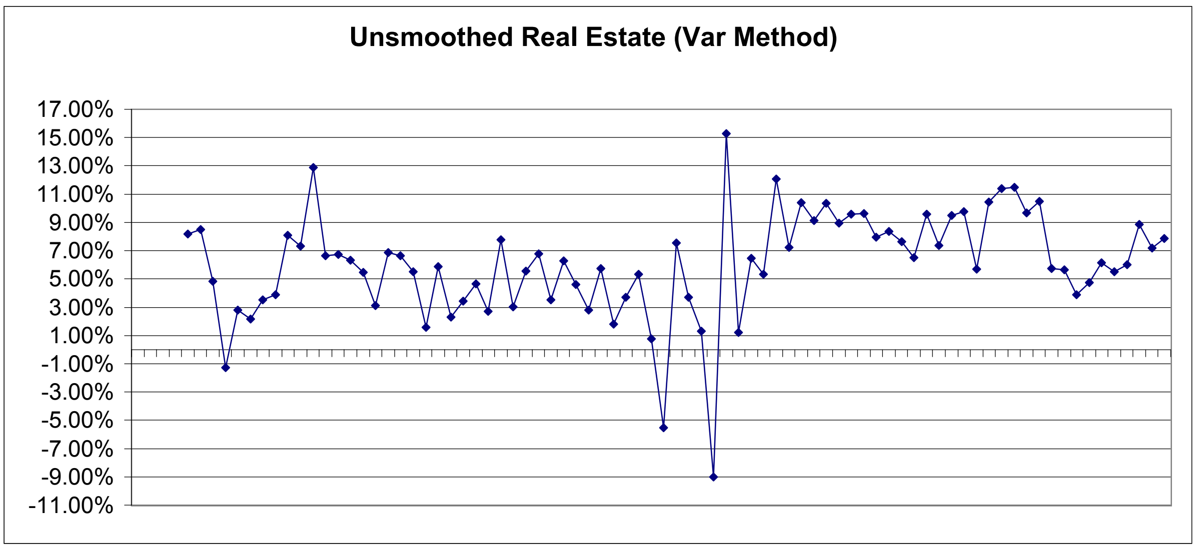


Figure 2 - Smoothed and Unsmoothed Appraised Real Estate Return Series





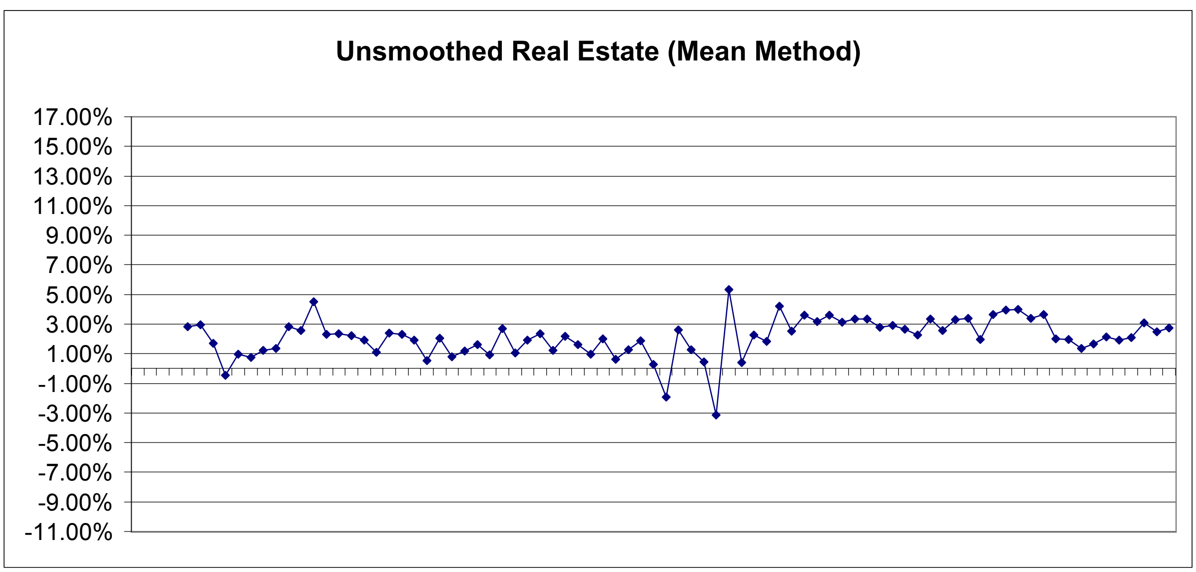


Table 1 - List of Factors

Variable	Description	Source
Stock market return	Total return on the S&P 500 composite index (dividends reinvested), converted to the quarterly return	Ibbotson & Associates SBBI Yearbook 2001
Term spread	The difference between the long-term government bond return and the one-month treasury bill rate from the previous month	Calculated using data from Ibbotson & Associates SBBI Yearbook 2001
Default spread	The difference between the long-term corporate bond return and the long-term government bond return	Calculated using data from Ibbotson & Associates SBBI Yearbook 2001
Unexpected inflation	The residuals from an inflation model with 3 lags, quarter dummies and ARCH(2), where inflation is the percentage change in the Consumer Price Index[2]	Constructed based on inflation data from Ibbotson & Associates SBBI Yearbook 2001
Consumption	Growth in personal consumption expenditures (consumer spending and retail) (constant 1985 dollars)	Bureau of Economic Analysis
Real T-bill	The difference between the one-month treasury bill return and inflation, where inflation is the percentage change in the Consumer Price Index	Constructed based on inflation data and treasury bill returns from Ibbotson & Associates SBBI Yearbook 2001
Firm size factor	The difference in the excess returns between small-stock portfolios and big-stock portfolios	Kenneth French's data library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
Book equity to market equity	The difference in the excess returns between high book equity to market equity portfolios and low book equity to market equity portfolios	Kenneth French's data library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[1] Since the commercial mortgage return series was only available quarterly, all data series were converted from monthly to quarterly. The exception is the factor growth in consumption which was obtained as a quarterly series.

[2] The model for inflation is

$$I_t = -0.003^{***} + 0.476^{***}\ I_{t-1} + 0.089\ I_{t-2} + 0.207^{***}\ I_{t-3} + 0.009^{***}\ Q1 + 0.004^{***}\ Q2 + 0.005^{***}\ Q3 + e_t$$

$$var(e_t) = 5.00 \times 10^{6}{}^{**} + 1.075^{***}\ e^2_{t-1} - 0.080^{**}\ e^2_{t-2}$$

where I_t is inflation in quarter t, Q1 to Q3 are quarter dummies and ***,**,* represent significance at the 1%, 5%, 10% level.

Table 2 - Descriptive Statistics

Variable	Mean	Std. Dev.	t-test	Min	Max	Sharpe
Return Series						
Stock portfolio (Medium size, medium book equity to market equity)	4.40%	8.70%	4.61	-22.14%	20.63%	0.506
BAA-rated Corporate Bond (Intermediate term)	0.64%	3.04%	1.92	-7.03%	10.27%	0.211
Commercial Mortgage Giliberto-Levy Return Index	0.98%	3.32%	2.69	-12.25%	9.59%	0.296
REIT	1.50%	6.68%	2.05	-17.66%	19.05%	0.225
Appraised real estate	0.47%	1.45%	2.97	-5.51%	3.32%	0.326
Unsmoothed Real Estate Series						
Variance-matching method	4.46%	3.94%	10.30	-10.18%	14.32%	1.131
Mean-matching method	0.52%	1.57%	3.03	-4.32%	4.36%	0.333
Factors						
Term spread	1.00%	5.70%	1.59	-14.62%	16.10%	
Default spread	-0.11%	1.69%	(0.59)	-7.78%	3.24%	
Stock market return	2.26%	7.56%	2.72	-26.99%	18.29%	
Firm size	0.43%	5.59%	0.70	-11.16%	19.56%	
Book-to-market equity	0.76%	7.05%	0.99	-28.48%	20.73%	
Real T-bill	0.70%	0.61%	10.51	-0.54%	2.34%	
Unexpected inflation	-0.03%	0.49%	(0.62)	-1.81%	1.54%	
Growth in consumption	0.82%	0.65%	11.48	-2.30%	2.06%	

Notes:

1. All returns series are quarterly, excess (the one month Tbill rate has been subtracted) and log form.
2. All factors are quarterly and log form.
2. The t-test is based on the hypothesis that the mean return=0. The formula for the test is r divided by the square root of the variance divided by N, where N is the number of observations.
3. The Sharpe ratio is the mean excess return divided by the standard deviation and can be interpreted as a reward for volatility.

Table 3 - Correlations

Return Series	Stock portfolio (Medium size, medium equity)	BAA-rated Corporate Bond (Intermediate term)	Commercial Mortgage	REIT
BAA-rated Corporate Bond (Intermediate term)	0.38	1.00		
Commercial Mortgage	0.42	0.63	1.00	
REIT	0.76	0.44	0.46	1.00
Appraised real estate	0.04	(0.22)	0.00	0.01

Factors	Term spread	Default spread	Stock market return	Firm size	Book-equity to market-equity	Real T-bill	Unexpected inflation
Default spread	(0.62)	1.00					
Stock market return	0.27	(0.03)	1.00				
Firm size	(0.09)	0.15	0.35	1.00			
Book-equity to market-equity	(0.08)	0.04	(0.52)	(0.23)	1.00		
Real T-bill	0.37	(0.16)	0.06	(0.12)	0.05	1.00	
Unexpected inflation	(0.38)	0.19	(0.15)	(0.05)	(0.06)	(0.58)	1.00
Growth in consumption	(0.26)	0.24	(0.01)	0.19	0.03	(0.05)	0.07

Table 4 - Estimation Results

Fama-French Specification	R-squared	Adjusted R-squared	Root mean-squared error	Term spread	Default spread	Stock market return	Size factor	Equity factor	Constant
Stock portfolio (medium size, medium equity)	88.1%	87.5%	3.046%	0.1432 *	-0.2082	0.9021 ***	0.7832 ***	0.4404 ***	0.0186 ***
				(1.77)	(0.85)	(15.88)	(11.91)	(5.94)	(4.86)
BAA-rated corporate bond (intermediate term)	49.3%	46.6%	2.106%	0.3996 ***	0.6455 ***	0.0404	0.1322 **	0.0608 *	0.0008
				(7.06)	(4.49)	(1.31)	(2.60)	(1.76)	(0.31)
Commercial mortgage	75.4%	74.1%	1.643%	0.5301 ***	0.3997 **	0.0536 **	0.0657	0.0152	0.0027
				(8.64)	(2.30)	(2.23)	(1.53)	(0.58)	(1.30)
REIT	63.2%	61.3%	4.177%	0.2843 ***	-0.0132	0.5290 ***	0.5637 ***	0.4167 ***	-0.0023
				(2.88)	(0.05)	(6.63)	(5.72)	(4.55)	(0.51)
Appraised real estate	5.4%	0.5%	5.440%	-0.0763 ***	-0.1321	0.0346	-0.0243	0.0108	0.0046 ***
				(3.00)	(1.50)	(1.39)	(0.61)	(0.42)	(2.74)

Ling-Naranjo Specification	R-squared	Adjusted R-squared	Root mean-squared error	Term spread	Real Tbill	Unexpected Inflation	Growth in consumption	Constant
Stock portfolio (medium size, medium equity)	10.6%	7.0%	8.314%	0.4559 ***	-1.0071	-2.3323	1.5077	0.0287
				(2.72)	(0.68)	(1.00)	(0.79)	(1.19)
BAA-rated corporate bond (intermediate term)	32.3%	29.6%	2.352%	0.2838 ***	0.0125	-0.1374	0.0484	0.0024
				(5.04)	(0.02)	(0.21)	(0.08)	(0.33)
Commercial mortgage	74.9%	73.9%	1.657%	0.4916 ***	0.1629	-0.6399	1.1501 ***	-0.0078 *
				(9.08)	(0.33)	(1.11)	(2.74)	(1.70)
REIT	18.6%	15.4%	6.226%	0.4061 ***	-1.8397	-3.8766 **	0.8474	0.0132
				(3.07)	(1.16)	(2.06)	(0.53)	(0.57)
Appraised real estate	21.3%	18.2%	1.317%	-0.0117	0.3203	-0.0469	1.1418 ***	-0.0076 *
				(0.52)	(1.31)	(0.17)	(3.24)	(1.98)

Six factor specification	R-squared	Adjusted R-squared	Root mean-squared error	Term spread	Default spread	Stock market return	Size factor	Equity factor	Growth in consumption	Constant
Stock portfolio (medium size, medium equity)	88.2%	87.4%	3.056%	0.1351	-0.1929	0.9023 ***	0.7913 ***	0.4423 ***	-0.4710	0.0227 ***
				(1.66)	(0.76)	(16.07)	(11.79)	(5.97)	(0.90)	(4.32)
BAA-rated corporate bond (intermediate term)	50.0%	46.7%	2.105%	0.3916 ***	0.6606 ***	0.0406	0.1402 ***	0.0627 *	-0.4638	0.0048
				(6.77)	(4.51)	(1.30)	(2.79)	(1.86)	(0.92)	(0.98)
Commercial mortgage	77.7%	76.2%	1.575%	0.5462 ***	0.3694 **	0.0533 **	0.0496	0.0114	0.9316 **	-0.0054
				(8.96)	(2.35)	(2.03)	(1.22)	(0.45)	(2.45)	(1.25)
REIT	63.4%	60.9%	4.196%	0.2757 ***	0.0031	0.5292 ***	0.5722 ***	0.4188 ***	-0.4991	0.0020
				(2.80)	(0.01)	(6.68)	(5.58)	(4.59)	(0.58)	(0.22)
Appraised real estate	24.9%	20.0%	1.314%	-0.0551 **	-0.1723 *	0.0342	-0.0456	0.0057	1.2332 ***	-0.0062
				(2.01)	(1.92)	(1.39)	(1.33)	(0.26)	(3.32)	(1.55)

Note
1. Adjusted R-squared is 1 - (1-R2)(N-1)/(N-k) where k is the number of factors.
2. The t-statistic is in parenthesis below the coefficient.
3. ***, **, * indicates significance at the 1%, 5% and 10% level.
4. There are 83 quarters in the sample, so N is 82 if the term spread is used (since one observation is lost in its construction) and N is 80 if unexpected inflation is used (since three lags are used in the inflation model).

Table 5 - Test for Equality of Coefficients between BAA Intermediate Term Corporate Bonds and Commercial Mortgages

	FF Specification		Ling-Naranjo Specification		Six factor Specification	
Term spread	0.3996	***	0.2838	***	0.3916	***
	(7.06)		(5.04)		(6.77)	
Default spread	0.6455	***			0.6606	***
	(4.49)				(4.51)	
Stock market return	0.0404				0.0406	
	(1.31)				(1.30)	
Size factor	0.1322	**			0.1402	***
	(2.60)				(2.79)	
Book to market factor	0.0608	*			0.0627	*
	(1.76)				(1.86)	
Growth in consumption			0.0484		-0.4638	
			(0.08)		(0.92)	
Real T-bill			0.0125			
			(0.02)			
Unexpected inflation			-0.1374			
			(0.21)			
Constant	0.0008		0.0024		0.0048	
	(0.31)		(0.33)		(0.98)	
Term spread * Dummy	0.1305		0.2078	***	0.1545	*
	(1.56)		(2.66)		(1.84)	
Default spread * Dummy	-0.2458				-0.2912	
	(1.09)				(1.36)	
Stock market return * Dummy	0.0132				0.0127	
	(0.34)				(0.31)	
Size factor * Dummy	-0.0666				-0.0906	
	(1.00)				(1.40)	
Book to market factor * Dummy	-0.0455				-0.0513	
	(1.05)				(1.22)	
Growth in consumption * Dummy			1.1017		1.3954	**
			(1.44)		(2.20)	
Real T-bill * Dummy			0.1504			
			(0.18)			
Unexpected inflation * Dummy			-0.5025			
			(0.58)			
Dummy	0.0019		-0.0102		-0.0102	
	(0.60)		(1.18)		(1.56)	
R^2	63.9%		56.7%		65.5%	
N	164		164		164	
F-test (ALL dummy-interacted terms are 0)	0.0047	***	0.0394	**	0.0002	***

Notes:
Dummy = 1 if commercial mortgage return, 0 if corporate bond return. Each factor in the specification is multiplied by the dum variable to create a fully interacted model. The coefficients on the factors will be equal to those obtained on the regression for t BAA Intermediate Term corporate bond returns on their own, and the coefficient on the dummy-interacted factors will be equal the difference between the coefficient on the BAA intermediate term corporate bond return regression and the commercial mortgage return regression. So if the coefficient on the dummy-interacted factor is insignificant, then the sensitivities are indistinguishable.

Table 6a - Estimation results for Stock Portfolios (Fama-French Specificati

Size ranking	BE/ME ranking	R-sq	Term spread	Default spread	Stock market	Size factor	Equity factor	Constant
1	1	93.8%	-0.0609	-0.3568	0.9106 ***	1.6172 ***	-0.6912 ***	-0.0002
			(0.860)	(1.100)	(13.230)	(16.830)	(6.570)	(0.040)
1	2	93.9%	0.0130	-0.0425	0.8434 ***	1.5271 ***	-0.1548	0.0229 ***
			(0.230)	(0.190)	(16.660)	(22.580)	(1.220)	(5.390)
1	3	94.6%	0.0575	-0.1467	0.8212 ***	1.4205 ***	0.0814	0.0261 ***
			(0.970)	(0.560)	(17.450)	(16.960)	(1.420)	(8.390)
1	4	93.2%	-0.0416	-0.4408	0.8513 ***	1.3412 ***	0.2611 ***	0.0291 ***
			(0.760)	(1.280)	(15.620)	(15.500)	(3.740)	(8.220)
1	5	92.6%	-0.0411	-0.1516	0.9459 ***	1.4228 ***	0.4844 ***	0.0261 ***
			(0.670)	(0.500)	(17.250)	(13.920)	(6.140)	(7.000)
2	1	95.9%	0.0211	-0.0223	0.9837 ***	1.1548 ***	-0.5280 ***	0.0091 **
			(0.260)	(0.080)	(12.380)	(14.710)	(7.710)	(2.440)
2	2	93.5%	0.0821	-0.1625	0.9325 ***	1.2108 ***	0.0567	0.0177 ***
			(1.320)	(0.890)	(18.820)	(15.980)	(0.970)	(5.450)
2	3	91.1%	0.1880 **	0.1319	0.8978 ***	0.9606 ***	0.2603 ***	0.0250 ***
			(2.440)	(0.620)	(18.290)	(15.360)	(3.930)	(6.970)
2	4	89.1%	0.1491 **	-0.1075	0.8769 ***	0.9441 ***	0.4956 ***	0.0257 ***
			(2.400)	(0.480)	(16.450)	(12.510)	(7.660)	(6.990)
2	5	93.2%	0.1118 **	-0.1903	0.9647 ***	1.0790 ***	0.6556 ***	0.0201 ***
			(2.200)	(0.890)	(25.170)	(14.320)	(12.850)	(6.470)
3	1	92.8%	0.1546	0.4883	0.9681 ***	0.8668 ***	-0.5118 ***	0.0146 ***
			(1.660)	(1.150)	(12.480)	(8.770)	(6.080)	(3.080)
3	2	89.9%	0.1399 *	0.0077	0.9259 ***	0.9241 ***	0.1258 *	0.0215 ***
			(1.740)	(0.030)	(14.740)	(12.620)	(1.800)	(5.550)
3	3	88.1%	0.1432 *	-0.2082	0.9021 ***	0.7832 ***	0.4404 ***	0.0186 ***
			(1.770)	(0.850)	(15.880)	(11.910)	(5.940)	(4.860)
3	4	83.2%	0.1793 **	0.0012	0.8898 ***	0.7258 ***	0.5551 ***	0.0209 ***
			(2.530)	(0.010)	(16.050)	(9.130)	(7.420)	(5.120)
3	5	86.1%	0.1442 *	-0.2062	0.9258 ***	0.7336 ***	0.6497 ***	0.0267 ***
			(1.910)	(0.750)	(16.030)	(9.690)	(8.140)	(6.820)
4	1	92.9%	0.0531	-0.0065	0.8615 ***	0.6501 ***	-0.6434 ***	0.0265 ***
			(0.510)	(0.020)	(10.440)	(7.530)	(5.490)	(5.860)
4	2	85.2%	-0.0011	-0.3986	0.9925 ***	0.5893 ***	0.2084 **	0.0166 ***
			(0.010)	(1.590)	(14.950)	(8.150)	(2.450)	(3.820)
4	3	83.7%	0.1568 **	-0.2816	0.9368 ***	0.6373 ***	0.3677 ***	0.0164 ***
			(2.010)	(0.910)	(16.150)	(7.760)	(4.310)	(3.770)
4	4	81.5%	0.2564 ***	-0.2401	0.8158 ***	0.4310 ***	0.3283 ***	0.0230 ***
			(4.030)	(0.710)	(13.660)	(5.310)	(3.990)	(5.640)
4	5	78.2%	0.2819 ***	-0.0063	0.8460 ***	0.5325 ***	0.4959 ***	0.0235 ***
			(3.450)	(0.030)	(13.830)	(6.740)	(4.270)	(4.900)
5	1	94.0%	0.0220	0.1085	0.9995 ***	-0.1219 *	-0.3799 ***	0.0240 ***
			(0.330)	(0.520)	(26.110)	(1.990)	(5.860)	(8.260)
5	2	87.9%	-0.0150	-0.2298	1.0711 ***	0.0047	0.0770	0.0179 ***
			(0.210)	(0.860)	(17.570)	(0.070)	(1.220)	(4.830)
5	3	80.8%	0.0189	-0.0202	0.9916 ***	-0.0991	0.1768 **	0.0154 ***
			(0.290)	(0.080)	(16.390)	(1.190)	(2.570)	(3.480)
5	4	77.1%	0.1428 *	0.2684	0.9716 ***	0.0257	0.5190 ***	0.0162 ***
			(1.960)	(0.970)	(16.210)	(0.330)	(7.350)	(3.750)
5	5	76.5%	0.0653	0.0080	0.9298 ***	0.1351	0.7068 ***	0.0208 ***
			(0.660)	(0.030)	(14.670)	(1.380)	(9.460)	(4.490)

Table 6b - Estimation results for Stock Portfolios (Ling Naranjo Specification)

Size ranking	BE/ME Ranking	R-sq	Term spread	Real tbill	Unexpected Inflation	Consumption	Constant
1	1	5.2%	0.4480	-4.3253	-3.4710	4.5347	-0.0039
			(1.350)	(1.340)	(0.830)	(1.150)	(0.080)
1	2	5.1%	0.3217	-2.9196	-3.4059	3.7059	0.0220
			(1.260)	(1.170)	(0.940)	(1.130)	(0.540)
1	3	5.8%	0.3188	-2.8118	-3.8245	2.8631	0.0338
			(1.310)	(1.200)	(1.120)	(0.910)	(0.860)
1	4	5.6%	0.2883	-2.6133	-3.1722	3.0645	0.0360
			(1.270)	(1.150)	(1.010)	(1.070)	(1.010)
1	5	7.6%	0.2597	-3.7355	-4.5865	3.8127	0.0379
			(1.180)	(1.630)	(1.330)	(1.240)	(0.960)
2	1	3.3%	0.4035	-2.0090	-2.2430	1.5479	0.0188
			(1.470)	(0.720)	(0.590)	(0.460)	(0.430)
2	2	5.7%	0.4173 *	-1.5315	-2.4127	2.3470	0.0217
			(1.930)	(0.700)	(0.750)	(0.840)	(0.620)
2	3	7.7%	0.4149 **	-0.7630	-2.2577	1.5572	0.0324
			(2.170)	(0.440)	(0.810)	(0.660)	(1.060)
2	4	7.6%	0.3862 **	-0.8633	-2.2527	1.7200	0.0338
			(2.120)	(0.550)	(0.910)	(0.830)	(1.240)
2	5	7.8%	0.3620 *	-2.0148	-3.8370	1.7028	0.0394
			(1.920)	(1.090)	(1.350)	(0.640)	(1.140)
3	1	4.0%	0.4093 *	-0.9938	-1.9769	0.5383	0.0270
			(1.690)	(0.410)	(0.610)	(0.180)	(0.700)
3	2	6.3%	0.4077 **	-1.1791	-2.2842	1.2110	0.0343
			(2.060)	(0.670)	(0.810)	(0.490)	(1.080)
3	3	10.6%	0.4559 ***	-1.0071	-2.3323	1.5077	0.0287
			(2.720)	(0.680)	(1.000)	(0.790)	(1.190)
3	4	8.5%	0.3806 **	-0.9232	-2.5116	0.7938	0.0389
			(2.240)	(0.630)	(1.120)	(0.400)	(1.470)
3	5	9.1%	0.3843 **	-0.7385	-2.6143	1.5447	0.0387
			(2.360)	(0.460)	(1.200)	(0.790)	(1.420)
4	1	3.7%	0.4351 *	-1.4299	-0.6785	0.9307	0.0360
			(1.830)	(0.640)	(0.230)	(0.350)	(1.100)
4	2	8.1%	0.4476 **	-1.9690	-2.1025	1.5548	0.0319
			(2.520)	(1.210)	(0.850)	(0.720)	(1.170)
4	3	11.0%	0.5376 ***	-1.6952	-1.6074	1.1011	0.0355
			(3.190)	(1.180)	(0.650)	(0.530)	(1.300)
4	4	15.0%	0.5013 ***	-0.6948	-1.6186	0.1890	0.0425 *
			(3.430)	(0.550)	(0.910)	(0.110)	(1.910)
4	5	14.7%	0.4935 ***	0.3668	-1.5322	1.6199	0.0246
			(3.030)	(0.250)	(0.790)	(0.940)	(1.090)
5	1	6.9%	0.3800 **	0.6434	-0.1159	-0.7585	0.0384
			(2.060)	(0.330)	(0.050)	(0.370)	(1.370)
5	2	8.8%	0.4098 **	-0.2559	-1.2704	0.1320	0.0348
			(2.610)	(0.180)	(0.600)	(0.070)	(1.440)
5	3	9.6%	0.4583 ***	-1.0781	-0.3288	1.0436	0.0290
			(2.700)	(0.870)	(0.180)	(0.760)	(1.630)
5	4	10.0%	0.3686 **	0.1883	-1.3173	0.2756	0.0328
			(2.560)	(0.150)	(0.750)	(0.180)	(1.600)
5	5	9.7%	0.2862 *	-0.1361	-2.6631	0.8610	0.0348
			(1.770)	(0.080)	(1.270)	(0.540)	(1.560)

Table 6c - Estimation results for Stock Portfolios (Six Factor Specification)

Size ranking	BE/ME Ranking	R-sq	Term spread	Default spread	Stock market	Size factor	Equity factor	Consumption	Constant
1	1	94.1%	-0.0348	-0.4062	0.9101 ***	1.5911 ***	-0.6974 ***	1.5172 **	-0.0134 *
			(0.500)	(1.390)	(13.520)	(16.770)	(6.950)	(2.060)	(1.820)
1	2	94.0%	0.0245	-0.0642	0.8432 ***	1.5156 ***	-0.1576	0.6678	0.0170 ***
			(0.390)	(0.300)	(16.460)	(21.870)	(1.250)	(1.170)	(3.070)
1	3	94.6%	0.0578	-0.1473	0.8212 ***	1.4202 ***	0.0813	0.0174	0.0260 ***
			(0.980)	(0.550)	(17.320)	(16.460)	(1.390)	(0.030)	(4.050)
1	4	93.3%	-0.0358	-0.4517	0.8512 ***	1.3354 ***	0.2597 ***	0.3374	0.0261 ***
			(0.650)	(1.300)	(15.590)	(16.210)	(3.710)	(0.580)	(5.560)
1	5	92.7%	-0.0276	-0.1772	0.9456 ***	1.4093 ***	0.4811 ***	0.7848	0.0193 ***
			(0.450)	(0.590)	(17.010)	(13.650)	(6.240)	(1.000)	(2.690)
2	1	96.0%	0.0042	0.0098	0.9841 ***	1.1717 ***	-0.5239 ***	-0.9833 *	0.0177 ***
			(0.060)	(0.040)	(12.890)	(16.110)	(7.710)	(1.800)	(3.100)
2	2	93.5%	0.0772	-0.1532	0.9326 ***	1.2157 ***	0.0579	-0.2867	0.0202 ***
			(1.250)	(0.830)	(19.080)	(15.680)	(0.990)	(0.430)	(2.980)
2	3	91.3%	0.1749 **	0.1567	0.8981 ***	0.9737 ***	0.2634 ***	-0.7641 *	0.0317 ***
			(2.260)	(0.810)	(17.990)	(16.650)	(3.920)	(1.740)	(6.380)
2	4	89.2%	0.1418 **	-0.0936	0.8771 ***	0.9515 ***	0.4973 ***	-0.4253	0.0294 ***
			(2.300)	(0.410)	(16.450)	(12.730)	(7.600)	(0.860)	(5.960)
2	5	93.4%	0.0987 **	-0.1656	0.9650 ***	1.0921 ***	0.6587 ***	-0.7588	0.0267 ***
			(2.020)	(0.740)	(25.670)	(14.330)	(12.230)	(1.100)	(4.020)
3	1	93.4%	0.1249	0.5446	0.9687 ***	0.8966 ***	-0.5046 ***	-1.7298 **	0.0297 ***
			(1.430)	(1.360)	(13.510)	(10.250)	(6.230)	(2.470)	(4.470)
3	2	90.2%	0.1224	0.0408	0.9263 ***	0.9417 ***	0.1300 *	-1.0182	0.0304 ***
			(1.560)	(0.140)	(15.570)	(12.670)	(1.940)	(1.570)	(4.800)
3	3	88.2%	0.1351	-0.1929	0.9023 ***	0.7913 ***	0.4423 ***	-0.4710	0.0227 ***
			(1.660)	(0.760)	(16.070)	(11.790)	(5.970)	(0.900)	(4.320)
3	4	83.7%	0.1603 **	0.0374	0.8902 ***	0.7449 ***	0.5597 ***	-1.1105 **	0.0306 ***
			(2.360)	(0.190)	(16.630)	(9.890)	(7.370)	(2.090)	(5.230)
3	5	86.2%	0.1385 *	-0.1955	0.9259 ***	0.7393 ***	0.6510 ***	-0.3305	0.0296 ***
			(1.760)	(0.690)	(15.690)	(10.120)	(7.940)	(0.550)	(5.330)
4	1	93.0%	0.0397	0.0190	0.8618 ***	0.6636 ***	-0.6401 ***	-0.7845	0.0333 ***
			(0.390)	(0.060)	(10.760)	(7.870)	(5.310)	(1.360)	(5.550)
4	2	85.2%	-0.0021	-0.3966	0.9925 ***	0.5903 ***	0.2087 **	-0.0588	0.0171 ***
			(0.030)	(1.540)	(14.880)	(8.110)	(2.440)	(0.100)	(2.870)
4	3	83.9%	0.1441 *	-0.2575	0.9370 ***	0.6501 ***	0.3707 ***	-0.7393	0.0228 ***
			(1.860)	(0.790)	(16.200)	(7.950)	(4.300)	(1.190)	(3.800)
4	4	82.1%	0.2367 ***	-0.2029	0.8162 ***	0.4506 ***	0.3331 ***	-1.1434 *	0.0330 ***
			(3.630)	(0.560)	(13.770)	(5.960)	(3.780)	(1.740)	(6.180)
4	5	78.2%	0.2831 ***	-0.0087	0.8459 ***	0.5313 ***	0.4956 ***	0.0730	0.0228 ***
			(3.330)	(0.040)	(13.770)	(6.610)	(4.210)	(0.110)	(3.560)
5	1	94.6%	-0.0020	0.1540	1.0000 ***	-0.0978 *	-0.3741 ***	-1.3990 ***	0.0362 ***
			(0.030)	(0.810)	(28.250)	(1.850)	(6.050)	(3.080)	(7.840)
5	2	88.0%	-0.0265	-0.2081	1.0714 ***	0.0162	0.0798	-0.6684	0.0237 ***
			(0.380)	(0.770)	(18.520)	(0.260)	(1.300)	(1.170)	(4.160)
5	3	80.9%	0.0271	-0.0356	0.9915 ***	-0.1073	0.1748 **	0.4740	0.0112
			(0.410)	(0.130)	(15.820)	(1.230)	(2.470)	(0.740)	(1.650)
5	4	77.3%	0.1308 *	0.2910	0.9719 ***	0.0376	0.5219 ***	-0.6948	0.0223 ***
			(1.790)	(1.060)	(16.440)	(0.470)	(7.480)	(1.160)	(3.680)
5	5	76.5%	0.0634	0.0117	0.9299 ***	0.1370	0.7073 ***	-0.1139	0.0218 ***
			(0.630)	(0.040)	(14.600)	(1.410)	(9.450)	(0.190)	(3.240)

Table 7 - Estimation results for Bond Series

Rating	Term	R-sq	Term spread	Default spread	Stock market	Size factor	Equity factor	Constant
AAA	Intermediate	52.3%	0.4138 ***	0.5993 ***	0.0207	0.0814 *	0.0310	-0.0011
			(8.100)	(4.290)	(0.660)	(1.740)	(1.020)	(0.510)
AA	Intermediate	52.7%	0.4183 ***	0.6022 ***	0.0287	0.0970 **	0.0401	-0.0010
			(8.190)	(4.410)	(0.840)	(2.030)	(1.250)	(0.460)
A	Intermediate	51.9%	0.4186 ***	0.6321 ***	0.0290	0.1095 **	0.0429	-0.0006
			(8.030)	(4.560)	(0.860)	(2.220)	(1.300)	(0.250)
BAA	Intermediate	49.3%	0.3996 ***	0.6455 ***	0.0404	0.1322 **	0.0608 *	0.0008
			(7.060)	(4.490)	(1.310)	(2.600)	(1.760)	(0.310)
AAA	Long	60.7%	0.7368 ***	0.7579 **	0.0868 *	0.1343 *	0.0655	-0.0045
			(8.740)	(2.640)	(1.710)	(1.700)	(1.330)	(1.280)
AA	Long	59.9%	0.7162 ***	0.7886 ***	0.0701	0.1393 *	0.0536	-0.0035
			(8.510)	(2.850)	(1.490)	(1.820)	(1.130)	(1.020)
A	Long	57.9%	0.6961 ***	0.7756 ***	0.0773	0.1601 **	0.0603	-0.0026
			(7.910)	(2.930)	(1.610)	(2.040)	(1.250)	(0.750)
BAA	Long	57.5%	0.6819 ***	0.8920 ***	0.0874 *	0.1956 **	0.0540	-0.0008
			(8.280)	(3.620)	(1.790)	(2.450)	(1.100)	(0.240)

Rating	Term	R-sq	Term spread	Real tbill	Unexp infl	Consumption	Constant
AAA	Intermediate	39.2%	0.2767 ***	0.1846	-0.1608	-0.3483	0.0024
			(5.420)	(0.280)	(0.280)	(0.570)	(0.410)
AA	Intermediate	37.9%	0.2880 ***	0.0709	-0.1289	-0.2683	0.0028
			(5.470)	(0.110)	(0.210)	(0.450)	(0.460)
A	Intermediate	36.8%	0.2890 ***	0.1205	-0.1240	-0.1657	0.0019
			(5.360)	(0.180)	(0.200)	(0.280)	(0.310)
BAA	Intermediate	32.3%	0.2838 ***	0.0125	-0.1374	0.0484	0.0024
			(5.040)	(0.020)	(0.210)	(0.080)	(0.330)
AAA	Long	50.0%	0.5932 ***	0.1144	-0.3073	0.0530	-0.0022
			(6.800)	(0.110)	(0.290)	(0.060)	(0.240)
AA	Long	48.5%	0.5676 ***	0.2153	-0.0632	0.0791	-0.0026
			(6.790)	(0.210)	(0.060)	(0.090)	(0.280)
A	Long	45.6%	0.5538 ***	0.1628	-0.0225	0.0592	-0.0010
			(6.320)	(0.160)	(0.020)	(0.070)	(0.100)
BAA	Long	41.3%	0.5339 ***	0.1765	-0.0186	0.3509	-0.0020
			(5.870)	(0.170)	(0.020)	(0.360)	(0.190)

Rating	Term	R-sq	Term spread	Default spread	Stock market	Size factor	Equity factor	Consumption	Constant
AAA	Intermediate	54.1%	0.4016 ***	0.6225 ***	0.0210	0.0937 *	0.0339	-0.7124	0.0048
			(7.770)	(4.330)	(0.650)	(1.930)	(1.180)	(1.260)	(0.930)
AA	Intermediate	54.2%	0.4068 ***	0.6239629 ***	0.028973	0.1084535 **	0.0429106	-0.6682622	0.004724
			(7.820)	(4.440)	(0.820)	(2.240)	(1.400)	(1.300)	(0.950)
A	Intermediate	53.2%	0.4081 ***	0.6519 ***	0.0292	0.1200 **	0.0454	-0.6084	0.0048
			(7.670)	(4.570)	(0.840)	(2.420)	(1.430)	(1.210)	(0.980)
BAA	Intermediate	50.0%	0.3916 ***	0.6606 ***	0.0406	0.1402 ***	0.0627 *	-0.4638	-0.0001
			(6.770)	(4.510)	(1.300)	(2.790)	(1.860)	(0.920)	(0.010)
AAA	Long	61.0%	0.7280 ***	0.7746 **	0.0870 *	0.1432 *	0.0676	-0.5135	0.0007
			(8.370)	(2.630)	(1.690)	(1.830)	(1.400)	(0.690)	(0.110)
AA	Long	60.2%	0.7079 ***	0.8044 ***	0.0703	0.1476 *	0.0556	-0.4850	0.0022
			(8.090)	(2.840)	(1.490)	(1.970)	(1.200)	(0.700)	(0.310)
A	Long	58.3%	0.6867 ***	0.7934 ***	0.0775	0.1695 **	0.0625	-0.5469	0.0021
			(7.570)	(2.940)	(1.600)	(2.190)	(1.320)	(0.760)	(0.280)
BAA	Long	57.6%	0.6760 ***	0.9031 ***	0.0875 *	0.2015 **	0.0554	-0.3408	
			(8.020)	(3.630)	(1.770)	(2.530)	(1.140)	(0.440)	?????

Table 8 - Estimation results for Unsmoothed real estate series

Series	R-squared	Term spread	Default spread	Stock market	Size factor	Equity factor	Constant
Smoothed real estate	5.4%	-0.0763 ***	-0.1321	0.0346	-0.0243	0.0108	0.0046 ***
		(3.00)	(1.50)	(1.39)	(0.61)	(0.42)	(2.74)
Unsmoothed (var method)	12.9%	-0.2038 ***	-0.2346	0.0943	0.1476	0.1629 **	0.0441 ***
		(2.79)	(0.83)	(1.60)	(1.49)	(2.13)	(10.39)
Unsmoothed (mean method)	10.0%	-0.0712 *	-0.0688	0.0409	0.0510	0.0500	0.0050 ***
		(1.99)	(0.58)	(1.64)	(1.28)	(1.63)	(2.72)

Series	R-squared	Term spread	Real tbill	Unexp infl	Consumption	Constant
Smoothed real estate	21.3%	-0.0117	0.3203	-0.0469	1.1418 ***	-0.0076 *
		(0.52)	(1.31)	(0.17)	(3.24)	(1.98)
Unsmoothed (var method)	23.0%	-0.0260	-2.1501 **	-1.2580	2.6181 **	0.0378 ***
		(0.36)	(2.54)	(1.39)	(2.62)	(3.13)
Unsmoothed (mean method)	34.9%	0.0074	-1.3919 ***	-0.9157 ***	1.1164 ***	0.0054
		(0.27)	(4.67)	(2.67)	(3.32)	(1.31)

Series	R-squared	Term spread	Default spread	Stock market	Size factor	Equity factor	Consumption	Constant
Smoothed real estate	24.9%	-0.0551 **	-0.1723 *	0.0342	-0.0456	0.0057	1.2332 ***	-0.0062
		(2.01)	(1.92)	(1.39)	(1.33)	(0.26)	(3.32)	(1.55)
Unsmoothed (var method)	22.4%	-0.1546 *	-0.2985	0.0933	0.0961	0.1475 **	2.3239 **	0.0236 **
		(1.95)	(0.94)	(1.53)	(1.04)	(2.01)	(2.44)	(2.34)
Unsmoothed (mean method)	21.0%	-0.0501	-0.0962	0.0404	0.0289	0.0434	0.9975 ***	-0.0038
		(1.35)	(0.75)	(1.54)	(0.80)	(1.44)	(2.78)	(0.99)