



UNIVERSITY OF CAPE TOWN
DEPARTMENT OF CONSTRUCTION ECONOMICS AND MANAGEMENT

DISSERTATION

Presented in partial fulfilment of the requirements for the degree
of
Master of Science (Property Studies)

Topic:

Assessing the risk and relative value of commercial
mortgage-backed securities issued in South Africa

Presented by:

Stuart Thomson (THMSTU005) (thomsot@netactive.co.za)

August 2007

Free from Plagiarism declaration

1. Each significant contribution to, and quotation in, this report from the work, or works, of other people has been attributed, and has been cited and referenced.
2. I know the meaning of plagiarism and declare that all the work in the document, save for that which is properly acknowledged, is my own.

SIGNATURE _____

Name: Stuart Thomson

31 August 2007

ACKNOWLEDGEMENTS

I would like to thank Kathy Evans of UCT for her direction and guidance throughout the writing of this research. Kathy was instrumental in the development of the research problem and questions. Her constant enthusiasm for documenting financial innovation in the South African property market kept me motivated to provide a high-quality contribution to the body of knowledge on CMBS pricing. I would also like to thank Dr. Dave Root for reviewing my research proposal and suggesting key changes to the overall structure.

TABLE OF CONTENTS

ABSTRACT.....	4
ACKNOWLEDGEMENT.....	5
TABLE OF CONTENTS.....	6
LIST OF FIGURES.....	11
LIST OF TABLES.....	13
1. INTRODUCTION.....	14
1.1. BACKGROUND TO RESEARCH.....	14
1.1.1. Definition of Securitization.....	14
1.1.2. Definition of Commercial Mortgage-Backed Securitization.....	16
1.1.3. History and Development of Commercial Mortgage-Backed Securitization.....	17
1.1.4. CMBS in South Africa.....	19
1.1.4.1. <i>The expanding domestic CMBS market.....</i>	19
1.1.4.2. <i>Demand for South African CMBS by investors.....</i>	22
1.1.4.3. <i>Overview of CMBS deals issued on the Bond Exchange of South Africa.....</i>	23
1.1.4.4. <i>Legislation amendments and evolution of the securitization market.....</i>	27
1.1.4.4.1. <i>South African securitization market before 13 December 2001.....</i>	27
1.1.4.4.2. <i>South African securitization market after 13 December 2001.....</i>	28
1.1.4.5. <i>The South African property market.....</i>	29
1.2. DEVELOPMENT OF RESEARCH PROBLEM AND HYPOTHESES.....	30
1.2.1. Research Questions.....	32
1.2.2. Aim and Objectives.....	32
1.2.3. Hypotheses.....	33
1.3. JUSTIFICATION FOR THE RESEARCH.....	33
1.4. METHODOLOGY STATEMENT.....	34
1.4.1. Research Methodology.....	34
1.4.1. Data Collection.....	34
1.4.3. Treatment of Data.....	34
1.5. DELIMITATIONS OF SCOPE AND ASSUMPTIONS.....	35
1.5.1. Scope of Research.....	35
1.5.2. Limitations of Research on the South African CMBS market.....	35
1.5.3. Key Assumptions.....	36

1.5.4. Abbreviations.....	37
1.6. THE OUTLINE OF THE REPORT.....	37
2. LITERATURE REVIEW.....	38
2.1. INTRODUCTION.....	38
2.2. STRUCTURE OF CMBS DEALS.....	39
2.2.1. The Basic Structure of CMBS Deals.....	39
2.2.1.1. <i>Structural call protection</i>	40
2.2.1.2. <i>Balloon maturity provisions</i>	42
2.2.2. The Servicer's Role in a CMBS Transaction.....	43
2.2.3. Types of CMBS Deals.....	44
2.2.3.1. <i>Single-Borrower/Multi-Property deals</i>	44
2.2.3.2. <i>Multi-borrower/conduit deals</i>	46
2.3. RISK OF CMBS TRANSACTIONS.....	46
2.3.1. Credit Risk.....	47
2.3.1.1. <i>Default risk</i>	47
2.3.1.2. <i>Credit spread risk</i>	48
2.3.1.3. <i>Downgrade risk</i>	48
2.3.2. Interest Rate Risk.....	49
2.3.2.1. <i>Yield curve risk</i>	49
2.3.2.2. <i>Volatility risk</i>	50
2.3.3. Prepayment Risk.....	50
2.3.4. Extension Risk.....	51
2.3.5. Liquidity Risk and the Costly Search for Information.....	53
2.3.6. Model Risk.....	55
2.4. CMBS PRICING.....	56
2.5. RATING CMBS IN SOUTH AFRICA.....	58
2.5.1. Performing Due Diligence on CMBS deals.....	60
2.5.1.1. <i>Overview of due diligence process</i>	60
2.5.1.2. <i>CMBS due diligence process</i>	62
2.5.2. The Rating Process and Summary of Bond Rating System.....	62
2.5.3. The Role of a Rating Agency in a CMBS deal.....	63
2.5.4. General Overview of Rating Agency Approaches to CMBS.....	66

2.5.4.1. <i>Fitch's rating approach for CMBS deals</i>	66
2.5.4.2. <i>Moody's rating approach for CMBS deals</i>	67
2.5.4.3. <i>Standard and Poor's rating approach for CMBS deal</i>	68
2.5.5. Rating Agency Activity in South African CMBS market	68
2.6. SUMMARY.....	69
3. RESEARCH METHODOLOGY.....	72
3.1. INTRODUCTION.....	72
3.2. RESEARCH STRATEGY.....	72
3.3. RESEARCH DESIGN.....	73
3.4. THE CASE STUDY APPROACH.....	75
3.5. MULTIPLE REGRESSION MODELLING.....	76
3.5.1. Descriptive Statistics.....	76
3.5.2. Simple Linear Regression Analysis.....	76
3.5.2.1. <i>Correlation analysis</i>	76
3.5.2.2. <i>Linear regression with one independent variable</i>	79
3.5.2.3. <i>Limitations of correlation analysis and linear regression</i>	80
3.5.3. Multiple Regression Analysis.....	81
3.5.3.1. <i>Basics of multiple linear regression models</i>	82
3.5.3.2. <i>Limitations of multiple regression analysis</i>	83
3.5.3.2.1. <i>Conditional heteroskedascity</i>	84
3.5.3.2.2. <i>Autocorrelation</i>	84
3.5.3.2.3. <i>Multicollinearity</i>	84
3.5.3.3. <i>Limited and Missing Observations</i>	85
3.5.3.4. <i>Estimating models with panel data</i>	86
3.5.3.4.1. <i>Estimating the pooled (least-squares pooling) data regression model</i>	87
3.5.3.4.2. <i>Estimating the fixed effects regression model</i>	87
3.6. Multi-Factor Risk Models.....	88
3.6.1. <i>Systematic risk</i>	88
3.6.2. <i>Non-systematic risk</i>	89
3.6.3. <i>Relative value analysis using multi-factor regression models</i>	89
3.7. COLLECTING THE DATA.....	90

3.7.1. Selecting a Method of Data Collection.....	90
3.7.2. Using Multiple Sources of Data Collection.....	90
3.7.3. Creating a Database of CMBS deals.....	90
3.7.4. Sources of Data on South African CMBS.....	91
3.7.4.1. <i>Selecting a method of data collection on CMBS</i>	91
3.7.4.2. <i>Problems with collecting data on CMBS</i>	92
3.8. VARIABLE DESCRIPTION.....	93
3.8.1. Dependent Variables.....	94
3.8.2. Independent Variables.....	95
3.8.2.1. <i>Variables describing the quality of loans</i>	95
3.8.2.2. <i>Variables used to proxy market indicators</i>	95
3.8.2.2.1. <i>10-year government bond</i>	95
3.8.2.2.2. <i>Interest rate volatility</i>	95
3.8.2.2.3. <i>Yield curve slope</i>	95
3.8.2.2.4. <i>Experimental property index</i>	96
3.8.2.3. <i>Variables describing the deal structure</i>	96
3.8.2.3.1. <i>Number of years to maturity</i>	96
3.8.2.3.2. <i>Weighted average life</i>	97
3.8.2.3.3. <i>Tranche splitting</i>	97
3.8.2.3.4. <i>Deal and tranche size</i>	97
3.8.2.3.5. <i>Type of deal</i>	97
3.8.2.4. <i>Variables measuring diversification and property mix concentrations</i>	98
3.8.2.4.1. <i>Property types</i>	98
3.8.2.4.2. <i>Geographical distribution</i>	98
3.8.2.4.3. <i>Number of properties</i>	98
3.8.2.5. <i>Other control variables</i>	98
3.8.2.5.1. <i>Year of Issue</i>	99
3.8.2.5.2. <i>Ratings Category</i>	99
3.9. SUMMARY.....	101
4. ANALYSIS OF DATA.....	102
4.1. OVERVIEW OF STRUCTURE OF THE CHAPTER.....	102
4.2. DEVELOPMENT OF HYPOTHESIZED SIGNS FOR ESTIMATED COEFFICIENTS.....	109
4.2.1. Variables Describing the Quality of Loans.....	109
4.2.2. Variables Used to Proxy Market Indicators.....	110

4.2.3. Variables Describing the Deal Structure.....	117
4.2.4. Variables Measuring Diversification and Property Mix Concentrations.....	119
4.3. DATA DESCRIPTION.....	122
4.3.1. Descriptive Statistics.....	122
4.3.2. Pearson Correlation Matrix and Simple Linear Regression Analysis.....	124
4.4. RESULTS OF MULTIPLE REGRESSION ANALYSIS.....	129
4.4.1. Spread Model.....	130
4.4.2. Subordination Model.....	137
4.5. RISK AND RELATIVE VALUE ANALYSIS OF SOUTH AFRICAN CMBS MARKET....	142
4.6. SUMMARY.....	147
5. CONCLUSION AND IMPLICATIONS.....	148
5.1. INTRODUCTION.....	148
5.2. TESTING CONCLUSIONS ABOUT HYPOTHESES.....	151
5.2.1. Hypothesis (i).....	151
5.2.2. Hypothesis (ii).....	153
5.2.3. Hypothesis (iii).....	154
5.2.4. Hypothesis (iv).....	155
5.3. IMPLICATIONS FOR THEORY.....	157
5.4. IMPLICATIONS FOR INVESTORS AND OTHER MARKET PARTICIPANTS.....	158
5.5. LIMITATIONS OF RESEARCH.....	161
5.6. IMPLICATIONS FOR FUTURE RESEARCH.....	162
REFERENCES.....	164
APPENDIX 1. : SOUTH AFRICAN CMBS DATABASE.....	171

LIST OF FIGURES

Figure 1.1	Volume of New CMBS Issues.....	18
Figure 1.2	South African CMBS Market by Size and Number of New Issues.....	21
Figure 2.1	Sequence of Principal Paydowns of the CMBS Deal.....	41
Figure 2.2	Types of Servicers Found in South African CMBS Transactions.....	43
Figure 2.3	Rating Agency Activities in the South African CMBS Market.....	68
Figure 2.4	Average Floating-Rate CMBS Spreads.....	69
Figure 4.1	Calculated Loan-to-Value Ratios for South African CMBS.....	104
Figure 4.2	Subordination Levels for AAA-Rated CMBS.....	106
Figure 4.3	CMBS Spreads Versus Subordination.....	107
Figure 4.4	Loan-to-value ratios	109
Figure 4.5	Subordination Versus LTV Ratios.....	110
Figure 4.6	AAA-Rated CMBS Spreads to 3m-Jibar Versus 10-Year Yield.....	111
Figure 4.7	AAA-Rated CMBS Spreads to 3m-Jibar Versus Yield Volatility.....	112
Figure 4.8	Bond Exchange of South Africa Yield Curves.....	113
Figure 4.9	Slope of BESA Yield Curve.....	114
Figure 4.10	Average AAA-Rated CMBS Price and BESA Yield Curve Shifts.....	115
Figure 4.11	JSE Property Loan Stock Index (2003=100).....	116
Figure 4.12	AAA-Rated CMBS Prices Versus Property Index.....	116
Figure 4.13	AAA-Rated CMBS Spread Versus WAL.....	117
Figure 4.14	Spread and Tranche Size.....	118
Figure 4.15	CMBS Provincial Property Distribution (% of Total Property Value).....	120

Figure 4.16 Property Type by CMBS Deal (% of Total Property Value)..... 121

Figure 4.17 Diversification of South African CMBS Deals..... 122

LIST OF TABLES

Table 1.1	South African CMBS Programmes: 4 th Quarter 2004 – 1 st Quarter 2007.....	20
Table 1.2	Tranches of South African CMBS Market: 4 th Quarter 2004 – 1 st Quarter 2007.	25
Table 1.3	Corporate Bonds Listed on the Bond Exchange of South Africa.....	33
Table 2.1	Summary of Bond Rating Categories.....	64
Table 3.1	Summary of investment-grade bond rating system and symbols.....	100
Table 3.2	Bond Market Sectors.....	100
Table 4.1	South African Floating-Rate CMBS Spreads to 3m-Jibar and Tranche Size.....	102
Table 4.2	Comparative Floating-Rate Spreads of South African CMBS Spreads.....	108
Table 4.3	Descriptive Statistics.....	124
Table 4.4	(i) Pearson Correlation Matrix.....	125
Table 4.4	(ii) Simple Linear Regression Analysis.....	129
Table 4.5	Regression of Spreads on Explanatory Variables for 7 CMBS Deals.....	132
Table 4.6	Regression of Subordination on Explanatory Variables for 7 CMBS Deals.....	138
Table 4.7	Relative Value of Floating-Rate CMBS Deals and Tranches at Issue Date.....	145
Table 4.8	Relative Value of Floating-Rate CMBS by Ratings Category.....	146

1. INTRODUCTION

1.1. BACKGROUND TO RESEARCH

Although only a recent innovation in capital markets, commercial mortgage-backed securities (CMBS) have emerged to become one of the most popular alternative investments in some of the world's largest bond markets. Gichon (1999) asserts that limited prepayment risk, wide trading spreads and availability of property related information have attracted investors into the sector. Vigorous issuance worldwide has provided market participants with a wide range of opportunities, spanning all investment grades (from AAA-rated to unrated classes) and structured with floating- and fixed-rate coupons, intermediate and long maturities, and diversified across property types.

Although the South African CMBS market is currently in its infancy, projected issuance and improved liquidity look positive. Priced correctly, CMBS securities have the potential to be very profitable. Nevertheless, like other risky financial instruments, the continued interest in these securities should not obscure the risks to which they expose investors and they must be analyzed intelligently (Mathew and Katz, 1999). Investors must be aware of the risks involving structure, optionality and credit quality when assuming positions in either new or existing issues.

1.1.1. Definition of Securitization

Securitization involves pooling and repackaging cash flows generated by financial assets into bonds that are then sold into capital markets. The techniques originated out of a funding shortfall in the U.S. residential mortgage market during the late 1970s and the resultant financial instruments have become one of the most popular investment vehicles in the global bond market (Roever, 1996).

Kendall (1996, p. 1) defines securitisation as a "*process of pooling individual loans and other debt instruments*", converting the package into liquid, marketable securities, and "*enhancing their credit status or rating to further their sale*" to bond investors. As a second definition, Blum and DiAngelo (1996) define securitization as a transaction in which a company effectively issues securities backed by financial assets for which it is generally not corporately liable. The financial instrument is structured under applicable laws to stand on its own and pass through timely payment of interest and principal to investors. Securitisation, as a funding strategy, substitutes less efficient traditional financial intermediaries and lenders for more efficient public capital markets.

Roever (1996) extends the basic definitions and describes securitization as funding strategy where financial assets with constant cash flows are pooled and sold to a specially created bankruptcy remote Special Purpose Entity (SPE), which has borrowed money to fund the purchase. These borrowed funds are raised either through the sale of asset-backed commercial paper (ABCP) or bonds. The securities are backed by the specific asset pool or collateral of the SPE rather than by the assets of the issuing company. Cash flow generated by the financial assets collateralizing the loan pool is used to support bonds, which are typically of a higher credit quality than the issuing company.

Investors have a claim of the highest priority against the financial assets securitized and are protected from the risk of claims that may arise from creditors against the issuing company in the normal course of business or in the event of bankruptcy. These risks are isolated from the collateral and this is accomplished by the sale of the assets to a specially created SPE, which is either a limited liability company or trust. The SPE is usually structured to be a subsidiary of the originator or of the investment bank that underwrites the deal and issues the securities (Kendall, 1996; Dunlevy 1999, Roever, 1996; Rosenblatt, 1996).

Enhancements are added to the entitled rights purchased by investors and are done when the collateral backing the transaction will not provide sufficient protection for investors. Credit status enhancement decisions are normally made by the issuer (borrower), in consultation with an investment banker and ratings company, and are based on the relative costs (Blum and DiAngelo, 1996, Kendall, 1996). Various techniques of credit enhancement include excess spreads, a reserve fund, senior/subordinated bond structuring (modeling), over-collateralization, and bank letter of credit from a top-rated international bank or guarantee from a company with a high credit-rating.

Securitization is an attractive funding alternative for a broad range of companies across several different industries. The many advantages provided by securitization relative to traditional bank financing or corporate debt, include lowering cost of funds, liquidity, diversifying funding sources, earnings acceleration and management, off-balance sheet financing, and less public disclosure than competing methods of financing (Kendall, 1996; Roever, 1996). Investors benefit from the conversion of illiquid loans into credit rated, highly liquid, tradable securities at attractive market prices. Furthermore, these fixed-income instruments in the securitized sector of the bond market offer potential trading profits and deliver enhanced diversification benefits to the portfolios of institutional investors.

1.1.2. Definition of Commercial Mortgage-Backed Securitization

The basic component of a CMBS transaction is a commercial mortgage loan originated either to fund the purchase of a property or refinance a prior mortgage (debt) obligation. Securitizing non-recourse commercial mortgage loans backed by income-producing properties is a process commonly known as commercial mortgage-backed securitisation (CMBS), in which tradable securities are created for investors to diversify their portfolio into commercial mortgages and/or property (Lancaster, 2001). The pool of loans are secured against properties such as residential apartments, office buildings, retail properties, hotels, warehouses and industrial buildings, and/or mixed developments with hybrid property use types (Fabozzi, 2004). CMBS securities are formed

when an issuing company deposits commercial mortgages into a SPE and then creates classes of ABCP or bonds collateralised by the pool of loans backed by income-producing properties (Sanders, 2001).

CMBS securities are usually structured into sequential pay bonds within a senior/subordinated structure that are credit rated from AAA-rated through to the lower credit grades. This security design ensures that the lower-rated subordinate or junior bond classes enhance the credit quality of the higher-rated senior classes (Mathew and Katz, 1999). The amount of credit enhancement necessary is established on a deal by deal basis by a credit rating agency or company (Roever, 1996). Principal and interest payments are passed through to the bondholders according to the terms (contract) governing the allocation of the proceeds.

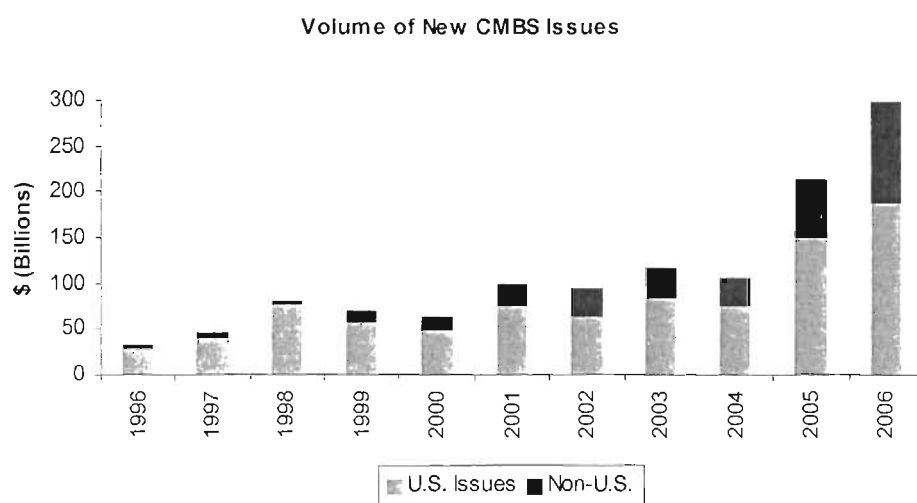
1.1.3. History and Development of Commercial Mortgage-Backed Securitization

The U.S. dominates the worldwide CMBS market with \$67.8 billion issued in 2004 and \$122.8 billion issued in 2005.¹ Issuance volume in 1992, 1993, and 1994, was \$14 billion, \$17 billion, and \$20 billion respectively. The U.S. CMBS market accounts for approximately 70 percent of total worldwide-CMBS issuance. Non-U.S. year-to-date issuance volume has reached approximately \$53 billion with the majority of the collateral located in Canada, Europe, Japan and Australia. Gichon (1999) attributes this worldwide growth to limited prepayment risk of the securities and improved availability of information that has attracted investors to this sub-sector of the securitised bond market.

Ong et al. (2004) summarize the development of the worldwide-CMBS market, focusing specifically on its origins in the U.S. The first phase of development took place in the mid-1980s, which involved packaging of commercial mortgages on single properties into CMBS. This period saw an increase in the level of capital flows into the commercial real estate market. According to Adams (1996), total commercial mortgages outstanding grew from \$400 billion in 1982 to

¹ The *Commercial Mortgage Alert* database provides worldwide monthly issuance volume reports.

approximately \$1 trillion by 1990. This was attributed to a strong economy and the deregulation of the financial services industry. Excessive overbuilding caused the formation of a property bubble. The bubble burst and commercial property values were devalued, with commercial mortgage lenders experiencing considerable losses. In the early 1990s, a severe recession in the commercial property market led to traditional lenders withdrawing almost completely from the market (DeMichele and Adams, 1999).



Source: *Commercial Mortgage Alert*

Figure 1.1. Worldwide volume of new CMBS issues over the 1996-2006 period.

The second phase, the setting-up of the Resolution Trust Corporation, was the catalyst for the rapid development of the CMBS market in the United States. The RTC was a government agency created to liquidate non-performing loans of distressed thrifts and banks that were severely hit by the real estate crash in the late 1980s. According to the Commercial Mortgage Alert Database (2005), the RTC issued \$15 billion in CMBS between 1991 and 1993. Each deal consisted of a large number of loans offering the diversification benefits similar to that of residential mortgage-backed securities (RMBS). By pooling commercial loans into a senior/subordinated deal structure, the RTC was able to provide adequate risk protection and sell the non-performing loans to investors. A study by Harding and Sirmans (1997) illustrates the operation of this senior subordinated structure for a pool of commercial mortgage loans in a CMBS transaction.

The RTC was finally disbanded in 1995 after liquidating these non-performing commercial mortgage loans and recapitalising failed thrifts and banks. However, the CMBS market continued to grow because of the strong demand by investors for the attractive yield spreads offered by CMBS issued by the RTC. The third phase, consisting of mainly seasoned secured loans, saw CMBS continuing to be issued by private lending institutions. Currently, conduit originations dominate the market. Conduit vehicles are established for the sole purpose of generating collateral (commercial mortgage loans) to securitize. These lenders focus their operations specifically on the origination of loans for securitization and have emerged to fill the vacuum that institutional lenders left as they scaled back their lending activity after the property recession. Gichon (1999) found that by creating conduit origination facilities for the sole purpose of securitization, originators and issuers have created a more standardized product that more readily fits the preference of investors. Conduit originations now account for more than half of CMBS collateral in the U.S and have also been the main contributor to the growth of the CMBS market in Europe (Commercial Mortgage Alert, 2007).

Japan has also experienced a real estate market recession similar to the U.S. credit crunch; however, the market in non-performing loans has been relatively unimportant for the development of the CMBS market. Corcoran and Phillips (2001) attribute this to government policy of supporting ailing banks with public money, rather than selling off the non-performing loans similar to the RTC. The majority of CMBS transactions in Japan have involved weakened real estate and life insurance companies using valuable real estate assets to obtain new financing.

1.1.4. CMBS in South Africa²

1.1.4.1. The expanding domestic CMBS market

² The outline of Section 1.1.4 closely follows earlier work by Corcoran and Phillips (2001) on CMBS in Japan.

By first quarter 2007, five CMBS programmes had issued seven deals with a total value of approximately R7.9 billion (see Table 1.1). All issues were listed on the Bond Exchange of South Africa. The first deal, a R800 million floating-rate single-borrower/multi-property (large loan) CMBS, was issued in November 2004. This deal was followed by two similar issuances in 2005 that accounted for a further R1.575 billion in notes. Volumes increased significantly in 2006 with four transactions brought to market totaling R4.03 billion. Towards the end of the first quarter 2007, the first multi-borrower/multi-property (conduit) CMBS was placed with the total value of notes issued of R1.469 billion. Figure 1.2 shows the growth of the South African CMBS market by number of deals and volume.

TABLE 1.1
South African CMBS Programmes: 4th Quarter 2004 - 1st Quarter 2007

No.	Issuer	Transaction Type	Arranger	Amt (R'bill.)	Issue Date
1	Prime Realty Obligors Packaged Securities	Single-borrower/ multi-property	Absa Corporate and Merchant	2.00	02/11/04
2	Vukile Investment Property Securitisation (Pty) Ltd	Single-borrower/ multi-property	Absa Corporate and Merchant Bank	2.00	07/11/05
3	Growthpoint Note Issuer Company (Pty) Ltd	Single-borrower/ multi-property	Investec Bank Limited	5.00	28/11/05
4	Freestone Finance Company (Pty) Ltd	Single-borrower/ multi-property	Rand Merchant Bank	5.00	19/06/06
5	Private Commercial Mortgages (Pty) Ltd	Multi-borrower/ multi-property	Investec Bank Limited	10.00	27/03/07

This issuance compares to 36 deals with just under \$5 billion done during the formative stages of the U.S. CMBS market in 1990. Subsequently, demand for these securities has grown exponentially with issuance volume totaling approximately \$300 billion in 2006 (Figure 1.1 and Commercial Mortgage Alert, 2007). With non-US volumes now exceeding yearly issuance of \$100 billion, similar growth is expected in Europe, Japan, and other markets. Considering worldwide trends; we can expect domestic arrangers and originators to structure further CMBS programmes into the future.

The emergence of a CMBS market towards the top of the commercial property cycle in South Africa has not paralleled the earlier 1990s U.S. experience. The U.S. had more extensive experience with securitisation and the CMBS market was built on the foundation of earlier securitisation of residential mortgages. Securitisation of commercial mortgage loans as collateral in the form of CMBS was pioneered by selling off the seasoned performing and non-performing loans of failed banks and thrifts (Corcoran and Phillips, 2001). Furthermore, the U.S. lenders, predominantly banks, thrifts (non-banking financial institutions) and life insurance companies had established, as early as the 1950s, had commercial mortgage underwriting standards that were non-recourse to the borrower. However, South African commercial banks structure underwriting standards with recourse to the borrower.

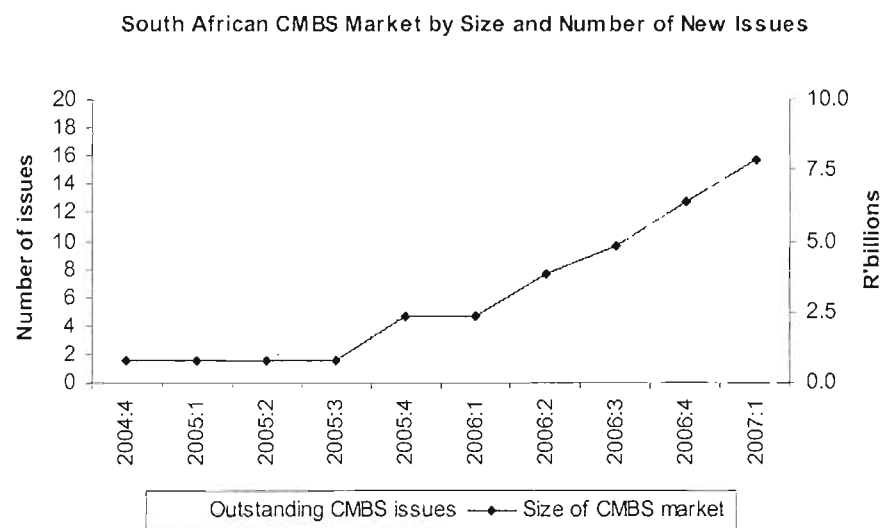


Figure 1.2. South African CMBS market by size and number of outstanding issues. Deal size is measured in ZAR billions. An Issue refers to a new Series listed on the Bond Exchange of South Africa.

In South Africa, pooling of commercial mortgages for securitization purposes is a relatively new innovation and initially only emerged as a trend in the listed property sector. Unlike the first phase implementation of CMBS in the U.S, the first securitization of commercial mortgage loans by a commercial bank was only issued towards the end of first quarter 2007. Kendall (1996) suggests that the introduction of a securitized asset class into a financial market responds favourably to a

severe shortage of funds in a sector due to a withdrawal of traditional lenders (banks). Strong property market fundamentals, together with the low default risks of commercial mortgages and the reluctance of banks to sever the good relationships with their borrowers are factors that are seeing banks in South Africa retaining their valuable commercial mortgage loan portfolios, rather than securitizing them. Instead, banks are using securitization technology to hedge against credit risk in other loan types, so as to reduce the risk-weighted assets for their capital adequacy ratio requirements. These loans are backed by commercial paper, credit card receivables, fixed and floating-rate residential mortgages, and vehicle finance receivables.

It is the property loan stock companies, rather than banks, who have taken the lead in employing innovative CMBS structures, as a significantly cheaper funding alternative to that offered by traditional lenders.³ Tapping into the public capital markets is becoming an ideal way for property companies and funds to lower their cost of borrowings. In the past, financial constraints introduced by bank funding have limited property loan stock companies growing their property portfolio. Commercial mortgage-backed securitization can provide more strategic, reliable, long-term diversified funding for these companies, thereby reducing the risk of having to rely on bank funding. All bonds have a higher credit rating than the issuing property company because the agencies are only credit rating the underlying tenants and lease terms. The overall risk of single borrower/multi-property CMBS is less than bank lending that is secured on individual properties and this is attributed to the portfolio diversification effects offered by the loan pool which generally consists of a range of property types, geographical locations, types of tenants and lease lengths (Jacob, Gichon, Lee, and Tong, 1999).

1.1.4.2. Demand for South African CMBS by investors

³ Originators include property loan stock companies, real estate investment trusts, property funds, and banks. Property loan stock companies are real estate companies listed on the JSE Stock Exchange under the "Financial – Real Estate" sector.

The recent emergence of innovative financial instruments in the South African bond market, including single-borrower and multi-borrower (conduit) transactions, have required investors to become more familiar with these new structures. In 2004-2006, the strong initial demand by investors for CMBS has been notable with several deals being oversubscribed at issuance. On the supply side; this could be attributed to the recent low issuance volumes of government bonds. However, the effect of decreasing government offerings was offset with the recent increase in multiple corporate and securitized issuances. Investors demand for CMBS may possibly have been bolstered by increasing recognition of South Africa's solid property market fundamentals (see Section 1.1.4.5).

Rushton and Eis (2005, p. 2) note that a "*buy and hold bias still appears firmly entrenched*" in the bond market. In recent media articles in relation to the Private Commercial Mortgages (Pty) Ltd deal, Job (2007) states that CMBS notes are purchased by institutional investors.⁴

1.1.4.3. Overview of CMBS deals issued on the Bond Exchange of South Africa

The first South African CMBS programme was launched by property loan stock company, iFour Properties Limited and listed on the Bond Exchange of South Africa in November 2004. This R2 billion programme featured a number of innovative features, specific to the South African market that permitted operational flexibility to iFour. The first placement of R800 million of bonds, secured by a portfolio of A-grade commercial properties, was arranged by ABSA Corporate and Merchant Bank (see Table 1.1). Approximately three quarters of iFour's investment property assets were secured in the deal and consisted of 92 properties diversified by property sector and geographical region. The innovative transaction was the first non-tax driven structured finance transaction in the commercial property market to receive a credit rating from an international credit rating agency. The securities were issued via a special purpose entity, Prime Realty Obligors Packaged Securities; with the two split senior tranches totalling R568 million and rated

⁴ Nick Job is Head of Debt Capital Markets at Investec Bank Limited.

A further four single-borrower/multi-property deals were brought to market in 2006, with a total value of R4.035 billion issued across 13 individual tranches. The A1 note issued by Freestone Finance Company (Pty) Ltd was rated AAA by Moody's and achieved a remarkably narrow spread at pricing date of 31 bps. In addition to the second tranche split of Series 1 under the Growthpoint Note Issuer Company (Pty) Ltd programme, two further Series' exceeding R2.5 billion in total value were also issued. The spread at time of issuance on the senior-rated tranches for both Series 2 and Series 3 was 40 bps.

As demonstrated in other listed property markets around the world, such as Australia and the UK, commercial property securitisation may prove an attractive funding strategy for other property loan stocks, and unit trusts listed on the JSE Stock Exchange. The initial set-up costs and implementation expenses of CMBS structures may also limit single borrower/multi-property securitization to funds with large property portfolios. Property companies and funds will have to balance and weigh the savings benefit of lower debt funding against these set-up costs. However, arrangers and underwriters are attempting to simplify the costs of securitising commercial property through innovative, interim conduit special purpose vehicles (SPEs). Conduit CMBS structures simplify the financial, operational and other legal restrictions imposed by rating agencies on smaller borrowers.

In the U.S. CMBS market, much of the issuance is dominated by conduit SPEs, called Real Estate Mortgage Investment Conduits (REIMCS), which originate, pool, and securitize mortgage loans (Gichon, 1999). Considering how conduits have also contributed significantly to the growth of the worldwide CMBS market; the long-term growth in the South African market will most likely be dependant on the development of an asset-backed commercial paper (ABCP) conduit lending market. Banks are already starting to look at offering commercial property financing via ABCP conduit vehicles, saving borrowers 20bps a year. It is likely that cheaper ABCP conduit funding should encourage commercial banks to offer more competitive lending rates, especially on A-grade commercial properties.

Investec Bank Limited placed the first multi-borrower/multi-property (conduit) CMBS in South Africa on 27 March 2007. Under the R10 billion Private Commercial Mortgage (Pty) Ltd programmes, seven tranches were structured and notes with a total value of R1.469 billion were issued. The notes are backed by a pool of 134 commercial mortgage loans. All the Class A notes were assigned a AAA.za credit rating by Moody's and accounted for approximately 80% of the deal. The floating-rate Class A1R and Class A2 notes were priced with spreads of 44 bps and 43 bps above 3m-Jibar respectively. Class A3, the first fixed-rate CMBS note issued in South Africa, was priced with an 8.835 % annual coupon. In addition, the first below investment-grade CMBS note was also offered to investors. The Class E1 note was assigned a BB-rating and priced with a spread of 250 bps.

1.1.4.4. Legislation amendments and evolution of the securitization market

The new regulations issued by the South African Reserve Bank have underpinned the growth of securitization in South Africa. These regulations allow properties or a commercial mortgage loan portfolio assembled by an originator to be ring-fenced into a SPE and then registered for the sole purpose of holding investment properties or loans for its securitisation programme. The South African SPE deal structure provides the issuing company with transparency for tax purposes, as all amounts accruing to the SPE are deemed to accrue to the issuer as the only capital appreciation and income recipient. The properties held by the trust are ring-fenced, insolvency remote, and carry no operational risk of the originator (Government Notice No. 1375 Government Gazette, No. 22948 of 13 December 2001).

1.1.4.4.1. South African securitization market before 13 December 2001

Until 13 December 2001, the South African securitization market consisted of approximately five transactions, including three cross-border deals (Couzen and van der Poel: 2006). Securitization transactions were initially regulated by two Government Notices, the Securitization Schemes Schedule (GN 153, GG 13723 of 3 January 1992) and the Commercial Paper Schedule (GN 2172, GG 16167 of 14 December 1994) both promulgated under the Banks Act 94 of 1990.

However, these notices created much uncertainty as to whether securitization activities undertaken by a special purpose entity (SPE) should be considered as “business of a bank” and stifled the development of the market.

1.1.4.4.2. South African securitization market after 13 December 2001

In 2001, the South African Reserve Bank promulgated its first set of reforms in the securitization market. The Registrar of Banks published new regulations governing securitization schemes in South Africa (GN 1375, GG 22948 of 13 December 2001) which repealed the Government Notice published in 1992. The new Government Notice clarified the law by stating an SPE receiving cash in a securitization transaction was not within the scope of the “business of a bank”, i.e., the notice governs all securitization transactions entered into by banks as well as non-banking institutions (Couzen and van der Poel, 2006). A SPE now need not be registered as a bank in order to accept funds against the issue of bonds in a securitization transaction. The 2001 Legislation changes were attributed to a highly consolidated banking system and the existence of a mature mortgage and personal loan industry. Furthermore, the Government Notices also implemented the ratings-based approach to risk weightings for asset-backed securities under the Basel II Capital Accord. This provided for a favorable capital risk weighting for investments by banks in asset-backed securities with high credit ratings.

The regulations contained in the 2001 Government Notice are more detailed than those contained in the 1992 Government Notice. One of the new primary conditions is that both the originator and sponsor in a securitization transaction should limit their association with the assets transferred to the SPE. This limitation is provided for by provisions which include limitations on recourse, requirements regarding control of the SPE, issues relating to the issue of commercial paper (Bonds), and conditions relating to disclosure.

The regulations require that the originator completely divest itself of all rights and obligations originating from transactions which underlie the assets sold to the SPE and from all risks in

connection with the underlying transfer of the collateral (see paragraph 3(a) of GN 1375, GG 22948 of 13 December 2001). However, the originator may still provide a credit enhancement facility, liquidity facility, or act as a servicer in the transaction. Furthermore, the SPE may not have a right of recourse against the originator in respect of any defaults after the collateral has been transferred (see paragraph 3(a) of GN 1375, GG 22948 of 13 December 2001).

The new regulations limit the originator or sponsor from acquiring or holding share capital of the SPE greater than 50% of the nominal value of all the issued share capital of the SPE. It is also required that the board of directors of the SPE must be independent of the originator, sponsor, or any other primary parties associated with the securitization transaction. The board of directors must also appoint an auditor for due diligence. This independent third party is required to issue a certificate stating that the SPE will comply with all the relevant provisions contained in the regulations published within the Government Notice.

The securitization market reacted positively to the 2001 Legislation by issuing debt instruments in excess of R40 billion between 2001 and 2004. However, the current regulatory framework (GN 681, GG 26415 of 4 June 2004) has broadened the definition of a SPE. Additionally, the range of financial assets that may be securitized has been significantly broadened and a pool of assets can now also be securitized within synthetic securitization transactions. The 2004 Regulations also stipulate the disclosure of certain additional information in the offering circular, specifically addressing the complexities involved with securitizing pools of revolving assets.

1.4.4.5. *The South African property market*

In South Africa, the major property markets consist of the residential, retail, commercial office, and industrial property sectors. Although residential property is a significant sector of the market, property loan stocks, property funds, and CMBS schemes have not diversified their property portfolios into this sub-sector. Each major property type is driven by different economic factors that explain to varying degrees new supply and change in value of existing stock (Corcoran,

1999). High-quality properties in every sector continue to see rents and prices stabilize or increase (Rode, 2006).

Schneider (2006) found that take up of existing stock in the office market is increasing countrywide. He attributes this to high building costs and limited serviced land availability. New developments in decentralised nodes have been a predominant trend in the office market since 2000. However, demand is now levelling off for new developments and picking up for existing stock. Schneider (2007) attributed this trend to a combination of the upgrading and refurbishing of existing buildings. Vacancy rates in major nodes have also been steadily decreasing. The industrial market has also shown solid growth over the past few years. Rentals have been steadily growing and vacancy rates have decreased sharply. According to Rode (2006), this is attributed to increased economic activity in the South African market.

1.2. DEVELOPMENT OF RESEARCH PROBLEM AND HYPOTHESES

Investing in CMBS is an intrinsically risky activity. These transactions are complex financial instruments with unique characteristics from both a property and bond perspective (Trepp and Sativsky, 1999). With regard to investing in CMBS; the investor should examine and compare the full spectrum of risks and expected returns in order to ensure that the risk exposures are justified by the rewards they can reasonably expect to reap. Proper identification and measurement of risk is a key step when making the investment decision.

Investors typically analyse the following risks: (1) credit risk, (2) extension risk, (3) prepayment risk, (4) interest-rate risk, and (5) liquidity risk.

No CMBS transaction will contain exactly the same risk/return profile as another issue. Bond classes of the same rating and stated weighted average life will perform very differently. For example, the bond structures may be identical, but then the type and geographical distribution of the properties backing the loans is different and/or the provisions of the loan contracts vary.

Jacob and Gichon (1999) assert that relative value analysis of any CMBS security must consider the spread relative to the combination of three components. These include: (1) the quality and valuation of the underlying properties; (2) the underwriting and structural aspect of the each loan; and, (3) the cash flow characteristics of the bond structure.

The spreads where these issues were originally priced as available to investors at date of issuance were priced at similar levels. Each bond class is expected to trade at different spread levels because they each have different structural features. They should therefore not be priced at the similar levels. The structural features of the deals and the quality of the collateral vary substantially. In addition, investors must assess which tranche contains better relative value. When a new investment product reaches the market, the learning curve tends to be steep for investors (Kochen, 1996). Investors in South Africa are still on this learning curve. This makes CMBS, as an alternative asset class, more risky than it may be at a later stage when investors have historical experience to draw from.

Yield spreads in the CMBS market have historically traded with wider spreads than their corporate counterparts, however, over time these move closer as the investor base widens. Arrangers generally offer investors generous spreads at time of issue to attract investors. Esaki (2003) notes that it took the US CMBS market approximately seven years to develop the liquidity and broad investor base necessary just to achieve parity with corporate bonds. At the time of issue, several corporate bond issues in South Africa offered greater spreads than similarly rated CMBS notes. It is important for investors to determine if each tranche is correctly priced at date of issue. The application of corporate bond valuation methods to capture value will cause inaccurate pricing. Investor must implement a framework to model and analyse all aspects of the transaction,

1.2.1. Research Questions

The main research question is:

Are elements of risk in commercial mortgage-backed securities issued in South Africa priced correctly and reflected in spreads at issuance date?

Subsidiary research questions are:

- i. Are investors performing "asset differential" relative pricing between the different South African CMBS issues and bond classes?⁵
- ii. Are investors purchasing South African commercial mortgage-backed securities for credit risk rather than interest rate and liquidity risk?
- iii. Are rating agencies correctly assessing credit risk when assigning credit ratings and determining credit enhancement levels?

1.2.2. Aim and Objectives

The aim of the research is to assess the risks and current pricing of single-borrower/multi-property and multi-borrower/multi-property commercial mortgage-backed securities in South Africa and make investors aware of the potential pitfalls of investing in these new bond instruments.

Specific objectives arising from the aim are to:

- i. Critically review the existing models for pricing risks in commercial mortgage-backed securities.
- ii. Draw lessons from developments in the U.S. CMBS market;
- iii. Identify the main risks associated with commercial mortgage-backed securities in South Africa;

⁵ This question was initially raised by investors at the *Securitisation and Debt Capital Market's Conference November 2005* (Rushton and Els, 2005)

- iv. Examine case studies of single-borrower/multi-property and multi-borrower/multi-property commercial mortgage-backed securities to illustrate the potential risks of investing in these financial instruments;
- v. Develop a conceptual framework that investors can use to perform risk and relative value analysis of a CMBS deal;
- vi. Establish whether regression analysis is appropriate to perform "asset differential" relative pricing between different CMBS issue and bond classes in South Africa.
- vii. Determine if investors are correctly pricing the risks of these innovative securities;
- viii. Consider the likely future trends in the South African market and assess the interaction between risk and return.

1.2.3. Hypotheses

The hypotheses arising from the development of the research questions are:

- i. The risks of commercial mortgage-backed securities issued in South Africa are being correctly priced by investors.
- ii. Investors are performing relative value asset differential relative pricing between different South African CMBS issues and bond classes.
- iii. Investors are purchasing commercial mortgage-backed securities issued in South Africa according to their credit rating rather for their interest rate risk and liquidity risk.
- iv. Rating agencies are correctly assessing credit risk in South African commercial mortgage-backed securities.

1.3. JUSTIFICATION FOR THE RESEARCH

Commercial mortgage-backed securities are a relatively new innovation to feature on the Bond Exchange of South Africa. With the significant growth in issuance in other countries, the number and types of CMBS transactions in South Africa are expected to increase substantially over the next decade. It is therefore necessary that research be initiated to explore the idiosyncrasies and

risks specific to commercial mortgage-backed securities. This research takes the very important first step in assessing and quantifying the risk inherent in CMBS in South Africa. Furthermore, it is anticipated that the research will contribute to the practice and knowledge of pricing CMBS in an emerging market.

1.4. METHODOLOGY STATEMENT

1.4.1. Research Methodology

The research problem is addressed by combining elements of both quantitative and qualitative analysis. A case study methodology will allow for the analytical treatment of several methods of data collection simultaneously. This research design defines the unit of analysis as a commercial mortgage-backed security and explains the unique, complex situations through an in-depth narrative description of each South African CMBS issue. The case study design will support exploratory analysis of CMBS pricing using correlation analysis, descriptive statistics, and simple linear regression modelling. The case study methodology is used when the interaction of variables is generally known, but to an uncertain level of accuracy, while the statistical tool of correlation and regression analysis will be used to test and quantify relationships between pricing variables.

1.4.1. Data Collection

The primary sources of data include Rating Agency Pre-sale Reports and Programme Memorandums (including Series Supplements) from single-borrower/multi-property and multi-borrower/conduit CMBS deals. Data will also be drawn from the following resources: Stats SA; DataStream; BFA McGregors; Rode's databases; and SARB monthly statistical reports. Secondary data sources include books, journal articles, international conference papers, professional publications and the internet.

1.4.3. Treatment of Data

An intensive literature search covering academic and professional publications describes previous research findings regarding the problem statement. The research reviews, compares and summarises seven CMBS deals starting with the underlying real estate, followed by an analysis of the loans, and concludes with the deal structure.

A basic analytical approach using correlation and simple regression modelling is used to empirically test the pricing of individual bond classes. Specifically, the risks associated with default, extension, liquidity, and prepayments are trapped and evaluated. The statistical method is used to reveal the hidden weaknesses of pricing commercial mortgage-backed securities in South Africa. Using multiple regression modelling, a framework that investors can use to assess the risk and relative value of different South African CMBS tranches is developed. It is also determined if these models could be implemented in the current secondary market trading environment which currently suffers from lack of depth and required liquidity (Bond Exchange of South Africa, 2007).

1.5. DELIMITATIONS OF SCOPE AND ASSUMPTIONS

1.5.1. Scope of Research

The research considers only floating-rate commercial mortgage-backed securities listed on the Bond Exchange of South Africa and excludes private-label deals, privately placed by arrangers. The case study is restricted to single-borrower/multi-property and multi-borrower/conduit deals originated by property loan stock companies listed on the JSE Stock Exchange and commercial banks respectively.

1.5.2. Limitations of Research on the South African CMBS market

An underlying limitation of this research is unavailability of detailed information pertaining to CMBS deals. Reports related to CMBS deals remain proprietary information of the arrangers,

issuers, and institutional investors. Confidentiality and competitive issues limit public dissemination of deal specific reports. This information is required to implement a comprehensive risk management framework and develop pricing models that can be used in practice. An important consideration throughout the investigation of CMBS pricing is the lack of observations available to conduct regression analysis. This is attributed to two factors, namely, (1) the small sample period available (Quarter 4 2004 until Quarter 1 2007), and (2) the illiquidity of the South African secondary market for securitised products. Correlation analysis and linear regression models that include a maximum of two independent variables are therefore used to test pricing relationships. This analysis is supported by descriptive statistics that highlight graphically the complicated relationship between the independent and dependent variables. It is important that investors and other market participants realise that the lack observations available in the market limit the “validity” of any relative value equations derived through the use of multiple regression analysis. Rather, the research develops a theoretical framework that CMBS investors and traders can use to develop relative value trading strategies, which can only be implemented in practice once the secondary market has developed the necessary depth and required liquidity.

1.5.3. Key Assumptions

The following assumptions have been made and are applicable throughout this research.

- i. The research assumes that listed property loan stock companies, property unit trusts, and real estate investment trusts will continue to fund their commercial property portfolios through commercial mortgage-backed securitization.
- ii. The research assumes that commercial banks will continue to originate commercial mortgage loans for the purpose of securitization
- iii. The research assumes that the South African bond market is slightly inefficient and that investors can exploit these inefficiencies through superior research aimed at generating attractive returns with lower than normal risk.

- iv. The research assumes that commercial mortgage-backed securities issued on the Bond Exchange of South Africa are liquid and can be freely traded between investors.

1.5.4. Abbreviations

- 3m-Jibar – three month Johannesburg interbank agreed rate
- BESA – the Bond Exchange of South Africa
- bps – basis points
- CMBS – commercial mortgage-backed securities
- ICR – interest coverage ratio
- LTV – loan-to-value ratio
- ρ – correlation coefficient
- R^2 – coefficient of determination
- WAL – weighted average life
- ZAR – South African Rand

1.6. THE OUTLINE OF THE REPORT

Following on from the introduction, Chapter 2 reviews the literature relating to structuring, risk identification and rating of commercial mortgage-backed securities. Moreover, it highlights previous research that has investigated CMBS pricing. Chapter 3 identifies the research methodology that will be used to answer the research questions and test the hypotheses. Chapter 4 analyzes the data and presents results of the research, which are assessed for their relevance to the research questions and hypotheses. Finally, Chapter 5 presents the conclusions relating to the research questions and hypotheses. Implications for pricing theory, investors and future research are also discussed.

2. LITERATURE REVIEW

2.1. INTRODUCTION

Investors will usually make a decision to purchase commercial mortgage-backed securities based on their views of the risks and opportunities presented by the asset class (Jacob and Patel, 2001). However, there are no standard tools or approaches used to assess the risk/return characteristics of each issue and bond class. Investors in the commercial mortgage-backed securitization (CMBS) market will typically use credit ratings and subordination levels assigned by international credit rating agencies and yield spreads to estimate expected future performance.

The structure of a CMBS deal can greatly affect the risk/return characteristics of each bond class (Jacob and Tong, 1999). Commercial mortgage loans, the underlying collateral in a CMBS transaction, differ somewhat from their residential mortgage counterparts. Commercial mortgage loans generally require prepayment penalties and as a result there is more cash flow certainty. They also include terms which allow for extension and other modifications of the loan terms in the event of a balloon payment default. In addition, the provisions of a CMBS issue can state that the servicer is required to advance scheduled principal and interest in the event of default. The investor should ideally perform structural analysis of a CMBS issue before investing in the individual bond classes to confirm pricing accuracy. The senior/subordinated structure almost always requires the principal from the asset pool to pay down the outstanding senior classes before that of the lower-rated bond classes. Jacob and Gichon (1999, p. 310) state that "*the specific structure dictates how each class is paid*". Rating agencies play an integral part in determining the final deal structure (Franzetti, 1999). They assign ratings to CMBS issues, which are opinions of the issuer's creditworthiness. It is therefore important that investors understand the different rating processes.

Fabozzi (2004, p. 249) suggests that proper analysis of CMBS issues and bond classes requires an “*understanding of the principal risks*” inherent, although to varying degrees, in each issue. The principal risks found in commercial mortgage-backed securities include spread risk, interest-rate risk, prepayment risk, extension risk, liquidity risk, and model risk. These risks will be priced into the yields spreads at issuance date. The yield spread measure of a fixed coupon CMBS security consists of two components, the yield on a reference rate benchmark plus a nominal spread. The spreads on floating-rate security will use the 3-month Johannesburg Interbank Agreed rate (3m-Jibar) as the benchmark reference rate. When pricing a CMBS deal, all risks of the deal should be considered equally. Each deal is unique and should be researched thoroughly. Once investors are familiar with the nuances, they can price each deal correctly.

Following on from the introduction, Section 2.3 focuses on the structural considerations impacting investment in CMBS deals. Risks of investing in CMBS securities are established in Section 2.3. Section 2.4 reviews literature relating CMBS pricing, as well as risk and relative value strategies. Section 2.5 describes the due diligence and the ratings process. The final section summarizes the key points identified in the chapter.

2.2. STRUCTURE OF CMBS DEALS

2.2.1. The Basic Structure of CMBS Deals

A CMBS deal is created when an issuer places commercial mortgage loans into a special purpose entity (SPE), which then issues classes of bonds backed by the interest and principal of the underlying loan pool. The basic structural element of the CMBS transaction is a commercial mortgage loan originated either to finance the purchase of a property or to refinance an existing loan (DunLevy, 1999). Until recently, South Africa institutional investors that desired exposure to the commercial mortgage market had to purchase portfolios of whole loans. However, commercial (retail) banks and originators have started to structure these mortgages into diverse loan pools collateralizing a CMBS issue.

Jacob and Tong (1999) discuss how structuring impacts the performance of bond classes. It is common for structural credit enhancements to accompany all CMBS transactions (Fabozzi, 2004). Rating agencies assist the issuer to determine the required level of credit enhancement needed to achieve the level of rating.⁶ There are two types of credit enhancements: (1) internal and (2) external. Examples of internal credit enhancements include reserve funds, overcollateralization, and senior/subordinated structures. Senior/subordinated structures are the most common credit enhancement used to achieve the necessary rating levels. These structures contain at least two tranches, a senior tranche and a junior (subordinated) tranche (Fabozzi, 2001; 2004). The level of protection for senior (highest-rated) tranches increases with the percentage of subordination in the structure. Each senior tranche has a companion or support tranche that has a second priority to the cash flows. External credit enhancements are financial guarantees from third parties to the transaction.

2.2.1.1. Structural call protection

Rating agencies require that tranches be retired sequentially with the senior highest-rated tranches paying off first in structure. As a result, any principal repayment caused by amortization, prepayment, or default will be used to repay the senior tranches. Interest on the outstanding notional is generally paid to all the tranches in the structure. DunLevy (1999) found that the level of structural call protection available to a CMBS investor is a function of both the call protection available at the loan level and from the bond structure. The borrower in a commercial mortgage loan has the right to exercise a prepayment and extension option. Fabozzi (2004) explains how the senior/subordinated bond structuring offers superior structural call protection to the investor. For example, the AA-rated tranche cannot pay down until the AAA is completely retired, and the A-rated tranche cannot pay down until the AA is completely retired, etc. Figure 2.1 demonstrates the mechanics of the sequential-pay senior/subordinated structure commonly found in CMBS deals.

⁶ Section 3.4 reviews the major ratings approaches to CMBS transactions.

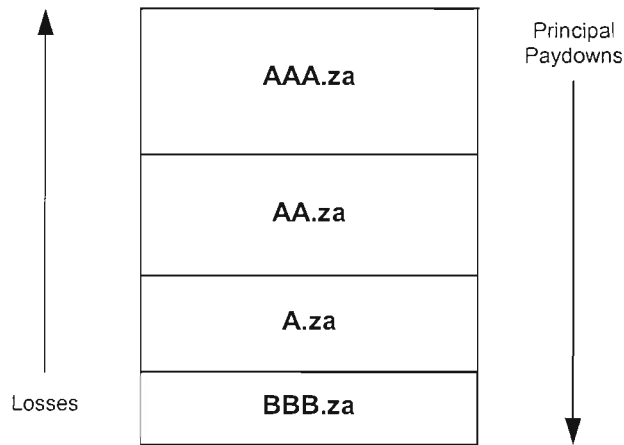


Figure 2.1. Sequence of Principal Paydowns of the CMBS Deal (Fabozzi, 1999)

Investors are attracted to commercial mortgage-backed securities because of the prepayment penalties and/or yield maintenance provisions structured into the underlying loans (Gordon and Gibson, 2001). At the commercial loan level, these provisions include prepayment lockout, prepayment penalty, and yield maintenance.

Prepayment lockout is the strongest form of prepayment protection. Fabozzi (2004, p. 167) defines a lockout provision as *"a contractual agreement that prevents the borrower making prepayments during a specified period"*. Loans that contain prepayment provisions generally prohibit unscheduled principal repayments for 2-5 years. On the other hand, prepayment penalties are predetermined penalties which must be paid to the lender if the borrower refinances the loan. Yield maintenance penalties are designed to make the lender or investor indifferent as to the timing and size of any prepayments. Gordon and Gibson (2001) asserts that yield maintenance or *"make whole charge provisions"* make it unbeneficial for the borrower to refinance a mortgage loan in order to take advantage of lower lending rates available in the market.

2.2.1.2. Balloon maturity provisions

The loans backing CMBS issues are generally balloon mortgages that require substantial principal repayment on the final maturity date. According to Dunlevy (1999), investors and lenders like the bullet principal paydown of the balloon maturities. However, it does present difficulties from a structural standpoint. For example, if the CMBS issue is structured to completely paydown the outstanding notional balance on a specified date; an event of default will occur if the issuer delays the paydown. The impact on investors is dependant on the type of bond issued (premium, par, or discount) and whether or not the servicer on the deal will advance to a particular tranche after the balloon default date. Dunlevy (2001) further notes that another risk for investors in multitranche transactions is the fact that all loans must be refinanced to pay off the senior note holders. Therefore, the balloon risk (also referred to as extension risk) to investors in the most senior tranches (AAA) may be equivalent to that of the lower-rated tranches (BBB-rated or below).

The investor must understand the internal and external tail balloon provisions that impact the average life of outstanding tranches and overall performance. The internal tail requires the borrower to provide ongoing data of its ability to refinance the loan. For example, market valuations, environmental and engineering reports would have to be undertaken within a pre-specified period of the balloon date. These processes would be undertaken within one year of the balloon date. Additionally, the borrower is required to obtain a refinancing commitment within six months prior to balloon date (Dunlevy, 1999; 2001; Jacob and Tong, 1999; Fabozzi, 2001).

Rating agencies prefer the external tail provision since it gives the borrower the most time to arrange refinancing, while avoiding default on the bond obligation (Dunlevy, 2001). With the external tail, the period between the loan balloon date and the CMBS maturity date acts as a buffer to arrange refinancing. Although the investor does not receive the balloon repayment during this period, the investor does not suffer an interruption in cash flow. Any interest and scheduled principal repayments during this period are advanced to all remaining note holders.

2.2.2. The Servicer's Role in a CMBS Transaction

The servicer is an important factor to the overall performance of the CMBS issue. The servicer is responsible for collecting monthly loan payments, preparing reports for the trustees, monitoring the condition of underlying properties, and transferring collected funds to the trustee for payment to CMBS note holders (Dunlevy, 2001).

There are three types of servicers: the sub-servicer, the master servicer, and the special servicer. The roles of different servicers are highlighted in Figure 2.2. The sub-servicer is usually the originator of the loan in a conduit deal who sells the loan to the issuer but retains the servicing of the cash flows. All interest and principal payments, including information on the underlying property will be sent by the sub-servicer to the master servicer. The master servicer oversees the CMBS deal and ensures the servicing agreements are maintained. Furthermore, the master servicer facilitates the timely payment of interest and principal to the trustee. The master servicer is also responsible for providing servicing advances when a loan goes into default. Therefore, it is important that investors accept both the financial strength and overall experience of the master servicer.

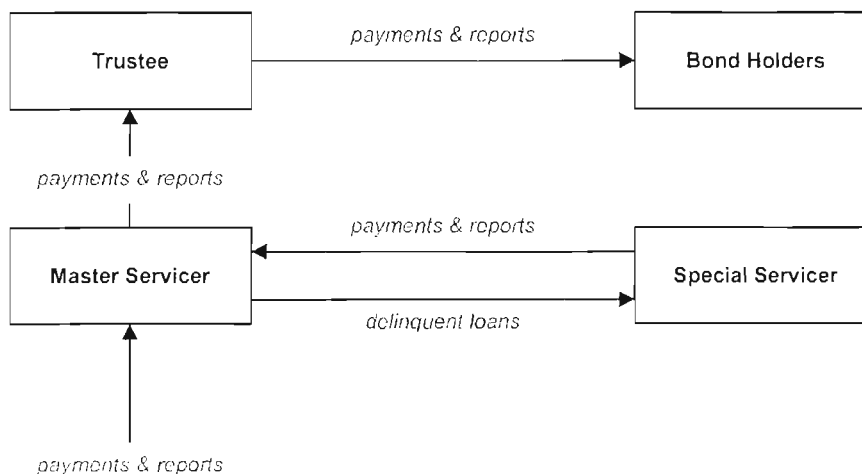


Figure 2.2. Types of Servicers commonly found in a CMBS transaction (Fabozzi, 1999)

Special servicers are important to investors in junior or subordinate CMBS tranches. The timing of default can impact the severity of the loss to the subordinate note holders, which impacts the return and performance. Special servicers usually extend defaulted or delinquent loans, make modifications or restructure the loan, or foreclose on the loan and sell the underlying properties.

2.2.3. Types of CMBS Deals

Dunlevy (1999) identifies five types of CMBS deal structures. These included (1) non-performing trusts, (2) single-borrower/multi-property, (3) multi-borrower/conduit, (4) multi-borrower/non-conduit, and (5) single-borrower/single-property deals. Single-borrower/multi-property deals are also referred to as single-borrower/large loans deals by market participants (Rushton and Els, 2005; Fitch, 2006). In the South African CMBS market, only single-borrower/multi-property and multi-borrower/conduit deals have been listed on the Bond Exchange of South Africa. With the remaining deal types unlikely to be publicly listed in the South African market, investors must be sure that they understand single-borrower/multi-property and conduit deals because the type of transaction can impact the overall performance of each issue.

2.2.3.1. Single-Borrower/Multi-Property deals

The single-borrower/multi-property CMBS deal type contains important structural considerations, including cross-collateralization/cross-default provisions, property release provisions, lock-box mechanisms, and cash trap features.

One of the features that reduce default risk is the structuring of cross-collateralization/cross-default provisions (Mathew and Katz, 1999). Cross-collateralization allows the issuer to use cash flows from performing properties to cover non-performing properties. Likewise, cross-default provisions allow the performing properties to cover defaulted loans. Furthermore, Franzetti (1999) found that properly cross-collateralized and cross-default asset pools are afforded lower subordination levels by rating agencies.

Single-borrower/multi-property transactions are often structured with property release provisions, which allow the lender and/or issuer to remove properties from the loan pool (see Dunlevy 1999). Property release provisions included in the transaction documentation protect investors from the stronger properties being replaced by weaker ones. Examples of these provisions include maintaining interest coverage ratios (ICR) and not permitting the substitution of properties.

The lock-box mechanism gives the trustee of the transaction autonomous control of the gross revenues generated by the underlying properties. According to Sanders (2001), the cash flows from the underlying properties flow through a "waterfall" payment mechanism similar to the cash flow priority schedules found in a senior-subordinate structure. Dunlevy (1999) found that the lock-box mechanism provides a stronger incentive for the issuers and property managers to operate the properties efficiently since they have a subordinate claim in the "waterfall" structure.

Cash-trap provisions are a common feature found in single-borrower/multi-property deals (Dunlevy, 2001). The purpose of the provision is to penalize the borrower (loan level) or issuer (bond level) by amortizing the loan pool before the scheduled balloon date. If a borrower fails to make the balloon principal payment, the accumulated cash flow from the properties backing the loans will be trapped to accelerate principal repayment and to pay interest (Jacob and Tong, 2001). Additionally, the cash trap feature prevents the borrower from receiving any excess cash flow. Common cash-trap triggers include failure to maintain: (1) pre-determined interest coverage ratios, (2) pre-determined property reserves, and/or (3) a pre-determined minimum credit rating. Together with lock-box structure, the cash-trap provision allows the trustee to withhold all the excess cash flows.

2.2.3.2. Multi-borrower/conduit deals

Multi-borrower/conduit deals are special purpose entities that originate mortgage loans for the sole purpose of generating collateral to securitize. A commercial bank was the first entity in South Africa to establish a SPE to originate commercial mortgage loans for issuing classes of CMBS notes. Dunlevy (1999) identifies the following four important factors that investors must consider when analyzing conduit structures: (1) loan origination standards, (2) number of originators, (3) pool diversification, and (4) degree of loan standardization.

Key origination factors include ICR and loan-to-value (LTV) ratios, property reserving, property valuation methods, the loan terms offered to the borrower, geographic location and property type diversification, and year of loan originations. Analyzing the number of originators is another important factor that investors should consider. Issuers will often include additional originators to reduce the loan pool ramp-up period, i.e. the period required to originate the collateral for the CMBS transaction. Dunlevy (1999) attributed this to investors not being comfortable with multiple underwriting standards. In addition, investors should also consider the diversification of the underlying loans. Franzetti (1999) found that rating agencies require lower levels of credit enhancement for conduit deals backed by loan pools that are not concentrated geographically and by property type. The final important factor relates to the homogeneity of the loan pool. Investors generally prefer asset pools that are highly standardized across loan terms.

2.3. RISK OF CMBS TRANSACTIONS

Credit risk is the most important risk priced into yield spreads for both credit (corporate bonds) and CMBS securities. However, CMBS yield spreads are also affected by additional risks. This is confirmed in a study by Harding and Sirmans (1997) that found that approximately half the spread on AAA-rated CMBS securities is attributable to cash flow uncertainty and liquidity risk. Comparing CMBS spreads to other bond market sectors without adjusting for different imbedded borrower options (cash flow uncertainty) results in the inaccurate pricing of these securities.

Liquidity refers to the depth of the secondary market, the costly information search required to make investment decisions, and monitoring once a security has been purchased by an investor.

This section introduces the risks that investors should expect to find in CMBS transactions. These risks include, but are not limited to credit risk, interest rate risk, prepayment risk, extension risk, liquidity risk, and model risk.

2.3.1. Credit Risk

Chance (2005, p. 588) defines credit risk as "*the risk of loss due to nonpayment by a counterparty*". An investor who lends funds by purchasing a CMBS issue is exposed to credit risk. CMBS assets are non-recourse loans secured by income-producing property (Ervolini, Haig, and Megliola, 1999). Depending on the fundamental quality of the underlying properties, these loans generally contain substantial credit risk in the form of prepayment or default risk. Investors focus on interest rates when assessing the performance of bonds, however, commercial mortgage performance is also driven by credit quality of the properties collateralizing the loans.

Fabozzi (2001) identifies default risk, credit risk, and downgrade risk as the three types of credit risk exposures.

2.3.1.1. Default risk

Default risk is defined as the risk that the issuer will fail to meet the terms of an obligation with respect to the timely payment of interest and repayment of the principal outstanding. It is important to remember that if a default occurs, the investor does not lose the entire principal invested in the bond issue. The investor can expect that a percentage of the principal will be recovered. Fabozzi (2001) refers to this as the recovery rate. Given the expected default rate and recovery rate of a bond issue, the expected loss of principal due to default can easily be calculated.

2.3.1.2. Credit spread risk

Fabozzi (2004, p. 273) defines credit spread risk as “the risk that the interest rate spread for a risky bond will increase after the risky bond has been purchased”. Investors will also be concerned that the market value of a bond will decline and/or the price performance of that bond will be worse than that of other similar issues available in the bond market. The price of a bond changes in the opposite direction to the change in the yield, i.e., as the yields increase, the price of a bond declines and vice versa. For fixed-rate and floating rate commercial mortgage-backed securities, the yield is equal to the yield on a government bond or similar “risk-free” benchmark plus a yield spread (Chance et al, 2003; Fabozzi, 2004).

2.3.1.3. Downgrade risk

Downgrade risk occurs when an internationally recognized rating company reduces its outstanding credit rating for an issuer (Fabozzi, 2004). Investors investigate the default risk of a bond issue by considering the credit ratings assigned by rating agencies. There are three major international credit rating agencies that operate in South Africa: Moody Investors Service Inc., Standard & Poor's Corporation, and Fitch. A credit rating is an indicator of the potential default risk associated with a specific bond issue. This rating represents an assessment of the issuer's ability to meet the terms of the obligation (Section 2.5 expands on the rating process further).

A rating agency will almost always continue monitoring the credit quality of the issuer once a credit rating is assigned to a bond issue. The bond issue can have a different rating assigned to it over the life of the security contract. A rating agency can assign better credit rating if there is an improvement in the credit quality of the issuer and this is referred to as an upgrade. Similarly, a rating agency can downgrade a bond issue if there is a deterioration of the credit quality of the issuer. Downgrade risk is closely related to credit spread risk (Fabozzi, 2001).

2.3.2. Interest Rate Risk

Fabozzi (2004) describes interest rate risk as the change in the price of a security that is caused by the volatility on an underlying reference "risk-free" benchmark with which the yield on the security is highly correlated. It is normally considered distinct from spread risk, because the interest rate can change without credit spreads changing. The interest rate risk of a commercial mortgage-backed security corresponds to the interest rate risk of comparable maturity government bonds or other reference securities with the same duration. Duration is a measure of the size and timing of cash flows paid by a bond (Fabozzi, 2001; 2004). According to Chance et al. (2003), the duration of a security will "*quantify the size and timing of cash flows by summarizing them in a form of a single number*". This section addresses the most important types of interest rate risks that investors need to investigate when pricing a CMBS issue, namely, yield curve risk and volatility risk.

2.3.2.1. Yield curve risk

Most discussions of interest rate risk of CMBS securities consider only risk exposure of spreads to changes in the level of interest rates, commonly referred to as a parallel shift in the yield curve. However, it is also important for investors to consider how CMBS spreads respond to changes (shifts) in the shape of the yield curve. A shift represents a nonparallel change in the yield curve shape. Chance et al. (2003, p. 656) defines the spot yield curve as "*the graph of spot rates versus term to maturity*". Adverse risk can be introduced from nonparallel shifts or twists in the yield curve.

For a non-amortizing simple noncallable bond issue, yield curve risk is not important because of the comparatively large bullet cash flow at maturity. An investor can generally focus on a single rate, because of the large bullet payment in the form of the bond's principal repayment at

maturity. Changes in the yield curve (twists) corresponding to a yield at a specified maturity will explain most of the changes (risk) in the price of the security.⁷

2.3.2.2. Volatility risk

Volatility risk is associated with the embedded options in commercial mortgage-backed securities. From option pricing theory, the value of an option increases with expected volatility. When future interest rate option volatility is expected to be high; the value of the interest rate option becomes more valuable to the borrower (Chance et al., 2003; Fabozzi, 2004). Unexpected yield volatility will decrease the value of a commercial mortgage-backed security. Because CMBS spreads should adjust to compensate investors for selling the prepayment and extension option to the borrowers, spreads tend to widen when expected volatility increases and narrow when expected volatility decreases.

2.3.3. Prepayment Risk

The majority of CMBS securities include intrinsic prepayment risk because the underlying mortgage loans backing the deal can generally be prepaid by the borrower before scheduled maturity (Adams and DeMichele, 2000; Fabozzi, 2001). Prepayments affect the weighted average life (WAL) maturity dates of each note and the resulting cash flow uncertainty ultimately impacts performance. Fortunately for investors, the majority of mortgage loans backing CMBS transactions contain prepayment provisions that reduce any incentive that a borrower may have to prepay the outstanding principal balance. The types of prepayment protection found in commercial mortgage loans include lockout, defeasance, yield maintenance, and fixed-point penalties (Dunlevy, 2001).

The cash flow uncertainty from prepayment of residential mortgages has been extensively researched over the past 20 years (Follain et al., 1992; Foster and van Order, 1990; and

⁷ Fabozzi (2004) compares and contrasts an individual mortgage security and Treasury with respect to yield curve risk.

Schwartz and Torous, 1992). However, only recent research (Abraham and Theobald, 1997; Boyer et al., 1997; Capone and Goldberg, 1998; Daingerfield, 1995; Elmer and Haifdorfer, 1997; Follain et al., 1997; Follain et al., 1999; Kelly and Slawson, 2001; and Fu et al., 2003) has focused on the prepayment behavior of commercial mortgage loans. This is attributed to the unavailability of commercial data and limited transferability of research results from the residential mortgage market.

Abraham and Theobald (1997) identify data quality and the borrower's incentive to prepay as key differences that exist between residential and commercial mortgages. In a model combining the effects of a borrower's eligibility to prepay and incentives to prepay, they find that commercial mortgage loans are more sensitive to interest rate movements. Using kernel density regression to model security prices as a function of property indices and interest rates, Maxam and Fisher (1998) investigated the pricing effects of prepayments on CMBS transactions. Together with research published by Follain et al. (1999), they argue that the transformation of default risk to prepayment risk is apparent in both the pricing of commercial mortgage loans and CMBS.

In addition, there is clear evidence that the terms of the prepayment provisions significantly affect the pattern of prepayments on commercial mortgage loans. Kelley and Slawson (2001) find that time-varying penalty structure alters optimal refinancing through the value of delay to the borrower. Fu et al. (2003) examine the extent to which prepayment provisions affects a borrower's decision to exercise prepayment options and confirm previous empirical research. For investors, they underline the importance of focusing on the prepayment penalty structure of the loans when pricing CMBS issues. Therefore, CMBS deals offering loan pools with comparatively weaker penalty structures should price up at levels reflecting the increased prepayment risk.

2.3.4. Extension Risk

Fabozzi (2004) defines extension risk as "the risk that a borrower will not be able to make the balloon payment". Many commercial mortgage loans backing CMBS are structured as amortising

balloon loans that require substantial principal payment at the loan maturity date. The borrower is in default if the final balloon (principal) payment is not received by the lender. If the borrower is in default, the lender may extend the loan into a workout period and modify the provisions and/or terms of the original loan (Fabozzi 2004). A higher interest rate will generally be charged during this period and is commonly referred to as the default interest (lending) rate.

Abraham and Theobald (1995, p. 38) define extension risk as, "*the risk that a borrower will be unable, or unwilling, to refinance a loan when a balloon payment is due.*" Furthermore, Fabozzi (2004) noted that the risk arises because either the inability of a borrower to refinance the loan at the balloon payment date or the sale of the property will not generate sufficient funds to pay the outstanding principal balance. This leads to extension and ultimately default (Tu and Eppli, 2002). In practice, extension risk is also referred to as balloon risk or refinance risk.

The scheduled principal and interest is paid from the cash flow generated from the underlying collateral (loans or properties) and the balloon payment is commonly made by refinancing the loan in the market at current lending rates. Repayment of the outstanding principal amount can cause undue financial stress to the borrower. The risk of the borrower being unable to refinance a loan on the balloon date is referred to as extension risk.

Research on extension risk is limited in the literature on commercial mortgages. Jacob and Fastovsky (1999) review some of the structural features which help reduce extension risk and then investigate how extension risk has been handled in nine CMBS transactions. Harding and Sirmans (1997) investigate the risk and return characteristics of CMBS securities through regression modeling. They find that balloon mortgages pose greater extension risk for senior classes. Using Monte Carlo simulation to assess the sensitivity of extension risk in commercial mortgage loans, Tu and Eppli (2002) find that the borrower's ability to refinance is dependent on changes in four factors between origination and the balloon date. These factors are: (1) mortgage loan interest rate, (2) net operating income (NOI) generated by the property, (3) interest coverage

ratio (ICR), and (4) loan-to-value ratio (LTV). Other potential factors that can be used by investors in predicting extension risk is the underwriting standards at balloon date. It is expected that if standards are more stringent at balloon date as opposed to origination date, then these provisions increase extension risk.

Investors in CMBS securities must consider the impact of balloon risk from a structural standpoint. That is, if all the notes are structured to pay down on a specified date, then the deal will experience an event of default if a delay in the final principal payment occurs (Fabozzi, 2004). Although, the final impact of such delays will be dependent on if the bonds are trading at a premium or discount to par and if the servicer will continue to advance interest and principal payments to each tranche. Jacob and Fastovsky (1999) further highlighted the importance of the interaction between deal structure and the terms of the underlying mortgages. However, innovative structural provisions are used to mitigate the effects of balloon risk for noteholders. These provisions include conservative underwriting, hyper amortisation, step-up coupon rates, and other structural features. A final concern for investors in CMBS transactions is the fact that all loans must be refinanced to pay off the most senior noteholders. Therefore, there is a possibility that extension risk of the senior rated tranches will be equivalent to that of junior noteholders.

2.3.5. Liquidity Risk and the Costly Search for Information

Before purchasing a security, investors will determine if positions in that security can be sold prior to its scheduled maturity date. Specifically, an investor will be concerned whether the price that can be obtained in the secondary market is close to the true value of the security. Liquidity risk in the CMBS market is the risk that the investor will have to sell a security below its true market value (Fabozzi, 2000). The primary measure of liquidity risk is the size of the spread between the bid price (the price at which a bond dealer is willing to buy a security from an investor) and the ask price (the price at which a bond dealer is willing to sell a security to an investor). In general, the wider the bid-ask spread, the greater the liquidity risk.

It is widely accepted that investors follow a buy and hold strategy in the securitized sector of the South African bond market (Rushton and Els, 2005). Domestic CMBS issues will most likely be purchased by institutional investors. Consequently, these securities will presumably be placed in a diversified portfolio and held until maturity. Els and Rushton (2005) find that investors in the South African bond market purchase securitization issues for credit risk rather than for interest rate risk. However, an active secondary (dealer) market is necessary for an investor to take advantage of credit risk. In order for investors to take advantage of a potential credit event through an active relative value trading strategy, it is important that investors and dealers are able to short the relevant asset in the secondary bond market.

The depth of the South African CMBS market will be positively correlated with its size. On the other hand, liquidity will be directly related to the number of dealers and investors active within the sector (Harding and Sirmans, 1997). Recent activity has increased the depth of the market and could account in part for narrowing of spreads. Table 1.1 shows the number of CMBS deals listed on the Bond Exchange of South Africa since the fourth quarter 2004 to first quarter 2007. Currently, five CMBS programmes and seven individual deals have been structured, with notes outstanding in excess of R7.8 billion.

The market has not developed the same reporting infrastructure for monitoring transactions after issuance as that of other sectors, such as corporate bonds. Information on the financial status of corporate bond issuers are regularly published and made available to market participants. However, information related to the performance of the underlying properties and loans backing CMBS issues is not readily available.

CMBS transaction reporting is required to evaluate the past and future performance of each individual note (Pottas et al. 2006). Investors must consider the availability and quality of transaction reporting before investing in CMBS. Likewise, dealers in the secondary market must receive timely and accurate information, as consistent data flows are essential for making a liquid

market in CMBS. The trustee must also publish notice of defaults with respect to failure of the issuer to provide timely reports, statements and other documentation as listed in the programme memorandum and series supplement (Davis, 1999; Franzetti, 1999).

The 2006 Deloitte South African Securitisation Industry Report emphasized that transaction reporting is often inadequate, with no specific standards existing for securitised transactions. In addition, the report found that definitions and calculations used for reported items vary from one issuer and one transaction to the next. Although South Africa CMBS require reports to be regularly distributed to holders of bonds, such reports are not available to the public. Moreover, the analysis of CMBS returns and performance is a complex task requiring deal-by-deal analysis of each issue. This information is especially important when investors and dealers are required to assess and model the sensitivity of CMBS returns to various assumptions about the property market.

According to Pottas et al. (2006), most key players are addressing problems relating to information flow through the introduction of standardized reporting in the South African securitisation market. Harding and Sirmans (1997) agree that these encouraging developments in a securitisation market further reduce the portion of spread attributable to liquidity and costly information search. They include a proxy for liquidity risk in a pricing model, however, they found that the results do not show any impact on initial CMBS pricing. The current research on liquidity risk is scarce and deserves further investigation.

2.3.6. Model Risk

Chance et al. (2005, p. 139) define model risk as "*the risk that a model is incorrect or misapplied*". Model risk is present in any pricing model that attempts to identify the relative value of financial instruments. Within the CMBS market, the pricing of securities is inherently referenced to an underlying valuation model. If the model is incorrectly specified and/or uses incorrect inputs, then the results will be misrepresented and the probability of not realizing expected performance

increases. Moreover, the control over other risks will be impaired (see Chance et al., 2003; Fabozzi, 2001; Pindyck and Rubinfeld, 1998). In addition, Fabozzi (2004) asserts that because current models adjust to historical experience, an investor will not know the magnitude of the model error going forward.

2.4. CMBS PRICING

Early models on CMBS pricing focus on the relationship of structure and credit risk. Credit risk includes the risk of default, downgrades, and widening credit spreads (Fabozzi, 2004). Kau et al. (1987) present one of the first papers on valuing commercial mortgages and commercial mortgage-backed securities. Using standard asset pricing theory, they illustrated that the special contractual features of CMBS securities and the underlying mortgages exhibit complex relationships. In a model that explains a significant proportion of the change in the default premium, Titman and Torous (1989) showed that the spread between commercial mortgage rates and comparable maturity treasury securities will decline as the term to maturity increases. Pinto et al. (2001, p. 655) define a risk premium as: "*the expected return on an investment less the risk-free rate*". In addition, the model indicates that increases in the risk-free interest rate will bring about the compression of commercial mortgage spreads.

According to Harding and Sirmans (1997), models that focus exclusively on credit risk are missing a fundamental dynamic for pricing CMBS securities, specifically, the trade-off between cash flow uncertainty and credit risk. Similar to the methodology used by Jacob and Gichon (1996), they assembled a database of AAA-, AA-, AA-, and B-rated tranches from new CMBS issues at issuance date from early 1994 through to the second quarter of 1996. Harding and Sirmans (1997) showed that a number of variables describing the underlying properties, mortgage loans, security structure, and pricing/issuance of the CMBS transactions are significantly related to the pricing of these securities.

Nothaft and Freund (1999) analyzed the various factors influencing commercial mortgage spreads using data from a variety of sources to estimate a time-series model. They found that commercial mortgage spreads are positively related to the difference between AAA-rated and A-rated corporate bonds, as well as negatively related to property value. In recent academic literature, this difference in yields between high-grade and lower-grade corporate bonds is commonly used as a proxy for the default risk premium.

Riddiough and Polleys (1999) analyzed the determinants of CMBS subordination levels and of CMBS yield spreads. Using a combination of time-series and cross-sectional analysis of 119 AAA-rated CMBS tranches issued during 1994-1996, they find that variables measuring credit risk and the presence of cross-default clauses affect pricing via a default premium.

In a study that develops a framework for risk and relative value analysis of CMBS, Jacob and Gichon (1999) reviewed and compared new CMBS deals for the years 1994, 1995, and the first quarter 1996 starting with the underlying properties, followed by an analysis of the mortgage loans, and transaction structures. They then presented a model which evaluates numerous factors that explain the dispersion of CMBS spreads.

Maris and Segal (2002) examined spreads between the yields on CMBS securities and treasury securities of similar maturity. They explained the movement of CMBS yield spreads each year during 1994-1997 by estimating the relationship between yield spreads and also several economic variables. Their results indicated that floating-rate CMBS yield spreads are positively related to deal size, to spread between AAA-rated corporate bonds and treasury securities, and the business confidence index, and negatively related to credit rating.

Harding, Sirmans and Thebpanya (2004) extended the research on initial pricing of commercial mortgage-backed securities in several ways. Firstly, they extended the data set covering all multi-borrower/conduit issues from 1997-2001. They also introduced further variables on diversification

and prepayment penalties. In addition, CMBS prices are benchmarked against the swap curve as a reference interest rate. Previous studies on CMBS pricing used the U.S. treasury curve. Finally, they estimated a further regression model that captures the fact that pricing and structure are jointly determined. The empirical relationship between subordination levels required by rating agencies and pricing are also explored in their study.

Within the bond market, the concept of relative value refers to the ranking of bonds by sector, structures, issuers, and issues in terms of their expected returns during a specified investment horizon (Fabozzi 2004). For South African CMBS investors, the implementation of relative value trading strategies will usually span longer time frames because of the illiquidity of the secondary bond market.

The theory of relative value analysis refers to the methodologies used to generate the rankings of expected returns of various bond issues. Jacob and Gichon (1999) built a model that can be used to assess the relative value when comparing CMBS securities. By comparing the predicted model spread to the actual spread, they showed that several U.S. CMBS deals offer relative value, i.e. the securities were “cheap”. These pricing inefficiencies can be exploited by active private and institutional investors.

2.5. RATING CMBS IN SOUTH AFRICA

As discussed in Section 2.2, the issuer structures the priority of payments, and sells classes of notes (bonds) backed by the interest and principal from this loan pool to investors. For the most part, these bond issues are public transactions listed on a nationally recognized bond exchange, such as the Bond Exchange of South Africa (BESA). Each note is issued with a credit rating assigned by a rating company, which investors match to their risk profile (Dunlevy, 1999).

Credit ratings are opinions of the credit worthiness of securities being offered to investors and represent both a qualitative and quantitative assessment of credit risk (Franzetti, 1999; Lancaster,

2001; Silver, 2001). Credit risk is the risk that the issuer will fail to satisfy the terms of the obligation with respect to the timely payment of interest and repayment of the amount borrowed (Fabozzi, 2004). Section 2.3.1 provides a detailed discussion of credit risk and its impact on CMBS. Baron (1996) defines a rating as the level of risk associated with receiving the payment of principal and interest that will be made over the life of the security and in keeping with the terms of the debt obligation. Fundamentally, ratings are intended to serve as indicators of the relative risk premium necessary to compensate investors for bearing credit risk in the bond market. For investors, it is a simple, relatively accurate, and globally consistent framework for analyzing credit risk. They accept credit ratings as a good proxy for the due-diligence that would have to be carried out on individual securities.

Aufsatz and Palimeri (2005, p. 3) state that rating agencies aim to provide investors with “a *consistent and transparent system of rankings*” by which relative credit quality of a security can be reflected. Rating agencies assign the same ratings to all bonds exposed to similar loss estimates with the same term to maturity, irrespective of the country and industry sector, or the structure of the security. Therefore, securities with the same rating should contain similar amounts of credit risk.

Credit ratings will provide CMBS investors with a basis for bond pricing and trading. Fitch, Moody's, and Standard and Poor's are the three major international rating companies providing credit ratings for CMBS issues. The role of rating agencies is to assist investors in making investment decisions and protect investors against unknowingly taking credit risk (Baron, 1996). Rating agencies will test and stress the CMBS structures, research all aspects of the transaction, and approve the bundle of rights purchased by investors (Baum, 1996; Cantwell, 1996).

For over a decade, rating agencies have been consistently assigning credit ratings to single-borrower and multi-borrower CMBS transactions in Asia, European, U.S., and other worldwide financial markets. In the context of South African CMBS transactions, it is important that investors

be aware that there are features relating to the domestic market that make credit risk analysis more challenging for rating agencies. Most notably the lack of publicly available historical loan loss data, loans secured by heterogeneous properties, concentrated portfolios, prepayments, different bankruptcy proceedings and a lack of CMBS structuring experience. This section analyses major issues relating to the rating of single-borrower/multi-property and conduit deals.

2.5.1. Performing Due Diligence on CMBS deals

Blum and Mattera (2001) define due diligence as "*the process of detecting and analyzing potential risks inherent in a CMBS transaction*". Moreover, due diligence establishes whether the disclosure of these risks has been adequate. Various parties are involved in the due diligence process and include investment bankers, lawyers, credit enhancers, investors, rating agencies, accountants, and other professional experts.

There are predominantly two forms of due diligence, either descriptive or normative. Descriptive due diligence is the process of determining that the CMBS transaction disclosure is accurate and complete (Blum and Mattera, 2001). It determines whether the information would materially affect the investor's decision to invest in a transaction. Descriptive due diligence is that undertaken by issuers, lawyers, underwriters, and professional experts. Normative due diligence assess the appropriateness of a CMBS issue as an investment. It is performed predominantly by rating agencies and investors. As highlighted in Section 1, only rating agencies assign ratings that adequately describe credit risk, while investors verify that all the transaction's risks are correctly priced and appropriate to their risk/return profile.

2.5.1.1. Overview of due diligence process

Securitizations transactions are structured through a process that responds to the potential risks involved in the transaction. As will be discussed in Chapter 3, structuring is a process performed by arrangers that seeks to maximize the price for issuers and the risk-adjusted return for potential investors. When performing due diligence of a securitization issue, the scope of the transaction,

bankruptcy remoteness, current market dynamics, management experience, asset valuations, servicing arrangements, and data quality are the important topics that should be considered (Blum and Mattera, 2001).

When considering the scope of the transaction, any material risk should be evaluated and quantified. In addition, risks in the current legal, tax, and regulatory environment should also be assessed. At the start, a lawyer usually issues an opinion on the bankruptcy remoteness of the special purpose entity (SPE) and whether the collateral has been separated from the issuer/originator. Special purpose entities are structured to be bankruptcy remote by law.

Blum and Mattera (2001) stress that risk can increase significantly if the originator becomes bankrupt or its credit situation deteriorates. Although the SPE is structured to be legally bankruptcy-remote from the originator, it is common for due diligence to be conducted as if the bond issue was secured debt and not bankruptcy remote.⁸ Due diligence often subjects the originators financial statements to detailed financial analysis. For example, the financial strength of Investec would have been evaluated before the placement of the first series offered by the R10billion Private Commercial Mortgages (Pty) Ltd programme. Furthermore, the market dynamics of the asset pool is assessed. These dynamics include economic and regional trends, as well as cyclical movements in the property market.

Due diligence must also consider management experience with respect to the collateral. Background checks will confirm past performance of the collateral manager. The servicer is an integral part of a transaction when the collateral is not performing. Due diligence will consider the servicing company's workout/collection experience, negotiation skills, and their ability to maximize cash flow recovery during bankruptcy proceedings.

⁸ See Government Notice No. 1375 Government Gazette, No. 22948 of 13 December 2001.

The collateral backing a securitization transaction will be valued by an independent third party prior to date of issuance. The valuation company's experience and reputation within the market should be carefully reviewed. For some transactions, due diligence will verify the market value of a random sample of assets from the collateral pool. Finally, access to accurate historic data is also important in the overall due diligence process.

2.5.1.2. CMBS due diligence process

Jungman (1996) asserts that the degree of due diligence required on CMBS is much greater than for other structured products. This is directly attributed to the nature of the collateral. Specifically, a CMBS issue is collateralized by a pool of commercial mortgage loans, with each loan backed by income producing property. Due diligence is required to assess the ability of the property securing the loan to produce an income stream into the future. The process entails collecting property level information, such as financial statements, and calculating current ICR and LTV ratios (Franzetti, 1999). Due diligence can also extend to the physical inspection of the underlying properties in order to assess the quality of the buildings and ensure, for example, that there are no engineering defects.

Investors require that a rating agency perform due diligence on the CMBS programme before it is brought to market. They are generally paid for their services by the arranger, issuers, and/or originator of the deal (see Baron, 1996; Cantwell, 1996; Fabozzi 1999; Fabozzi, 2001). By reviewing each issue prior to placement, this independent third party provides due diligence as to the nature of the risks (Kendall, 1996).

2.5.2. The Rating Process and Summary of Bond Rating System

Fabozzi (2001; 2004) defines a credit rating as an indicator of the potential default risk associated with a particular bond issue, whether private or public. Credit rating symbols are used as representations for the assessment of an issuer's ability to meet the terms of the debt contract,

i.e., the payment of principal and interest to investors. These ratings are assigned for bonds by rating agencies such as Moody's, S&P, and Fitch.

Table 2.1 provides a summary of these symbols according to their rating categories. Based on this system, a bond rated high-grade (AAA-, AA-, A-, and BBB-rated) means that the issue contains low credit risk because of the probability of receiving future principal and interest receipts are high. Conversely, issues that are exposed to credit risk (BB-rated and below) are assigned a low rating symbol. A rating agency will continue to monitor the credit quality of the issuer once the credit rating is assigned to a bond issue. An improvement is awarded with an improved rating, commonly referred to as an upgrade. Rating agencies will downgrade a particular bond issue when the credit quality of an issuer deteriorates. Fabozzi (2001) notes that investors must be aware how rating agencies assess default risk on each bond sector for the purposes of assigning credit ratings in order to understand the other risk aspects of a transaction.

2.5.3. The Role of a Rating Agency in a CMBS deal

Although rating agencies assign similar rating symbols, their rating methodologies are all unique and investors need to be aware of any differences. Rating agencies begin the rating process when an issuer requests an analysis of the credit quality of the collateral backing a potential CMBS issue. The issuer requires credit ratings to make the notes more marketable to investors (Baron, 1996).

Investors need to understand that credit ratings only make statements on the probability that cash flows will be made according to the terms of the indenture of the bonds. It does not address the timing of the return of principal (Kochen, 1996). Credit ratings do not give an opinion on the protection the structure offers against other major risks, such as interest rate risk, prepayment risk, extension risk, and liquidity risk. Moreover, the accuracy of pricing is not reflected in credit ratings (Baron, 1996; Silver, 2001). CMBS Investors are responsible for assessing and quantifying these risks.

TABLE 2.1
Summary of Bond Rating Categories

Moody's	S&P	Fitch	Summary Description
Aaa	AAA	AAA	Gilt edge, prime, maximum safety
Aa1 Aa2 Aa3	AA+ AA AA-	AA+ AA AA-	High-grade, high-credit quality
A1 A2 A3	A+ A A-	A+ A A-	Upper-medium grade
Baa1 Baa2 Baa3	BBB+ BBB BBB-	BBB+ BBB BBB-	lower-medium grade
Ba1 Ba2 Ba3	BB+ BB BB-	BB+ BB BB-	Low grade, speculative
B1 B2 B3	B	B+ B B-	Highly speculative
Caa	CCC+ CCC	CCC+ CCC	Substantial risk, in poor standing
Ca	CC	CC	May be in default, very speculative
C	C	C	Extremely speculative
	CI		Income bonds - no interest being paid
	D	DDD DDD D	Default

Source: Fabozzi (2001). The term high grade means low credit risk related with a specific bond issue. High-grade bonds are designated by Moody's by the symbol Aaa and S&P and Fitch by symbol AAA. The next highest grade is denoted by the symbol Aa (Moody's) or AA (S&P and Fitch). Upper-medium grade and lower-medium grade is represented by A and BBB respectively. The next two grades are Ba or BB, and B respectively. There are also C and D grades. Moody's uses 1, 2, or 3 to provide a narrower credit quality breakdown within each class, and S&P and Fitch use plus and minus signs for the same purpose.

The LTV and ICR are important underwriting measures to rating agencies (Baron, 1996). In addition, the quality of the originator, loan seasoning, and geographic distribution of the underlying properties are also important factors. The risk models of rating agencies look favorably on a diversified property portfolio (Korell, 1996). The collateral of multi-borrower CMBS transactions normally consists of a large number of mortgages backed by geographically diversified properties. The rating agency will incorporate these risk factors into its modeling process to estimate an expected default and loss rate under normal market conditions. Furthermore, risk management techniques, such as stress testing (worst case analysis) and scenario analysis are also applied to the asset pool.

Credit enhancements are added to the bundle of rights purchased by investors (Kendall, 1996). These enhancements are included when the collateral will not provide adequate protection for investors against default risk in the severe property market downturns. The type and size of the enhancement is determined by the rating agency. They usually require credit enhancement to ensure that the cash flows generated by the collateral are sufficient to meet payments of interest and principal under various economic cycles. Rating agencies commonly follow the weakest link principle, which states that ratings on a particular issue can be no higher than the credit quality of the transaction's weakest link (see Kendall, 1996; Myerberg, 1996). Types of credit enhancement include letters of credit; subordination by senior/subordinate structuring; master leases'; surety bonds; insurance policies; reserve funds and over-collateralization. Subordination is commonly used in CMBS transactions and structured correctly, is often the only form of credit enhancement (Franzetti, 2000; Lancaster, 2001).

The legal structure of the CMBS deal and the protection it offers to noteholders is an important consideration and is a key element in the CMBS rating process (Baron, 1996). Rating agencies will establish whether the SPE adequately protects investors against bankruptcy of the transaction's originator. As stated in Chapter 1, the properties must represent a true sale and be entirely separate from the assets of the originator, in the event of the originator's bankruptcy.

The property types collateralized are typically office buildings, industrial properties (including warehouses), and retail centers (Fabozzi, 2004). Currently, South African CMBS programmes are being structured as single-borrower or multi-borrower deals backed by a cross-collateralized loan pool with several properties pledged as collateral. The rating approach is to analyze the cash flows and valuation reports of the properties, as well as the loan terms and structure of the deal. Franzetti (2001), notes that the rating process comprises four basic steps. Firstly, the term sheet, financial statements and other relevant data are assessed. This is followed by site visits, cash flow analysis, and due diligence from accountants, auditors, and lawyers. The third step comprises a comprehensive review of all deal documents. Finally, the rating agency will assign credit ratings to individual bond classes of the issue.

Corcoran and Phillips (2001) found that floating-rate CMBS transactions exhibit higher default risk than comparable fixed-rate deals. A rising interest rate environment will increase the default risk of the overall loan pool backing a CMBS deal. This risk increases for loans with balloon maturity dates. Rating agencies also find higher default probabilities of floating-rate CMBS deals and therefore underwrite floating-rate deals more punitively.

2.5.4. General Overview of Rating Agency Approaches to CMBS

2.5.4.1. Fitch's rating approach for CMBS deals

Fitch will initially re-underwrite the loan portfolio to reflect current market conditions. Their process also reviews financial (operating) statements of each property. Their research indicates that interest coverage ratios (ICRs) are the best indicators of default risk (Fitch, 1998; 2005). A loan with a high ICR is less likely to default. Stress testing, a common statistical tool used in risk management, is then used to stress the loan pool. Both the individual loans and the asset pool are stressed by calculating new ICRs and refinancing the position throughout the economic cycle. Additionally, loan-to-value (LTV) ratios are calculated by dividing an adjusted net cash flow by stressed capitalization rates. Next, the composition of the collateral is assessed for concentration

risks (Lancaster, 2001). The cash flow generated from the collateral depends on regional economics of the underlying properties. To reduce concentration risk of the collateral, rating agencies assess diversification through property type and geographical concentrations of the properties. Finally, the structure of the transaction is evaluated and credit ratings are assigned.

2.5.4.2. *Moody's rating approach for CMBS deals*

Moody's considers credit enhancement as protection from default risk when assigning ratings (Moody's Approach to Rating European CMBS, 2001). They stress that their rating assessment is fairly qualitative because of limited performance data available in the property market. To achieve a desired credit rating for a transaction, Moody's will review the collateral and determine the required credit enhancement. Property type, geographical location, creditworthiness of the tenant, terms of the lease contract, and physical condition of the building will be reviewed. They review the physical condition of the buildings through a combination of valuation reports, site visits, engineering reports, and other due diligence documentation.

Moody's evaluates key factors of potential default risk. In particular, the ICR and LTV ratios of each loan are reviewed. For example, the LTV ratio of a loan determines the decline property value and cash flow that can be absorbed by the property's equity (over-collateralization). In addition, the strength the geographical location, as well as the potential for regional economic declines are other factors considered in their due diligence. Moody's emphasize that net operating income (NOI) of a property is what drives ICR and LTV ratios. Therefore the NOI of each property backing the loan pool is extensively audited. Finally, scenario analysis on the NOI is performed and credit ratings are assigned (Lancaster, 2001). Scenario analysis is a statistical tool commonly used by risk management professionals

2.5.4.3. Standard and Poor's rating approach for CMBS deals

Standard and Poor's divide their analysis of CMBS deals into two categories; namely, property analysis and loan analysis (Lancaster, 2001). Properties are assessed through valuation and engineering reports. Each property's construction quality, location, tenancy, lease structures, historical performance, and anticipated competition are important considerations in the rating process. This is followed by a detailed review of the loan documentation. In addition, Standard and Poor's also assess the experience of the collateral manager and servicing company. Other important considerations include the bankruptcy remoteness of the SPE, as well as the issuer's capacity to acquire further debt.

2.5.5. Rating Agency Activity in South African CMBS market

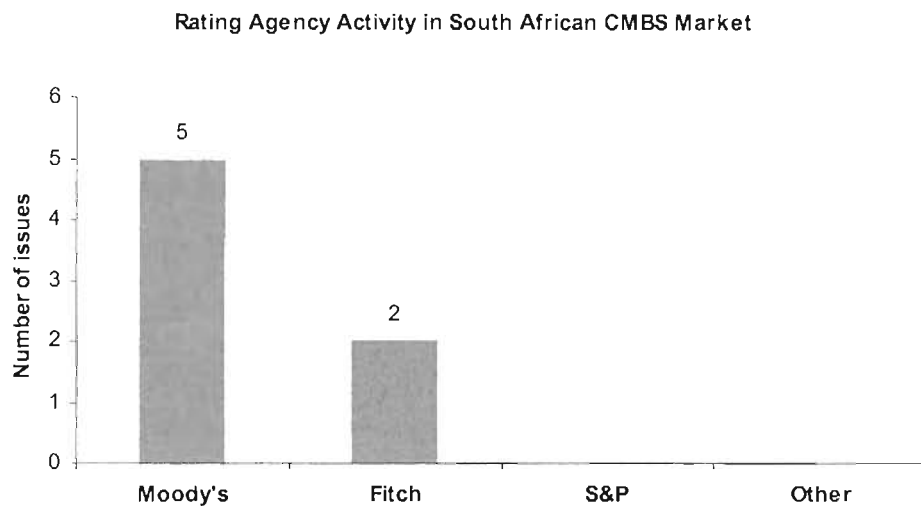


Figure 2.3. Rating activity in South African CMBS market from fourth quarter 2004 to first quarter 2007.

Of the 5 CMBS programmes and 7 issues to date, Moody's have taken a preeminent role, rating five of the issues alone (see Figure 2.3). Moody's has largely adopted the approach used in European CMBS markets, as opposed to the U.S. market. As discussed in the previous section, Moody's focuses on sustainable cash flows generated by the underlying properties, interest

coverage ratios, and loan-to-value ratios. Fitch has assigned credit ratings to 2 issues, while Standard and Poor's has yet to be active in the South African CMBS market.

Figure 2.4 shows the loan-to-value ratios of all the CMBS issues from fourth quarter 2004 to first quarter 2007. In general, loan-to-value ratios have been conservative relative to the more established markets of Europe and U.S. The LTV ratios range from 47.7 to 68.8 percent and an average of approximately 57 percent has been achieved across all issues. Corcoran and Phillips (2001) attribute cautious LTV ratios in Japan's CMBS market to the limited supply of below investment-grade securities (BB-rated and below). Until the depth of the market increases, the issuance of lower-rated notes is likely to remain limited. However, the first South African below investment-grade tranche was issued towards the end of first quarter 2007, marking a turning point for South African CMBS.

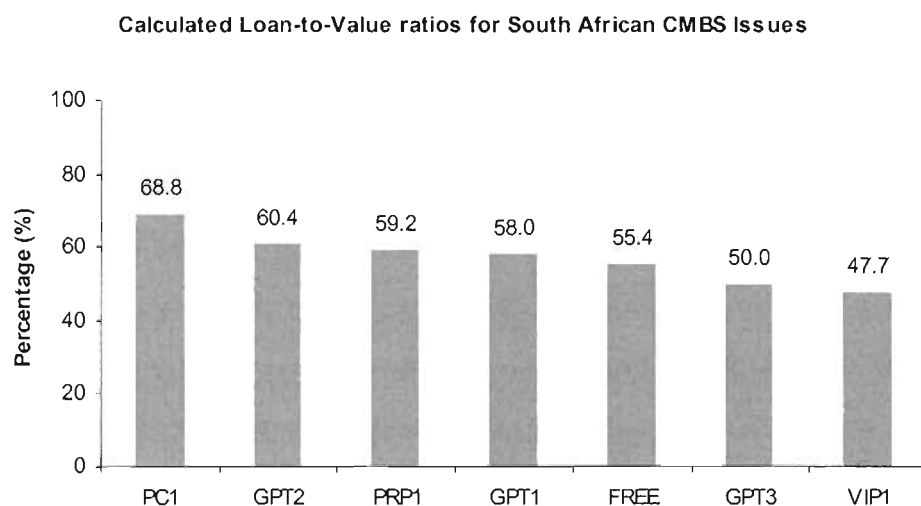


Figure 2.4. Rating agency's calculated LTV ratios for South African CMBS issues from fourth quarter 2004 to first quarter 2007.

2.6. SUMMARY

Commercial mortgage-backed securities are a complex asset class. With multiple layers of detail, it is important that investors fully understand the risks impacting the pricing and subsequent performance of these securities. This chapter initially focused on the structural considerations

impacting CMBS deals. The basic structure of a CMBS issue was introduced and senior/subordinate structuring, subordination, priority of paydowns, prepayment penalties, and balloon maturity provisions, as well as the servicer's role in a transaction were briefly explained. How the performance of individual bond classes can be affected by cash flow uncertainty was also discussed. The section on structuring considerations concluded with a discussion of the different types of CMBS deals. The two types of deals that are currently listed on the Bond Exchange of South Africa were focused on: (1) single-borrower/multi-property deals and (2) multi-borrower/conduit deals.

In the next section, an introduction to the risks commonly priced into CMBS securities was introduced. Risk factors that investors must be aware of when purchasing these bond classes were identified and explained. These risk parameters include credit, interest rate, prepayment, extension, liquidity, and model risk, which can cause substantive pricing differences between CMBS issues and bond classes. Furthermore, the literature review presented research that developed pricing and relative value methodologies.

Finally, the ratings process of CMBS issues by the three major international rating agencies currently involved in assigning credit ratings for these securities were examined. While there are similarities in their methodologies, there are also unique aspects to each approach. The section on credit ratings introduced other third parties involved during the initial structuring and/or post issuance phase of a CMBS transaction. These parties included accountants, auditors, lawyers, and property valuation companies who provide information, due diligence reports, and independent legal opinions.

In order to quantify the risk profile of these securities, it is necessary to implement a pricing model that will analyze all aspects of the transaction. This model needs to consider the type of CMBS deal and the structural characteristics of each transaction. Furthermore, each issue will be analyzed from three perspectives: (1) the property level, (2) the loan level, and (3) the bond level

(Trepp and Savitsky, 2001). The next chapter, Chapter 3, develops a theoretical pricing framework (methodology) and introduces the statistical tools that will be used answer the research questions presented in Chapter 1.

3. RESEARCH METHODOLOGY

3.1. INTRODUCTION

This chapter covers the methodology used to address the research questions presented in Chapter 1. The methodology provides the “*procedural framework*” within which the research on pricing commercial mortgage-backed securities (CMBS) issued in South Africa will be conducted. This framework also describes the various ways data will be collected and treated in order to answer the hypotheses (Hair, Money, Samouel, and Page, 2007).

Following the introduction, this chapter begins by developing the research strategy and research design in Section 2 and 3 respectively. Justification for the methodology in terms of the research problem is also provided. Section 4 and 5 presents the two types of research designs adopted, which include the case study design and the statistical procedure of multiple regression analysis. Section 6 introduces multi-factor regression modeling and provides a framework for relative value analysis of CMBS issues. Data collection methods and the development of a CMBS database are presented in Section 7. The next section describes the variables that will be used to empirically investigate pricing in the South African CMBS market. Finally, this chapter concludes with a brief summary.

3.2. RESEARCH STRATEGY

The research strategy is a high level outline of the research and is used to determine the level of detail needed to investigate the research problem (Hair, Money, Samouel, and Page, 2007). A research strategy is usually classified into two categories: (1) theoretical or (2) empirical research. The first category, theoretical research, is abstract in nature and draws on previous theories to develop a new explanation for problems and/or relationships between variables. For theoretical research to be successful, it requires an intensive review of past and current literature on the

chosen subject. In contrast, empirical research draws on primary quantitative and qualitative evidence to address the research questions. Because bond pricing requires extensive use of statistical procedures, empirical research is the most appropriate research strategy for assessing pricing of CMBS securities. Therefore, primary quantitative and qualitative evidence on South African CMBS issues will be used to test the research questions and address the hypotheses.

Empirical research can be further classified as either positivist or interpretivist (Hair, Money, Samouel, and Page, 2007; Yin, 1994). The Positivistic paradigm is commonly referred to as quantitative research, while interpretivism is referred to as qualitative research. Quantitative research is numerical in nature and relies on mathematical and/or statistical analysis, while qualitative research is categorical and has no real numerical or mathematical meaning (Keller and Warrack, 1999). Furthermore, qualitative research can create estimation and interpretation challenges (Gujarati, 2001). Following previous empirical work on CMBS pricing, postivistic research methodologies are used to achieve the aims and objectives presented in Section 1.2.2 (Harding and Sirmans, 1997; Harding et al., 2004; Jacob and Gichon, 1999; Maris and Segal, 2002). Once the research strategy has been identified, the next step is to select the research design.

3.3. RESEARCH DESIGN

Yin (1994, p. 18) defines a research design as: "*The logic that links the data collected (and the conclusions to be drawn) to the initial questions of a study.*" Smith et al. (2002, p. 43) provides an alternative definition and describes research design as: "*a process that is about organizing research activity, including the data collection, in ways that are most likely to achieve the research aims.*"

The research questions and hypotheses described in Chapter 1 direct attention to the pricing of CMBS securities issued in South Africa. Within the scope of the study the relationship between risk and return must be examined to test these questions. To correctly test each hypothesis, each

CMBS bond class issued on the Bond Exchange of South Africa has to be studied and therefore represents the unit of analysis. However, several different bond classes with different ratings and subordination levels are issued when each deal is brought to market. The majority of the risks found in each deal are embedded in all the bond classes issued through the transaction structure. Previous research on CMBS pricing has used the individual commercial mortgage-backed security note (bond class) as the unit of analysis or case study and not the deal. In these studies, information about each security issued over a sample period were collected and included in a multiple-case study design (Harding and Sirmans, 1997; Harding et al., 2004; Maris and Segal, 2002).

The collected data is used to identify the systematic risks inherent in each CMBS issue, as this allows for the identification of unsystematic risk factors that will not be common across issues. Correlation analysis will show if risk factors have been considered when pricing commercial mortgage-backed securities. Yin (1994) refers to this approach as “pattern matching”.

When the characteristics of each commercial mortgage-backed security note at issuance date are examined, which represents a specific point in time, cross-sectional data is being examined. On the other hand, because the data includes all CMBS securities issued from forth quarter 2004 to first quarter 2007, there is also time-series data. Gujarati (2003, p. 25) defines time-series data as, “*a set of observations on the values that a variable takes at different times*”, such as daily, monthly, quarterly, or annually and cross-sectional data as, “*data on one or more variables collected at the same point in time*”.

Both cross-sectional and time-series patterns will be used to identify preliminary relationships. In statistical multi-factor regression models, statistical methods are applied to the historical pricing and subordination levels of commercial mortgage-backed securities to determine factors that best explain what determined the covariance of spreads and subordination at issuance. A factor is a common risk which is correlated to spreads and the subordination level necessary to achieve

ratings at issuance (pricing) date. For example, interest rate risk is an underlying element with which spreads are expected to be correlated. A search is undertaken for systematic factors, which affect the spreads of a large number of commercial mortgage-backed securities. Pinto et al. (2001) labels these factors as “*priced risk*”, for which investors require additional compensation in the form of wider spreads offered at pricing date.

3.4. THE CASE STUDY APPROACH

A case study methodology is used to investigate a research problem through the analysis of individual cases (Kumar, 2005). Hair, Money, Samouel, and Page (2007, p. 14) defines a case study design as “*an in-depth narrative description of an investigation of a phenomenon or a social unit such as an organization, a location or individual.*” This approach is used because of a need to understand the structural complexities and risk inherent in different CMBS deals that are common across all bond classes issued.

Multiple-case study designs provide evidence that is often more convincing than single-case designs (Yin, 1994). Therefore all CMBS deals listed on the Bond Exchange of South Africa from the forth quarter 2004 to the first quarter 2007 are used. This represents a multiple-case approach and the overall study uses replication logic instead of sampling logic. All deals are used to either predict similar risk factors used in pricing or to produce contrasting risk factors but for predictable reasons. Yin (1994) refers to this as literal replication and theoretical replication respectively. As discussed in the previous section, the unit of analysis is the commercial mortgage-backed security and not the bond issue. However, risks inherent in the structure of a CMBS transaction generally extend to the classes of securities issued at the bond level.

3.5. MULTIPLE REGRESSION MODELLING

3.5.1. Descriptive Statistics

According to Keller and Warrack (1999, p. 18), descriptive statistics involve, "*arranging, summarizing, and presenting a set of data in such a way that meaningful essentials of the data can be extracted and interpreted easily*". Numerical descriptive measures are used to summarize the data, including the sample mean, median, standard deviation, maximum, minimum, and counting the number of observations. For example, the relationship between mean and median (measures of "*central location*") can be used to determine the distribution of the data. As discussed in the following section, an underlying assumption of a regression model is that the distribution is symmetrical (normal) and not positively or negatively skewed. Therefore, this preliminary analysis of the data plays a critical role in determining if any variables need to be dropped from the model.

3.5.2. Simple Linear Regression Analysis and Correlation Analysis

This section considers regression analysis with one independent variable. By quantifying the relationship between an independent and dependent variable, these statistical tools is used to determine empirical hypotheses for further multiple regression modeling.

3.5.2.1. Correlation analysis

To test the hypothesis that the risks of commercial mortgage-backed backed securities are being correctly priced by investors, it is necessary to determine if variables (risk factors) influence spreads at pricing. Similarly, to establish if rating agencies are considering risk factors such as loan quality, diversification, and other factors when assigning credit ratings, variables that influence subordination levels must be identified. Because subordination and pricing are jointly determined, Harding, Sirmans, and Thebpanya (2004) suggest that it is important to finds some variables that influence pricing and not subordination and vice versa.

At first, two-dimensional visual images, such as scatter plots, to identify relationships between variables are used. DeFusco, McLeavey, Pinto, and Runkle (2001, p. 655) describes a scatter plot as, “a display that shows the relationship between two variables, regardless whether the relationship is linear or not”. A scatter plot does not reflect time periods, however, only the actual observations of two data series plotted in pairs at a point in a two dimensional graph. In addition, the method of least squares to plot the “line of best fit” on the scatter plots is used (Pindyck and Rubinfeld, 1998). It is the line which “minimizes the sum of the squared deviations of the points on the graph from the points of the straight line”. The scatter plot will also identify data outliers. Pindyck and Rubinfeld (1998) refer to outliers as data points which are more than an arbitrary distance from the line of best fit or “regression line”. As discussed in Section 3.3, pricing over successive periods of time through a time series of year of issuance is considered. Observations on variables are graphed to identify any consistent pattern in the change in the time series over time (Pinto et al., 2001).

An assumption of the multiple regression models is that there is no multicollinearity among independent variables (Section 3.5.2.3 summarizes regression modeling with more than one independent variable). Multicollinearity occurs when combinations of independent variables are highly correlated with each other and the interpretation of the regression output becomes problematic (see Gujarati, 2003; Pinto et al., 2001). Specifically, the t -statistic of one or more of the coefficients is statistically insignificant and R^2 , the overall measure of goodness of fit, can be very high.

One of the ways to reduce multicollinearity is to include independent variables that appear to be uncorrelated with each other (Keller and Warrack, 2000). This is achieved by determining the coefficients of correlation for each pair of variables discussed in the previous section. This output is called the correlation matrix. Pinto et al. (2001, p. 364) define the coefficient of correlation (also called the *Pearson* coefficient of correlation) as, “a measure of the strength of the linear relationship (correlation) between two variables”. A coefficient of correlation can have a maximum

value of 1 and a minimum value of -1. A coefficient of correlation that is greater than 0 implies a positive linear association between two variables and a coefficient less than 0 implies a negative linear association.⁹

In addition, significance tests also allow the assessment of whether the apparent relationship between variables, fully described in Section 4.8, actually exists. If it is decided that the relationships between dependent and independent variables are real; then the variables to develop the empirical pricing model presented in the next section will be used. Pinto et al. (2001) propose the following two hypotheses: the null hypothesis, H_0 , that the correlation in the population is 0 ($\rho = 0$) and the alternative hypothesis, H_1 , that the correlation in the population is different from 0 ($\rho \neq 0$).¹⁰

Although not employed in this study because of limited cross-sectional issuance data, nonparametric techniques, such as a Spearman rank correlation matrix can also be used to measure and test if a relationship exists between the variables. This method is used when variables are either ranked (qualitative data) or if the normality requirement is not satisfied. However, descriptive statistics for the variables are used to investigate the normality requirements of the pricing data. It is important to be aware that the correlation matrix has an inherent limitation in that it does not always identify multicollinearity as there are many ways for variables to be intercorrelated (Pinto et al., 2001).

⁹ The coefficient of correlation is the covariance divided by standard deviations of X and Y. The population coefficient of correlation is labelled ρ and is calculated as follows:

$$\rho_{XY} = \text{cov}(X, Y) / (\sigma_X)(\sigma_Y)$$

where σ_X and σ_Y are the standard deviations of X and Y, respectively

¹⁰ The test statistic is defined as follows:

$$t = \rho [(n - 2) / (1 - \rho^2)]^{0.5}$$

which is Student t distributed with $n - 2$ degrees of freedom, provided that the variables are normally distributed.

3.5.2.2. *Linear regression with one independent variable*

Regression analysis is a statistical process used to summarize and explain the nature of the relationship between one variable in terms of one or more other variables. Simple linear regression is used to analyze the linear relationship between a dependent variable and only one independent variable (Pinto et al., 2001). It is used to explain the variation in a dependent variable that is associated with the variation in an independent variable. The following linear regression model is used to describe the relationship between two variables:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \varepsilon_i$$

where Y is the dependent variable, X the explanatory variable, β_0 the intercept term, β_1 the slope coefficient, ε the error term, and i the i th observation. If the data are time series, the subscript t will denote the t th observation.

Pinto et al. (2001, pp. 379-383) defines the dependent variable as, "*the variable whose variation is explained by the independent variable*" and the independent variable as, "*the variable whose variation is used to explain the variation of the dependent variable*". The above regression process estimates an equation for a line through the scatter plot of the data (outlined in the previous section) that best explains the observed values for Y in terms of the observed values for X . Pindyck and Rubinfeld (1998) state that the regression line (the slope coefficient) describes the relationship describes the change in Y for a given change in X . Depending on the relationship between the regression variables, it can be positive, negative, or zero. To interpret the slope coefficient, it indicates the change in the dependent variable for a one unit change in the independent variable. The intercept term is the regression line's intersection with the Y -axis at $X = 0$. The regression line can have a positive, negative, or zero intercept term with the Y -axis.

The validity of a linear regression model relies on a number of assumptions. Pinto et al. (2001) notes that most of these assumptions relate to the model's error term, ε . The error term is commonly called the residual, random error, or stochastic error term. The residual is the deviation

of the dependent variable observation from its fitted value as indicated by the regression line (Pindyck and Rubinfeld, 1998). The assumptions for a model with a single independent variable are listed below. The following section extends these to multiple regression models (Gujarati, 2003; Pinto et al., 2001; Pindyck and Rubinfeld, 1998):

- A linear relationship exists between the dependent and independent variables.
- The independent variable is uncorrelated with the error terms.
- The expected value of the error term is zero ($E(\epsilon_i) = 0$).
- The variance of the error term (ϵ_i) is constant/homoskedastic (A violation of this is referred to as heteroskedastic).
- The error term is independently distributed; that is, the error term for one observation is not correlated with that of another observation. (A violation of this is referred to as autocorrelation)

The coefficient of determination (R^2) is an important measurement in regression modeling and is defined as the percentage of the total variation in the dependent variable that is explained by the independent variable (Pinto et al, 2001). The next section considers the inherent limitations of correlation and simple linear regression analysis.

3.5.2.3. *Limitations of correlation analysis and linear regression*

Gujarati (2003) asserts that correlation between two variables does not always imply causation. This limitation of correlation analysis is referred to as spurious correlation. Spurious correlation occurs when there is a statistically significant relation for two variables that are theoretically unrelated. To avoid spurious correlation, variables presented in previous empirical research investigating CMBS pricing are included (Harding et al., 2004; Jacob and Gichon, 2001; Maris and Segal, 2002; Maxam and Fisher, 2001; Sirmans, 1997).

Similar to correlation analysis, the relationship between variables in a regression model can change over time. This means that the estimated regression equation based on data from a specific time period may not be relevant for forecasts or prediction in another period. Pinto et al. (2001) refer to this as “*non-stationarity*”. For example, an estimated regression equation for CMBS spreads at issuance date may be unstable across time. Finally, if the regression assumptions listed in Section 4.5.1.2 are violated, then the hypothesis tests and predictions of the equation will not be valid. Examples of violations include data that has a non-constant variance of the error terms (heteroschedastic) or error terms are not independent (exhibits autocorrelation).

In the next section, linear regression modeling with more than one independent variable is introduced. Multiple regression modeling is the statistical tool that will be used to test the hypotheses presented in Chapter 1. The estimated regression equation will also be used to determine if investors are performing “asset differential” relative pricing of commercial mortgage backed securities.

3.5.3. Multiple Regression Analysis

A more sophisticated method than correlation analysis and linear regression with a single independent variable is needed to assess the complex relationships involved when pricing CMBS and assigning required subordination levels (Harding and Sirmans, 1997; Jacob and Gichon, 1999; Maris and Segal, 2002; Maxam and Fisher, 2001; Harding et al., 2004). This study sets out to determine if risks are incorporated in CMBS pricing at date of issuance. Furthermore, we want to investigate whether rating agencies are correctly assessing credit risk when determining required subordination levels and whether investors are performing “asset differential” relative pricing in the South African CMBS market. These questions may be tested by using linear regression with more than one independent variable, specifically, multiple regression analysis.

This section introduces and illustrates the basic concepts and models of multiple regression analysis. As with simple regression analysis, the validity or usefulness of multiple regression

models also rest on assumptions. The corrective steps to take for violations of these assumptions are outlined. A summary of panel data models and dealing with missing observations are presented.

3.5.3.1. *Basics of multiple linear regression models*

Multiple regression analysis is regression modeling with more than one independent variable and is used to quantify the influence of two or more independent variables on a dependent variable. Gujarati (2003, p. 203) states that multiple linear regression models are linear in parameters (coefficients), but they may or may not be linear in the variables. The multiple linear regression model is written in the following form:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + \varepsilon_i$$

where Y is the dependent variable, β_0 the intercept term, β_1 the slope coefficient for each independent variables, X the explanatory variable, ε the error term, k the k th observations, and i the i th observation. Gujarati (2003) refers to ε as the stochastic disturbance term. If the data are time series, the subscript t will denote the t th observation.

Multiple regression analysis estimates the intercept and slope coefficients such that the sum of the squared error term is minimized (Pinto et al., 2001). As with simple linear regression, multiple regression analysis involves testing whether each independent variable contributes to explaining the variation in the dependent variable. Again, the t -test can be used to test the hypotheses. The R^2 , adjusted- R^2 and F -statistic are used to test whether some or all of the independent variables contribute to explaining the variation in the dependent variable. An F -statistic and test assesses how well a set of independent variables, together, explains the variation in the dependent variable (Pindyck and Rubinfeld, 1998). The hypothesis that all the regression coefficients are simultaneously equal to zero is commonly used to test the statistical significance of the F -test. In addition to the F -test, the adjusted coefficient of determination will be used to test the overall significance of the model. The adjusted measure is preferred because "*the coefficient of*

determination almost always increases as independent variables are added to the model" (Pinto et al. 2001, p. 439).

As with simple linear regression, the majority of multiple regression assumptions relate to the error term, ε . The assumptions for a multiple regression model are listed below (see *Pinto et al., 2001; Keller and Warrack, 1999*):

- A linear relationship exists between the dependent and independent variables.
- The independent variables are not random.
- The expected value of the error term is zero [$E(\varepsilon_i) = 0$]
- The variance of the error terms is constant (i.e., the errors are homoskedastic)
- The error term from one observation is not correlated with that of another observation (i.e., the errors are not serially correlated).
- The error term is normally distributed.

Multiple regression models will be used to test if risk factors are incorporated in initial pricing spreads and subordination levels. Testing the research questions and addressing the hypotheses relating to pricing will focus primarily on the economic meaning of the slope coefficients, β_k . The slope coefficients will indicate the change in pricing and subordination levels for a one-unit change in the independent risk variables. In addition, the regression model will be used to assess the relative value of securities trading in the primary and secondary CMBS markets (refer also to Section 4.6.3).

3.5.3.2. Limitations of multiple regression analysis

Multiple regression analysis relies on the assumptions listed above. Pinto et al. (2001) asserts that when these assumptions are violated, the inferences drawn from the model are uncertain. There are three primary violations: (1) conditional heteroskedascity, (2) autocorrelation, and (3) multicollinearity.

3.5.3.2.1. *Conditional heteroskedascity*

Conditional heteroskedascity arises from a non constant variance of the error terms, ϵ_i (Gujarati, 2003; Pindyck and Rubinfeld, 1998). This indicates that the residuals are dependent on one or more independent variables. Pinto et al. (2001) suggest that heteroskedascity can be detected using the White test and corrected by using generalized least squares regression models. To conduct the White test, the squared error terms on the independent variables are regressed. The number of observations (N) multiplied by the R^2 is distributed as a chi-square test statistic. The number of independent variables represent the degrees of freedom under the null hypothesis (White, 1980; Pindyck and Rubinfeld, 1998)

3.5.3.2.2. *Autocorrelation*

Autocorrelation results from a time series regression when the error terms are correlated from one period to another. It is detected by using the Durban-Watson test statistic, which is easily approximated as follows: $DW = 2 \times (1 - \rho)$. The correlation coefficient is between the residuals from one period with those from the previous period. Dummy variables that capture the time series (i.e. yearly or quarterly dummy) component can be used to correct for autocorrelation.

3.5.3.2.3. *Multicollinearity*

Multicollinearity will occur when a linear relationship exists among the independent variables of a regression model. It is identified in a model when there is a significant F -statistic and a high R^2 , but insignificant t -statistics on the coefficients, β_k . The correlation matrix (discussed in Section 4.5.3.2) can be used to identify correlated independent variables. In addition, stepwise regression can be used to correct for multicollinearity. Keller and Warrack (1999, p. 758) define stepwise regression as "*a procedure that eliminates correlated independent variables*". It is an "*iterative procedure*" where the decision to add or delete a variable is made on the basis of whether the variable improves the model. Although implementing the stepwise regression model is straightforward, assigning an economic interpretation to them is subjective and difficult.

3.5.3.3. Limited and Missing Observations

Before conducting the empirical analysis, it is important to draw attention to the fact that the number of cross-sectional tranche level observations available in the South African CMBS market is small relative to the number of independent variables in the regression equations. This is attributed to the first CMBS deal having only been completed in November 2004. Consequently, measurement errors will occur by having a large number of independent variables and a small number of cross-sectional observations. Notwithstanding this, the methodology has been used in studies elsewhere and it has been adopted for this research (Harding and Sirmans, 1999; Jacob and Gichon, 1999; Maris and Segal, 2002; and Harding et al, 2004). The reliability of the multiple regression models will also be reduced because of the limited number of CMBS transactions issued on the Bond Exchange of South Africa. Although it is still possible to conduct exploratory analysis using multiple regression analysis with a small data set, the research risks having significant coefficients for the independent variables that are not correct (Gujarati, 2003). The reliability of stepwise regression is also reduced by having a large number of independent variables. In general, correlation analysis and simple linear regression between a single independent and dependent variable can be used to empirically and reliably explore CMBS pricing. However, violations of the normality assumptions (skewness) of the dependent variable will require a greater number of observations especially if there are measurement errors in the independent variables. Descriptive statistical analysis is used to explore positively and negatively skewed variables present in the data set. Although the validity of the generalisations will be affected by the number of variables in relation to the number of observations in the data set, it is likely that the analysis will identify a reduced number of key variables that might be used in a subsequent analysis which would then have greater validity.

In addition, empirical work is complicated when observations for independent variables are missing. This is common in the CMBS market, because key deal information is often kept within the private domain of arrangers/issuers and only made available to investors in each deal. The straightforward solution for missing observations is to drop the relevant CMBS transactions from

the model. However, when modeling with limited data, the effect of dropping the transactions from the model is a significant loss in model efficiency. The model has seven additional observations available for the dependent variable but there are 7 missing observations for several independent variables.

The potential loss of efficiency necessitates an alternative to dropping CMBS issues from the study. Pindyck and Rubinfeld (1998) discuss relevant issues and solutions for the problem of missing observations. They suggest replacing the missing observations by the sample mean of the available observations of the independent variables. This strategy is commonly referred to as the zero-order (substitution) approach. This approach is equivalent to regressing the dependent variable on a constant and assigning the estimated slope coefficient of the related independent variable to each missing observation. However, the zero-order approach might yield different slope estimators for a model containing several independent variables and improve efficiency (Gujarati, 2003). Which of these statistical techniques is most appropriate will depend on the ability of the model to explain the missing observations which occurred in the first place.

3.5.3.4. *Estimating models with panel data*

Gujarati (2003) discusses the types of data that are available for empirical analysis, namely time-series, cross-section, and panel. In time-series data, values of one or more variables are observed over a period of time. With cross-sectional data, values of one or more variables are collected for several individual units at the same point in time. In panel data, the same cross-sectional unit is assessed over time. Panel data consists of both a space as well as time dimension.

Based on the available data set, the estimated regression equation will use a combination of cross-section and time-series data, i.e., the movement over time of cross-section units. Regression models based on such data are referred to as panel data regression models and the regression equation will be estimated using a “*panel data*” set. Panel data is also known as

pooled data, combination of time series and cross-section data, micropanel data, longitudinal data, event history analysis, and cohort analysis. (Gujarati, 2003; Pindyck and Rubinfeld, 1998). As a result, several alternative multiple regression models for pooling data need to be considered and the correct estimation techniques determined for the model. A panel data set will include all floating-rate commercial mortgage-backed securities listed on the Bond Exchange of South Africa (BESA) up to the first quarter 2007. Pindyck and Rubinfeld (1998) note that a panel data set can be useful if the model cannot be defined with the use of either cross-section or time-series data alone.

3.5.3.4.1. *Estimating the pooled (least-squares pooling) data regression model*

The first method for our panel data will simply pool all the time-series and cross-section data and then estimate the underlying model by utilizing ordinary least squares. Consider the following model:

$$Y_i = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \dots + \beta_k X_{kit} + \epsilon_{it}$$

for $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$

where N is the number of cross-section units (CMBS issues) and T is the year of issue.

3.5.3.4.2. *Estimating the fixed effects (Least-Squares Dummy Variable) regression model*

Pindyck and Rubinfeld (1998) document the difficulty with least-squares pooling regression technique and found the assumption of constant intercept and slope to be unreasonable. They suggest introducing dummy variables that allow the intercept term to vary over time and/or cross-section units. We write the model as follows:

$$Y_i = \beta_{0it} + \beta_1 X_{1it} + \beta_2 X_{2it} + \lambda_j D_{YEARit} + \lambda_i D_{CMBSit} \dots + \beta_k X_{kit} + \epsilon_{it}$$

for $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$

The difference between the pooled least-squared equation is the subscript i and t on the intercept term to suggest that the intercepts on each CMBS issue may be different, the difference may be attributed to special risk factors and year of issue (Greene, 1990; Gujarati, 2003; Pindyck and Rubinfeld; 1998).

3.6. Multi-Factor Risk Models

Multi-factor risk models can be used to quantify risk exposure of commercial mortgage-backed securities (Fabozzi, 2004). This section describes how the a multi-factor risk model can be used by investors to quantify the risk exposure in terms of the risk factors described in the literature review.

Pinto et al. (2001) categorizes the following three factor models according to the type of factor used: (1) macroeconomic factor models; (2) fundamental factor models; (3) statistical factor models. A statistical factor model will be used to determine which risk factors best explain the spreads and subordination levels of a cross section of CMBS securities. Although statistical procedures, such as stepwise regression, can easily be used to identify factors, assigning an interpretation to them can be difficult and subjective (Keller and Warrack, 1999).

The multi-factor risk model seeks to identify the specific risks of commercial mortgage-backed securities that contribute to nominal spreads and subordination levels to AAA-rated tranches. All risks are measured in terms of spreads and the analysis of these risks is split into two categories: (1) systematic risk and (2) non-systematic risk.

3.6.1. Systematic risk

A risk factor is a common element with which securities from several CMBS issues are correlated. Systematic factors are searched for, which affect the average spread and subordination for a large number of CMBS securities. Systematic risk is normally composed of several risks, which were extensively reviewed in Chapter 2. Term structure (interest rate) risk

measures a securities exposure to both a parallel and nonparallel shift in the yield curve. Other important risk factors include option, liquidity, loan quality, credit risk, etc. These factors represent priced risk, for which investors will require additional spread as compensation and rating agencies require greater levels of subordination. In estimating parameters for statistical factor models, spreads and subordination (the dependent variables) are regressed against a number of independent variables. Thus, the identification of systematic risk factors will allow investors to respond to these sensitivities with appropriate relative value investment strategies.

3.6.2. *Non-systematic risk*

In multi-factor regression models, non-systematic risk is composed of those risks that are issue specific. This risk will remain in CMBS spreads after removing systematic risk and is commonly referred to as residual risk. Fabozzi (2004) and Pinto et al. (2001) note that that non-systematic risk is greater than the exposure of a broad cross section of CMBS spreads. It represents the error term which is expected to have a zero mean. Specifically, it represents the part of CMBS security's spread that is not explained by the risk factors or independent variables.

3.6.3. *Relative value analysis using multi-factor regression models*

Besides being a useful explanatory multi-factor risk model, the regression equation can be used to assess relative value when comparing CMBS securities and issues. By inserting the values of the independent variables for each deal into the model, Gichon and Jacob (1999) found that investors can compute the expected spread. If a comparison is made between the expected spread and the actual spread at issuance date, it can be determine whether or not CMBS spreads are mispriced.

In relative value analysis, securities are compared along common characteristics and value measures (see Fabozzi, 2004). In comparing commercial mortgage-backed securities, risk measures are inserted into regression models for ranking. It can be investigated how spreads for CMBS securities are affected by risk factors in an attempt to identify individual securities that are

undervalued (cheap) or overvalued (rich) at date of issuance and rank CMBS issues by expected performance.

3.7. COLLECTING THE DATA

3.7.1. Selecting a Method of Data Collection

Kumar (2005) identifies two main approaches to collecting data to investigate a research problem. Information may already be available from a specific source and may only need to be extracted. However, it is often the case that the information is not readily available and needs to be collected. Data can be categorized as either primary or secondary. Examples of primary data sources include direct observation, interviews, and questionnaires. Secondary sources can be grouped into a number of categories and some common examples include government or semi-government publications, earlier research, personal records, and mass media.

3.7.2. Using Multiple Sources of Data Collection

Patton (1987) identifies four types of triangulation methods that can be used when collecting evidence, namely, (1) data triangulation; (2) investigator triangulation; (3) theory triangulation; and (4) methodological triangulation. The data and information relating to CMBS pricing is gathered by triangulating archival records, documents, and direct observations. Yin (1994) notes that the quality and validity of research can be improved through triangulation. Furthermore, Bateman et al. (1983) analyze case study methods and found that multiple sources of information are more valued than information from single sources. For this research, several sources of information are relied on in order to provide multiple measures that corroborate the accuracy of CMBS pricing in South Africa.

3.7.3. Creating a Database of CMBS deals

Yin (2004) claims that a formal database will consolidate data, which can improve the quality of case study research. Mathew and Katz (1999) assert that a CMBS database will be a common

depository for collecting data and information from various sources. A spreadsheet database will be used to consolidate a large volume of property, loan, and structural data in a consistent format that can be used to perform quantitative statistical analyses (see Appendix 1). A variety of reports and graphical outputs can also be exported from this database.

3.7.4. Sources of Data on South African CMBS

3.7.4.1. *Selecting a method of data collection on CMBS*

Katz and Mathew (1999) state that data relating to new CMBS issues will need to be collected from a variety of secondary sources. Data on South African CMBS transactions is available to investors and other market participants. It is possible to extract the data from archival records and documents, which play an explicit role in the study. It is important that these two secondary sources are not contradictory (Yin, 2004).

Collecting from archival records is necessary to construct a CMBS pricing database. Third party data providers will also be used and these include BFA McGregors, Bloomberg, Commercial Mortgage Alert, Datastream, Reuters, Rode's Report, Statistics South Africa, and the Bond Exchange of South Africa. These secondary sources will provide mainly quantitative data that will be used to develop regression models.

Relevant documents consist of programme memorandums, series supplements, pre-sale rating reports, and newspaper articles, as well as conference and research reports. The issuer of a CMBS deal is the initial link in the transaction. Issuers provide a programme memorandum and subsequent series supplements for each new issue. These are formal legal documents describing details of each issue and are important in analyzing these securities (Fabozzi, 2001; 2004). They include detailed information on the underlying collateral, loan contracts, and transaction structure. The presale report will also provide important information on CMBS deals. Fitch (2004) defines a pre-sale report as a document detailing the expected rating rationale of an upcoming structured finance issue. The pre-sale report is published before required subordination and rating

assignments are finalized. It provides investors with important details relating to the final deal structure, including potential default risk of the collateral.

A database is used to capture all data related to pricing and rating of South African CMBS deals. The database is compiled using multiple secondary data sources that contain all the relevant information for empirical analysis.

3.7.4.2. Problems with collecting data on CMBS

As highlighted in the previous section, multiple secondary sources is used to retrieve data relating to CMBS deals. However, data collection from secondary sources can suffer from limited availability, formatting issues, and quality concerns (Yin, 1994). Kumar (2005) stresses the need to also understand and correct for any inherent weaknesses in the data.

According to Yin (1994), it is important to review the purpose and target audience of secondary data. The purpose of programme memorandums and series supplements is to facilitate communication between the CMBS issuer and investors. All CMBS issues reviewed are publicly registered term securitizations listed on the Bond Exchange of South Africa. Each issuer is required to meet specific minimum disclosure guidelines before listing a transaction on the exchange. Moreover, Alexander (1998) noted that each issue will have extensive due diligence performed by independent professional service organizations before listing. Professional service organizations include accountants, auditors, lawyers, property valuers, and rating agencies. For example, accounting firms reverse-engineer the deal structure and verify the computational data included in these offering documents. After performing modeling, a “comfort” letter will be made available to investors and other market participants. Therefore, data collected from these secondary sources will require minimal evaluation for accuracy.

As discussed in chapter 2, a rating agency will assign credit ratings to each new issue (Blum and Mattera, 1998). Pre-sale rating reports review the deal from an investment standpoint and assess

default risk. These reports only analyze the transaction based on the information provided to the rating agency from the issuer. Risk exists that the reliability and validity of the report may be different from the final offering documents because particular details are only finalized closer to the pricing and/or closing date of the CMBS issue. Baranick and Quraishi (1999) found that updated property operating statements, rent rolls, and new lease agreements will become available subsequent to the publication of the pre-sale report. The ratings assigned to a proposed transaction in the pre-sale report are prospective, not definitive ratings (see Moody's, 2006). However, the report provides an excellent summary of the basic structure and investment considerations. For the purpose of data completeness, pre-sale reports for CMBS issues are used where offering documents are not distributed publicly.

Data collection from offering documents does not facilitate the process of loading the collateral static data into the deal model. In addition, there have been no standardized proprietary file formats or layouts for deal related information (Trepp and Savitsky, 1999). The **“South African Securitisation Industry: Top 10 Issues for 2006”** report maintains that securitization transaction reporting in South Africa is deficient. The report finds that the scope of reporting fails to provide data at a level of detail that is required by investors. Furthermore, report formatting varies from transaction to transaction because the market has yet to develop a universal transaction reporting standard. Finally, the process of reformatting data into a consistent format increases the difficulty of data collection. Moreover, transferring data from secondary sources can lead to data integrity errors (Keller and Warrick, 2000).

3.8. VARIABLE DESCRIPTION

Following the approach adopted by Gichon and Jacob (1999), only floating-rate tranches assigned ratings are included in the top four rating categories (see Table 1.2). Non-investment grade (BB-rated and below) notes are excluded. These tranches require additional property, loan level, and structural analysis. Currently, this is limited to structured finance investment professionals (Mathew and Katz, 2000). Only recently has a below investment-grade note been

issued in the South African CMBS market. The Private Commercial Mortgages (Pty) Ltd programme, arranged by Investec, was the first issue to include a speculative note in the transaction structure. The Class E notes, rated Ba3.za by Moody's, were issued at an initial spread of 250bp with a weighted average life (WAL) of approximately 4 years.

3.8.1. Dependent Variables

The spread at time of issuance (**SPRD**) is measured in basis points. This yield offered on a note is made up of two components: (1) the yield on the 3-month Johannesburg Interbank Acceptance Rate (3m-Jibar) and (2) a risk premium above the yield on 3m-Jibar necessary to compensate investors for the risk associated with taking a position in the note (Fabozzi, 2004). For this reason, the tranche and not the deal is the unit of observation for the dependent variable because **SPRD** at time of issuance will differ across tranches.

In South Africa, CMBS market participants focus on absolute spread ($r_i - r_{\text{JIBAR}}$) rather than relative spread, where r_i is the yield on tranche i and r_{JIBAR} is the yield on the 3m Jibar. This is because the majority of CMBS are floating-rate tranches. The relationship in the regression equation is estimated using the absolute spread as the dependant variable (Rothberg et al. 1989; Harding and Sirmans, 1997; Maris and Segal, 2002; Harding et al., 2004).

Maris and Segal (2002) assert that subordination (**SUB**) and pricing are jointly determined. For an issuer to achieve desired rating levels, the rating agency will review the transaction and provide a schedule of required subordination levels. For example, a 20% AAA-rated subordination level means that for R1 billion pool, an issuer could sell R800 million AAA-rated securities and a total of R200 million of subordinated securities. The dependent **SUB** variable is measured as subordination available to only AAA-rated bond classes, while the independent **SUB** variable is measured by the subordination level available to each bond class in a CMBS deal. Attention is then given to the variables that are thought to be related to spreads and/or subordination at date of issuance (pricing).

3.8.2. Independent Variables

3.8.2.1. Variables describing the quality of loans.

The loan-to-value ratio (**LTV**) is the ratio between the loan amount and the property market value. It is one of the primary measures of loan pool quality and is an important underwriting variable (Harding et al., 2004). It is used to measure the likelihood of default as well as the potential lost severity after foreclosure and liquidation. **LTV** is expected to be positively related to **SPRD** and **SUB**.

3.8.2.2. Variables used to proxy market indicators

Variables to measure current market conditions at pricing are included. Interest rates and the volatility of interest rates affect the borrower's options. To measure investor's expectations regarding the future level of interest rates, the slope of the yield curve as an independent variable is also included. Finally, a property index is used to measure the economic condition of the property market. None of the market indicators are included in the subordination model.

3.8.2.2.1. 10-year government bond

The 10-year Government Bond yield (**YIELD**) is used to measure the level of interest rates. The 10-year rate on the Bond Exchange of South Africa at pricing date is used. An inverse relationship is expected between **YIELD** and **SPRD**.

3.8.2.2.2. Interest rate volatility

Interest rate volatility (**STDEV**) is used to control for interest rate risk. **STDEV** is measured as the weekly standard deviation of 3m-Jibar over the year preceding date of issuance. This interest rate proxy is expected to be positively correlated with **SPRD**.

3.8.2.2.3. *Yield curve slope*

The slope of the yield curve (**CURVE**) is calculated as the spread between 10-year rate and the 1-year rate on the Bond Exchange of South Africa Yield Curve. We expect **CURVE** to be positively correlated with **SPRD**.

3.8.2.2.4. *Experimental property index*

As a proxy for the current cyclical stage of the property market, we use the *FTSE JSE Actuaries Property Loan Stock Index* (**INDEX**). If the property cycle is moving out of a trough, investors will expect strong property fundamentals in future periods. However, investors will be inclined to predict weakening property fundamentals in a market that has experienced significant growth and is approaching a peak in the property cycle. Therefore, **INDEX** is expected to be either positively or negatively correlated with **SPRD**. These relationships are tested empirically.

3.8.2.3. *Variables describing the deal structure*

For each deal, tranche size and deal size are included in the regression models. Harding et al. (2004) noted that tranche and aggregate size of a CMBS issue can have conflicting effects. Specifically, increased issue size generally translates into improved liquidity and depth in the secondary market. However, supply and demand considerations indirectly impact liquidity, where the issuer has to reduce the price (increase pricing spreads) to sell all the securities to investors (Rushton and Els, 2005). Maturity, weighted average life, and deal type measures are also included as independent variables and are included in the spread and subordination regression models.

3.8.2.3.1. *Number of years to maturity*

Maturity (**MAT**) is included as a control variable to account for the maturity differences of the CMBS securities. **MAT** is the difference between the legal maturity date and issue date of the CMBS tranche and is measured in years. **MAT** is expected to be positively correlated to **SPRD**.

3.8.2.3.2. *Weighted average life*

For every bond class, the **WAL** is calculated as the difference between the WAL maturity date and issue date, assuming no prepayments, measured in years. The **WAL** estimate is reported by rating agencies on the pricing date of a CMBS issue. The **WAL** years estimate is expected to be positively correlated to **SPRD**.

3.8.2.3.3. *Tranche splitting.*

A dummy variable (**DUMMY_{SPLIT}**) is used to explain the range of yield spreads within the same credit rating category of a CMBS deal, i.e, the priority of each tranche within the same credit rating category. The base case is a single tranche that is not split into sub-tranches with the same credit rating, but has different timing for return of principal. A positive relationship between **SPRD** and **DUMMY_{SPLIT}** is expected.

3.8.2.3.4. *Deal and tranche size*

The size of the CMBS transaction (**DSIZE**) is included to control for size effects and liquidity risk. A study presented by Maris and Segal (2002) found that tranche size had a greater effect on yield spreads than the total deal size had. For this reason, the size of the tranche (**TSIZE**) is also included to measure which of these competing effects are empirically greater related to yield spreads. A higher order size terms is included to allow for the effect of size on yield spreads to vary with the size of individual issues. **SPRD** is expected to have a negative relationship with both **DSIZE** and **TSIZE**. However, **DSIZE²** and **TSIZE²**, the square of **DSIZE** and **TSIZE** respectively, are expected to be positively correlated to **SPRD**.

3.8.2.3.5. *Type of deal*

A dummy variable (**DUMMY_{CONDUIT}**) is included to measure the impact of deal type on **SPRD** and **SUB**. The two deal types included in the model are single-borrower/multi-property (large loan) and multi-borrower/conduit CMBS. As discussed in Section 2.2.3 of the literature review, multi-borrower/multi-property and multi-borrower/conduit deals each contain unique structural features.

The base case is a single-borrower/multi-property CMBS deal. $DUMMY_{CONDUIT}$ is expected to be positively correlated to **SPRD** and **SUB**.

3.8.2.4. Variables measuring diversification and property mix concentrations

Variables related to diversification in both the spread and subordination models are used. Indicators of geographic and property type concentrations will also be included in each model.

3.8.2.4.1. Property types

The property types found in each CMBS transaction are aggregated by industrial (**IND**), office (**OFFICE**), retail (**RETAIL**) and other income-producing properties (**OTHER**). Each property type is measured as a percentage of total property value backing the loan pool. The property type is included to control for the portfolio diversification effect (concentration risk) and to measure which of these variables are empirically related to **SPRD** and **SUB**.

3.8.2.4.2. Geographical distribution.

Geographical distribution is used as a proxy diversification for each CMBS transaction. Each province concentration threshold is measured as a percentage of total property value backing the loan pool. The Eastern Cape (**ECAPE**), Free State (**FREE**), Gauteng (**GAUTENG**), Kwa-zulu Natal (**KZN**), Western Cape (**WCAPE**) and other province (**PROV**) are the provisional regions used in the regression model. Provincial distribution is also included to control for the portfolio diversification (concentration risk) and to measure which of these variables is empirically related to **SPRD** and **SUB**.

3.8.2.4.3. Number of properties

The number of properties (**COUNT**) backing the mortgage loan pool is also used as a proxy for diversification and concentration. A negative relationship for the **COUNT** variable with **SPRD** and **SUB** is expected.

3.8.2.5. Other control variables

3.8.2.5.1. *Year of Issue*

With spreads having compressed over the 2005-2007 period, dummy variables (**DUMMY₂₀₀₅**; **DUMMY₂₀₀₆**; **DUMMY₂₀₀₇**) are included for each year other than 2004. They also control for the time series effect in the panel data regression models. The base case in the regression model is a CMBS issued in 2004 and the dummy variables (**DUMMY₂₀₀₅**; **DUMMY₂₀₀₆**; **DUMMY₂₀₀₇**) corresponding to issue year are expected to be positively correlated with **SPRD**.

3.8.2.5.2. *Ratings Category*

A credit rating is an indicator of the potential default risk associated with a particular bond issue. It represents the rating agency's assessment (summary opinion) of an issuer's ability to meet the payment of principal and interest in accordance with the terms of the transaction documentation. Dummy variables (**DUMMY_{AA}**, **DUMMY_A**, and **DUMMY_B**) are included (other than AAA) for credit ratings because lower rated bonds require higher yield spreads to compensate investors for the greater potential risk of default. Table 3.1 provides a summary of the ratings assigned by Moody's, S&P and Fitch and the meaning of each credit rating included.

TABLE 3.1

Summary of Investment-grade Bond Rating System and Symbols

Moody's	S&P	Fitch	Summary Description	Dummy Variable
Aaa.za	AAA.zaf	AAA.zaf	Prime (maximum safety)	n/a
Aa1.za Aa2.za Aa3.za	AA+ AA AA-	AA+ AA AA-	High-grade (high-credit quality)	D_{AA}
A1.za A2.za A3.za	A+ A zaf A- zaf	A+ A zaf A- zaf	Upper-medium grade	D_A
Baa1.za Baa2.za Baa3.za	BBB+ zaf BBB zaf BBB- zaf	BBB+ zaf BBB zaf BBB- zaf	low er-medium grade	D_{BBB}

Source: Fabozzi (2001). The term high grade means low credit risk related with a specific bond issue. High-grade bonds are designated by Moody's by the symbol Aaa.za, and S&P and Fitch by symbol AAA.zaf. The next highest grade is denoted by the symbol Aa.za (Moody's) or AA.zaf (S&P and Fitch). Upper-medium grade and low er-medium grade is represented by A.zaf/zaf and BBB.zaf/zaf respectively.

Bonds rated AAA.za or Aaa.za are said to be prime grade; AA.za or Aa.za are of high quality grade (D_{AA}); A.za issues are called upper medium grade (D_A), and BBB.za are medium grade (D_{BBB}). External Credit Ratings at the time of issue are measured using the SA national scale and include the abbreviation "za" after the issue rating, i.e., AAA.za; AA.za; A.za; BBB.za. Bond issues that are assigned a rating in these categories are referred to as investment-grade bonds (see Table 3.2). Lower-rated bonds are referred to as non-investment-grade bonds and are not included in the regression model. The base case is therefore an AAA-rated CMBS and a positive relationship between **SPRD** and bond credit rating (D_{AA} , D_A , and D_B) is expected.

TABLE 3.2

Bond Market Sectors

Bond Market Sector	Credit Rating
Investment grade bonds	AAA, AA, A, and BBB
Non-investment grade bonds (speculative/high yield)	Below BBB

3.9. SUMMARY

In this chapter, the research methodology is developed, which will enable the testing of the research questions and hypotheses. Specifically, the research strategy and design that potential investors should use to investigate CMBS pricing and rating relationships is introduced. The case study design and regression analysis are discussed, including how these can be used to deal pricing, subordination and relative value assessment in the CMBS market. The next section presented a summary of data collection methods and discussed how to construct a database of CMBS issues. The chapter concluded with the provision of definitions for the dependent and independent variables of the regression models. Chapter 4 presents the patterns of results for the spread and subordination regression models. These results are analyzed with reference to the research questions and hypotheses set out in Chapter 1.

4. ANALYSIS OF DATA

4.1. OVERVIEW OF STRUCTURE OF THE CHAPTER

By the end of the first quarter 2007, five commercial mortgage-backed securitization (CMBS) programmes with a total value of notes exceeding R7.8 billion have been issued on the Bond Exchange of South Africa. These five programmes consist of a seven deals (Series') and 38 individual tranches (bond classes). Table 4.1 shows the total number of tranches issued each year, the mean annual yield spread to 3m-Jibar and the mean annual tranche size for all investment-grade floating-rate CMBS securities issued in South Africa.

TABLE 4.1.
SOUTH AFRICAN FLOATING-RATE CMBS YIELD SPREADS TO 3M-JIBAR AND TRANCHE SIZE BY YEAR AND CREDIT RATING

Year	Rating	Number of Tranches Issued	Mean Annual Yield Spread	Mean Annual Spread for All Ratings	Mean Annual Tranche Size (R'millions)	Mean Annual Tranche Size for All Ratings (R'millions)
2004	AAA	2	39.0		284	
	AA	2	58.5		47	
	A	2	113.5		47	
	BBB	2	181.0	98.0	22	100
2005	AAA	3	39.3		324	
	AA	3	55.3		78	
	A	3	96.3		105	
	BBB	1	105.0	74.0	55	140
2006	AAA	4	38.0		600	
	AA	4	45.8		97	
	A	4	76.3		291	
	BBB	1	105.0	66.3	83	268

Source: Bond Exchange of South Africa

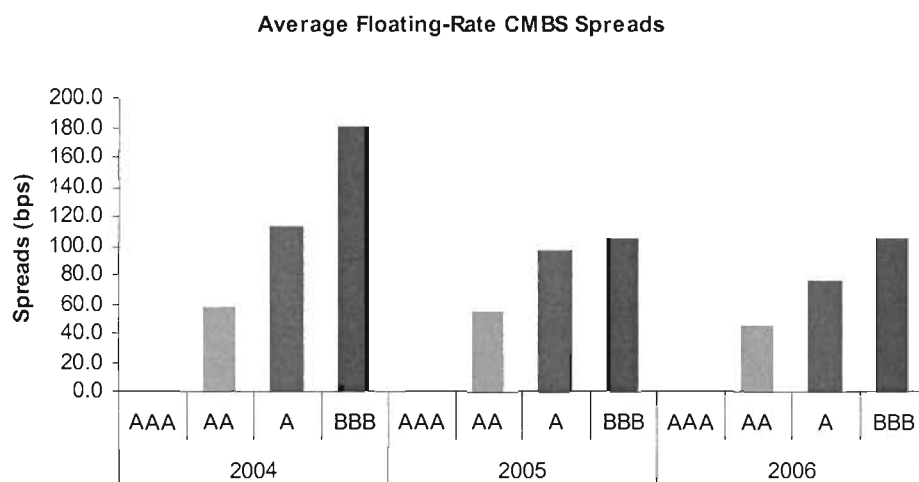
Since the first single-borrower/multi-borrower (large loans) issue was brought to market in November 2004, issuance spreads across all rating categories have narrowed. Relative to other categories, the average prime and high grade spreads have been resistant to compression, only decreasing 1bps and 12.7bps over the 2004-2006 period. Investors participating in the South African 2005 *Securitization and Debt Capital Markets Conference* suggested that spreads for

highly-rated credit issues had “bottomed-out” and would start consolidating at these tight levels. However, some investors believed that spreads of notes within the upper-medium grade and lower-investment grade ratings categories would continue to narrow. This is clearly visible within the A- and BBB-rating categories, where average spreads at pricing have lowered significantly over the 2004-2006 period. Specifically, the average spreads on A-rated bond classes have lowered 37.2 basis points (bps) and BBB-rated notes have lowered 76bps. Average spreads across all ratings categories have lowered from 98bps in 2004 to 66.3bps in 2006.

In a market for a particular fixed-income security, liquidity and market depth will improve as the number of issues, bond classes and size of deals increases (Madhavan, Treynor and Wagner, 2006). The average tranche size of new issues across all rating categories of floating-rate CMBS issues has increased from R100 million to R268 million over the 2004-2006 period. For prime grade AAA-rated notes, the average tranche size has increased from R284 million to R600 million over the 2004-2006 period. Similarly, the average tranche size for BBB-rated classes has increased from R22 million to R83 million. This could be attributed to the recent strong demand for spread products by institutional investors and is reflected in the year on year growth in both the size of CMBS programmes, issues’ and tranches. The depth of the primary market has improved significantly and will continue to improve liquidity in the secondary market.

CMBS yield spreads in the U.S. market declined significantly as the volume of transactions increased. Maris and Segal (2002) attributed this decline to a negative time coefficient related to the initial “rational” learning process involving issuers, rating agencies, and investors. This argument is also considered in a study presented by Riddiough and Polleys (1999). They concluded that the development of the U.S. CMBS market is possibly linked to a rational process as apposed to “herding” psychology and pricing bubbles. Similar to the U.S. experience, CMBS spreads to the 3m-Jibar on floating-rate transactions in South Africa have also declined across all rating categories over 2004-2006 period (see Figure 4.1. for a graphical depiction in average

spreads). The trend has continued through the first quarter of 2007 with the first CMBS issue of the year achieving a weighted average funding spread of 47 bps.



Source: Bond Exchange of South Africa

Figure 4.1. Average floating-rate CMBS spreads over the 2004-2005. Spreads are measured in basis points (bps) above 3m-Jibar.

Although average spreads across all rating categories continued to decline through the first quarter 2007; average prime-grade AAA-rated spreads increased to their highest levels (not shown in Figure 4.1 and Table 4.1.). This is possibly attributed to either the market having bottomed-out or these securities being part of the first multi-borrower/conduit CMBS deal to be issued in South Africa (Job, 2007). Assigned the PC1 BESA code, this issue represents the first series under a R10 billion programme, with the value of notes issued of R1.469 billion and includes the first fixed-rate CMBS tranche. The PC1A3 note was priced with a coupon per annum of 8.835%.

Based on simple bond valuation techniques and multi-factor modeling, initial yield spreads at issuance are expected to adjust to a variety risk factors. Although not all measurable, systematic and unsystematic risk factors include interest rate risk, credit risk, call and prepayment risk, yield curve risk, reinvestment risk, liquidity risk, volatility risk, extension (balloon) risk and other factors

(Fabozzi, 2001; 2004). The relationship between floating-rate CMBS spreads and risk factors is empirically estimated using multiple regression analysis. The data is fitted to equations and test the statistical significance of the slope coefficients and regression models are tested. The extent to which recent compression in South Africa CMBS issuance spreads can be attributed to and explained by changes in the observable variables is determined and presented in Section 3.8. The statistically significant regression coefficients will indicate that investors are analyzing elements of risk inherent in CMBS issues and are correctly assessing the pricing of these securities. However, if the variations in the ratings category and subordination independent variables are explaining all the variation in spread, then it may be concluded that investors are only purchasing commercial mortgage-backed securities for credit risk.

According to Rushton and Els (2005), investors rely on the comfort of rating agencies for more complex structured products. Rating agencies look at measures of loan quality and diversification of the asset pool to determine subordination. An issuer must meet the rating agency's subordination schedule to achieve desired rating categories and spreads for their transaction at pricing. Figure 4.2 shows subordination required for AAA-rated bonds of South African CMBS deals at issuance. What is notable is how subordination levels vary widely across deals. For example, the single-borrower/multi-property GPT3 deal required 49% subordination, while the conduit PC1 deal required only 20% subordination.

As discussed in Chapter 2, ratings are established by international ratings companies, such as Fitch and Moodys. These rating agencies have had extensive experience rating CMBS in Europe, Asia, U.S. and other countries. With the first securities only issued in 2004, the South African CMBS market is still in the early stages of its product lifecycle. As with any new structured product, market participants have to overcome an initial "learning" hurdle. Rating agencies would have recruited international staff to assess domestic CMBS transactions. This initial inexperience, together with the idiosyncrasies of the South African property and bond markets, could cause institutional investors to question the accuracy of the rating categories assigned to new issues.

Market participants that attended the *2005 Securitization and Debt Capital Markets Conference* cautioned against the level of detail and analysis found in reports produced by rating agencies.

Again, multiple regression analysis is used to investigate whether rating agencies are correctly modeling default risk when assigning subordination levels and rating categories to CMBS issues. The extent to which subordination can be explained by changes in loan quality, pool diversification, and structure is determined. Again, statistically significant regression coefficients will indicate that rating agencies are incorporating these factors into their ratings process.

Subordination Levels for AAA-Rated CMBS

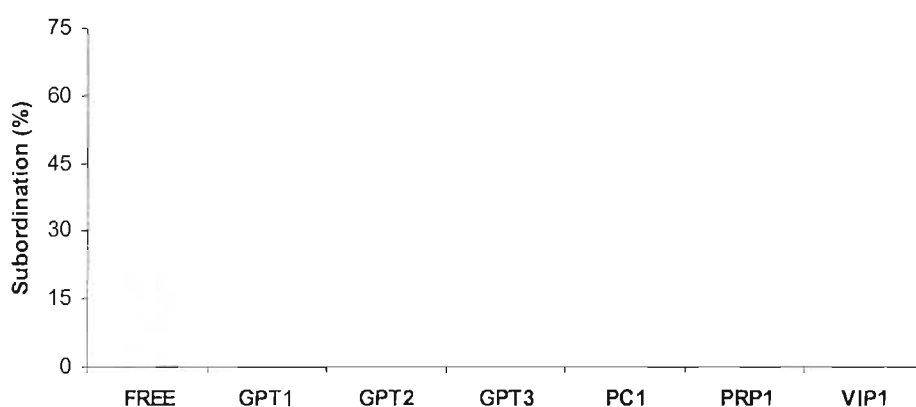


Figure 4.2. Subordination levels required for AAA-rated tranches of South African CMBS issues. A rating agency determines the subordination required to achieve various rating assignments.

Notes: Spreads are measured in basis points and maturity is year estimate difference between legal maturity date and issue date. CMBS Deal abbreviations:

- FREE = Freestone Finance Company (Pty) Ltd
- GPT1 = Growthpoint Note Issuer Company (Pty) Ltd Series 1
- GPT2 = Growthpoint Note Issuer Company (Pty) Ltd Series 2
- GPT3 = Growthpoint Note Issuer Company (Pty) Ltd Series 3
- PRP1 = Prime Realty Obligors Packaged Securities Series 1
- PC1 = Private Commercial Mortgages (Pty) Ltd – Series 1
- VIP1 = Vukile Investment Property Securitisation (Pty) Ltd

In the bond market, an issuer will endeavor to achieve the best “execution” or price from the sale of securities into the market. Within the CMBS market, senior/subordinating tranching gives the issuer the option to sell smaller amount of AAA-rated notes at narrower spreads or a larger amount at wider levels. Thus, depending on supply and demand dynamics in the bond market, an

issuer can use explicit credit enhancement and/or alter the subordination levels within the deal structure to achieve the required spreads. From this relationship, it is evident that subordination and pricing are jointly determined. Figure 4.3 shows how subordination levels translate into spreads at pricing. The graphical plot is indicative of the negative relationship that exists between subordination and spreads.

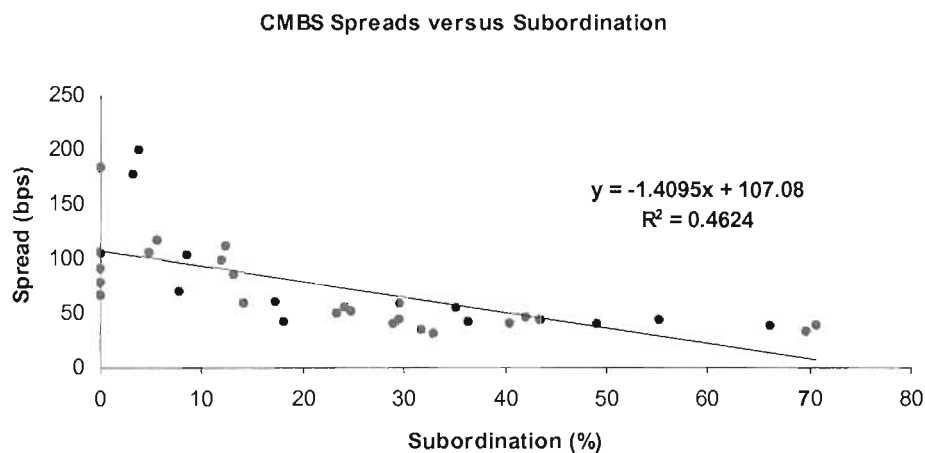


Figure 4.3. South African floating-rate CMBS spreads at date of issuance versus subordination levels from fourth quarter 2004 to first quarter 2007. CMBS spreads are measured in basis points (bps). Subordination level is the percentage of deal that is junior to each note.

Table 4.2 shows the spreads where South African CMBS deals were originally priced on the Bond Exchange of South Africa (BESA) at issuance date. As highlighted in chapter 1, it is remarkable how close these spreads are to each other. After reviewing the risk of investing in commercial mortgage backed securities in Chapter 2, it is evident that these deals should not be priced the same. The rating agencies do a significant amount of work when analyzing collateral, loan quality, and the deal structure before determining necessary subordination levels and assigning credit ratings to a CMBS deal. These ratings reflect the risk of default and loss, i.e. credit risk. It is important to establish if the ratings agencies' assessment of subordination levels and subsequent assignment of ratings are accurately reflecting the risks inherent in each deal. Between and within rating categories, although narrow, there still remains a dispersion of

spreads. Therefore, it appears that the ratings alone do not explain the spreads as priced at issuance.

The opportunities for investors lie in differentiating between CMBS deals and tranches. Jacob and Gichon (1999) explored the concept of relative value analysis in the CMBS market by considering the performance of individual tranches relative to loan quality, structure, and other variables. Following their methodology, the equations from the regression spread models to assess the relative value of notes issued in the CMBS market are used. The results of this investigation will determine if investors are performing “asset differential” relative pricing between the different South African CMBS issues and bond classes.

TABLE 4.2
COMPARATIVE SPREADS OF FLOATING-RATE SOUTH AFRICAN CMBS TRANSACTIONS AT DATE OF ISSUANCE

Deal	AAA	AA	A	BBB	BB
FREE	+31/7.0 yr.	+50/7.0 yr.	+67/7.0 yr.		
GPT1	+34/6.7 yr.	+51/6.7 yr.	+85/6.7 yr.	+105/6.7 yr.	
	+35/7.1 yr.	+42/7.1 yr.	+71/7.1 yr.	+105/7.1 yr.	
GPT2	+40/7.0 yr.	+45/7.0 yr.	+77/7.0 yr.		
GPT3	+40/5.0 yr.	+46/5.0 yr.	+90/5.0 yr.		
PC1	+44/17.1 yr.	+60/17.1 yr.	+104/17.1 yr.	+200/17.1 yr.	+250/17.1 yr.
	+43/17.1 yr.				
PRP1	+38/4.9 yr.	+55/4.9 yr.	+111/4.9 yr.	+178/4.9 yr.	
	+40/6.9 yr.	+62/6.9 yr.	+116/6.9 yr.	+184/6.9 yr.	
VIP1	+39/7.0 yr.	+55/7.0 yr.	+99/7.0yr.		
	+45/9.0 yr.	+60/9.0 yr.	+105/9.0 yr.		

The remainder of this chapter is structured as follows. Following on from the introduction above, Section 2 develops the empirical hypotheses through exploratory analysis. Section 3 summarizes the data set through descriptive statistics and the Pearson correlation matrix. After considering the results of this initial analysis, Section 4 presents the results of the spread and subordination regression models. Relative value analysis within the South African CMBS market is performed in Section 5. Finally, Chapter 4 is concluded with a brief summary.

4.2. DEVELOPMENT OF HYPOTHESIZED SIGNS FOR ESTIMATED COEFFICIENTS

In this section signs for the estimated regression coefficients that are used in CMBS pricing models are theorized. The risk factors relate to the underlying property (the property level), the mortgage loans (the loan level) and the structure of the deal (the bond level) including the individual bond classes (Jacob et al., 1999; Trepp and Savitsky, 1999). Investors must investigate all three levels simultaneously to fully understand the transaction, properly model risk over a variety of property market cycles, and estimate the expected performance of each bond class.

4.2.1. Variables Describing the Quality of Loans.

The primary measure of loan pool quality used by rating agencies is underwritten loan-to-value (LTV) and interest coverage (ICR) ratios. Only LTV ratios are calculated for this empirical study because of limited availability of property operating statements needed to calculate ICR. Of the single-borrower/multi-property (large loan) deal types; the VIP1 deal has the lowest LTV ratio and GPT2 deal has the highest ratio at 47.7% and 60.4% respectively (see Figure 4.4). The Investec PC1 issue, a multi-borrower/conduit deal, has the highest LTV ratio.

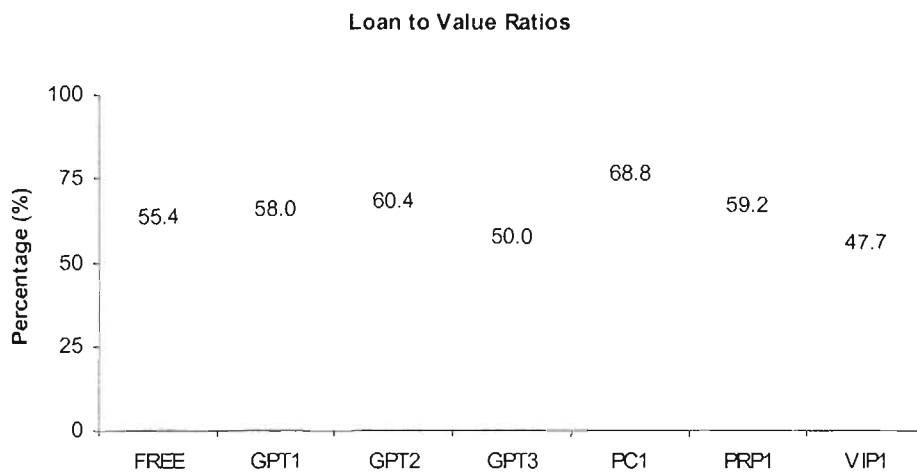


Figure 4.4. Average loan to value ratios of floating-rate South African CMBS deals issued between the fourth quarter 2004 and first quarter 2007.

Figure 4.5 plots the LTV ratios against subordination levels for each CMBS deal. Subordination appears to be inversely related to LTV ratios. This contrasts with the subordination model presented by Harding et al. (2004). They predicted subordination to be positively related to the LTV ratio and their regression model found a significant positive relationship between the estimated LTV slope coefficient and their dependent variable. Maxam and Fisher (2001), using kernel density estimation, also investigated this relationship and found LTV ratios to be positively correlated with CMBS prices. A narrowing (widening) yield spread is linked to an increasing (decreasing) bond price.

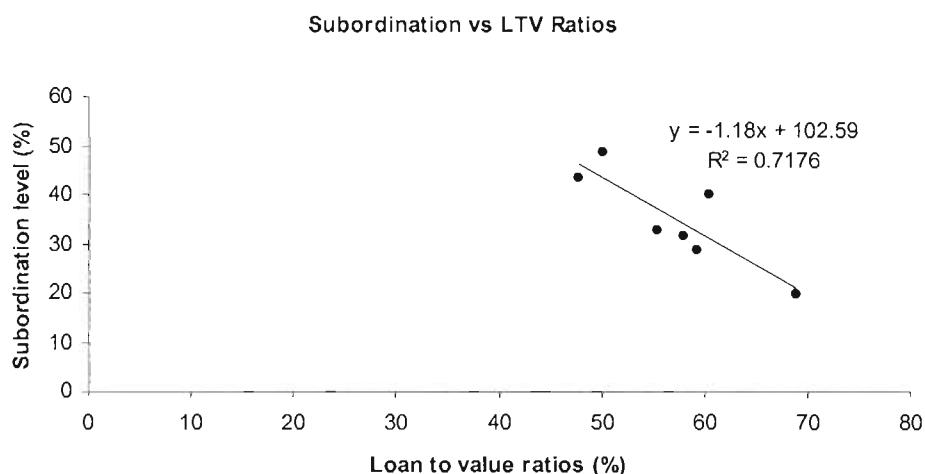


Figure 4.5. Subordination versus loan to value ratios of South African CMBS deals listed on the Bond Exchange of South Africa from the fourth quarter 2004 to first quarter 2007. Subordination level is measured as the percentage of the total securities subordinated to AAA-rated bond classes to the total size of the deal. The loan-to-value ratio is measured as the percentage of loans to total market value of the properties at date of issuance.

4.2.2. Variables Used to Proxy Market Indicators

It is widely documented that the level and volatility of interest rates will affect the option of the borrower to prepay or extend the underlying loans. Maris and Segal (2002, p. 505) stated that “higher interest rate volatility results in greater cash flow uncertainty” and a higher option value to the borrower. Chance et al. (2003) noted that volatility is an extremely important variable in the valuation of an option. Investors will require additional spread at issuance if there is an unstable

interest rate outlook. Harding et al. (2004) included the 10-year U.S. Treasury rate on the pricing date and the weekly volatility of the 10-year rate over the preceding year in their model. They showed that the level of interest rates are negatively related to CMBS spreads and volatility has an opposing effect.

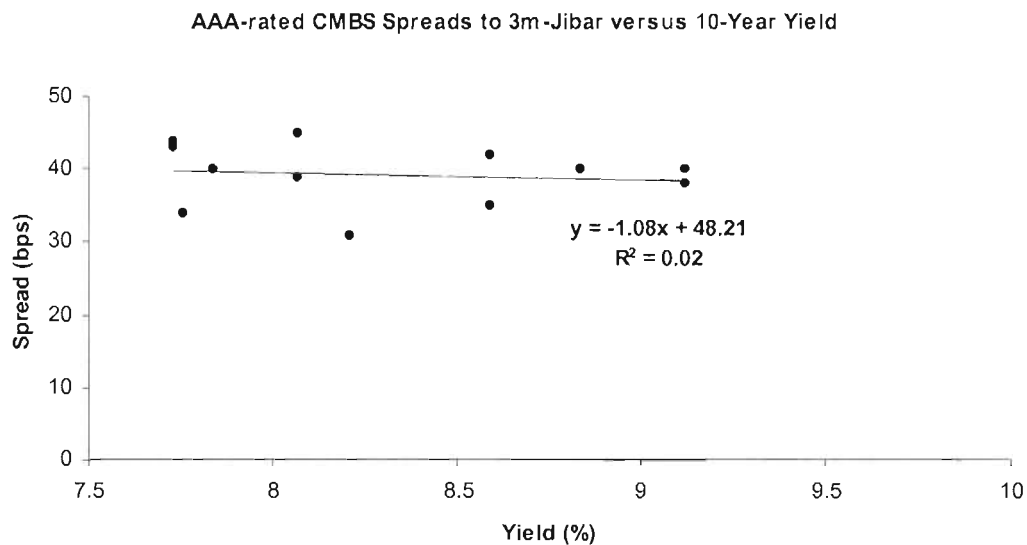


Figure 4.6. Spreads to 3m-Jibar on floating-rate South Africa CMBS deals listed on the Bond Exchange of South Africa versus yield on-the-run 10-year yield on BESSA Yield Curve from 4th quarter 2004 to 1st quarter 2007. Spreads from AAA-rated tranches are measured in basis points (bps).

Figure 4.6 shows how the 10-year maturity spot rate on the BESA Yield Curve influences initial spreads on CMBS securities. Although, it appears that the level of the spot rate is not correlated with spreads, the relationship is expected to be significant when interacted with other interest rate risk variables such as interest rate volatility and shifts in the yield curve. The weekly volatility of the 3m-Jibar over the year preceding issuance of AAA-rated CMBS securities is plotted against initial pricing spreads in Figure 4.7. The 3m-Jibar is used as a proxy for interest rate volatility because 3m-Jibar is used as the reference benchmark in floating-rate CMBS pricing. Confirming previous work on CMBS pricing, the volatility of interest rates appear to be directly related to initial spreads at issuance.

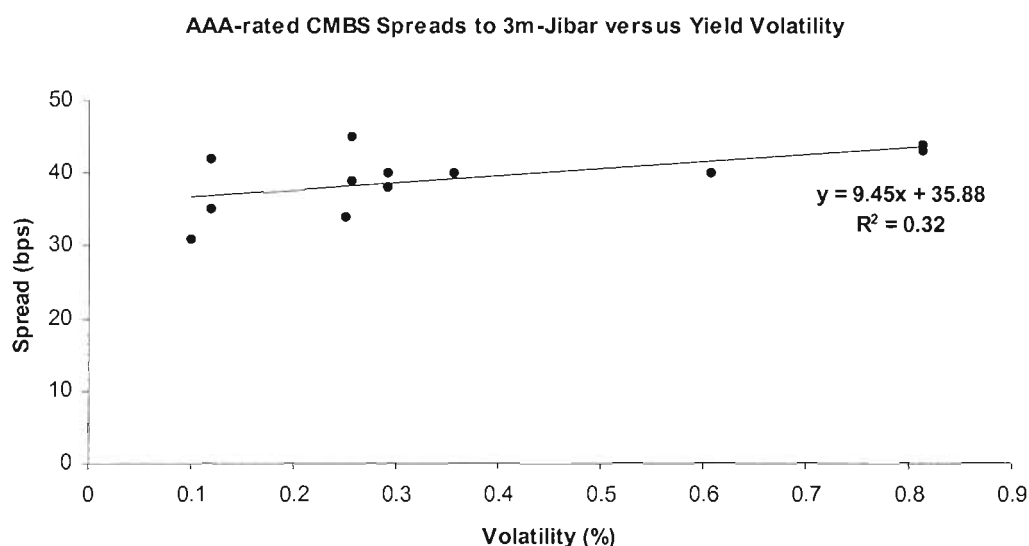
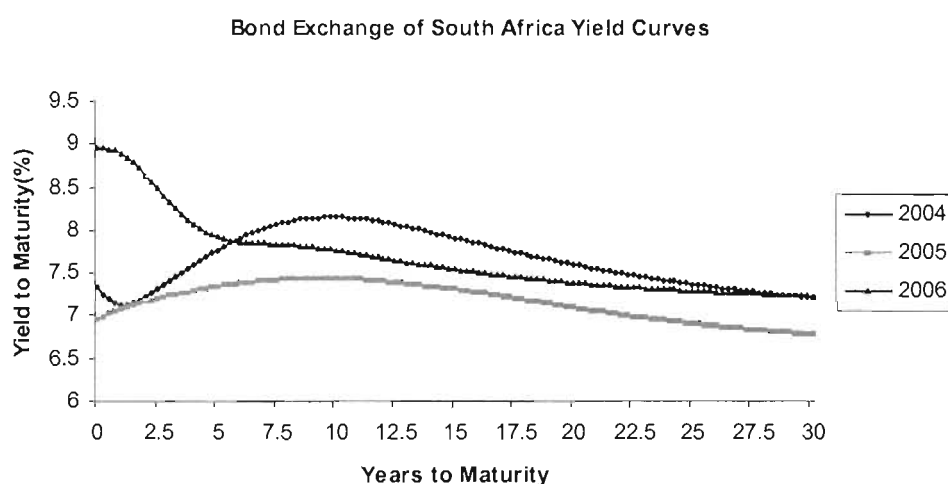


Figure 4.7. Spreads to 3m-Jibar versus volatility of floating-rate South Africa CMBS deals listed on the Bond Exchange of South Africa from 4th quarter 2004 to 1st quarter 2007. Spreads from AAA-rated tranches are measured in basis points (bps). Yield volatility is measured as the standard deviation of 3m-Jibar over the preceding year at issuance date.

Yield curve risk is the exposure of a security to a non-parallel change in the shape of the yield curve (Fabozzi 2004). Prior research has shown that CMBS spreads can be affected by the type and magnitude of shifts in the yield curve. Fisher and Maxam (2001) asserted that CMBS prices should be “a function of an interest rate”. They tested yield curve risk by using the difference between the constant maturity ten year US Treasury Note rate and the constant maturity one year Treasury bill rate as a proxy for yield curve steepness.¹¹ Moreover, the results of their linear regression model are consistent with the Child et al. (1996) argument that the price of senior tranches in a CMBS transaction should be lower in steeper interest rate environments. Therefore, a steeper yield curve will cause CMBS spreads to trade at wider levels (compensation for additional cash flow uncertainty). It is important to draw clear conceptual attention to the relationship between the yield spreads and price of bonds. In short, the price of a bond will fall when yield spreads widen (inverse relationship), and vice versa (Nattrass et al., 2002).

¹¹ The Treasury bill rate is provided by the St Louis Federal Reserve.

As shown in Figure 4.8, the BESA yield curve has taken on two fundamental shapes over the 2004-2006 period. During 2005, the yield curve experienced a slight positive butterfly shift and flattened over the 1-10 year maturity range.¹² Towards the end of 2006, the yield curve had inverted which reflects the conditions where long-term rates are lower than short-term rates, giving the yield curve a negative slope. Interestingly, the yields for longer maturities (i.e., yields greater than 10-years) have not fluctuated much over the 2004-2006 period. However, the shape of the yield curve for maturities less than 10-years has changed from a normal (positive slope) yield curve to one that is inverted.



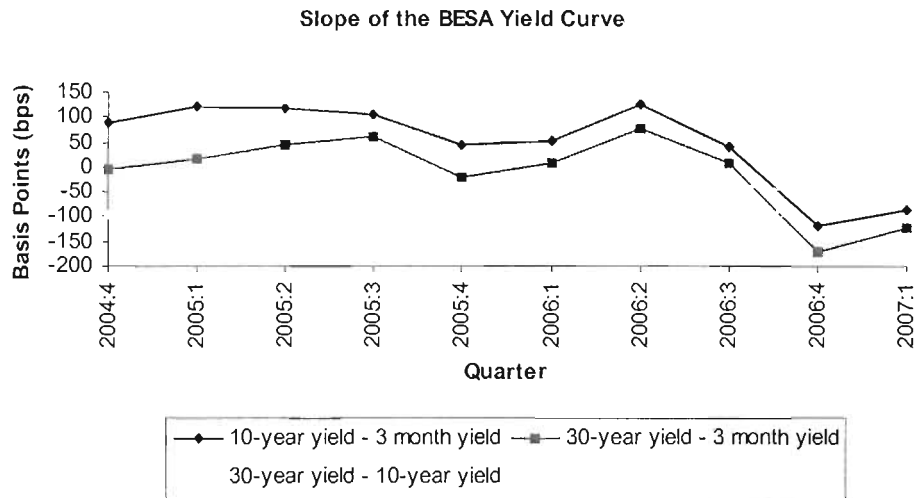
Source: Bond Exchange of South Africa

Figure 4.8. Bond Exchange of South Africa (BESA) Yield Curves at year end for 2004, 2005, and 2006.

According to the theory of term structure of interest rates (Ross et al., 1987), the slope of the yield curve is an indicator of the expected future levels of interest rates. Rationally, if interest rates are expected to be lower in the future, the probability of prepayment by borrowers is likely to increase and should result in larger spreads on CMBS (Rothberg et al., 1989; Maris and Segal, 2001). Figure 4.9 shows the slope of the yield curve over various maturities ranges from the fourth

¹² Yield curve butterfly shifts refer to changes in curvature of the yield curve. A positive butterfly shift means that the yield curve has become less curved, and a negative butterfly shift means that there is more curvature to the yield curve. Fabozzi (2001) provides information on the construction, theoretical underpinnings, and implications of the term structure of interest rates.

quarter 2004 to the first quarter 2007. Specifically, the slope of the yield curve is measured as the difference between the 30-year Government Bond and 3-month Government Bond yield. The short-term and long-term yield curves are also highlighted.



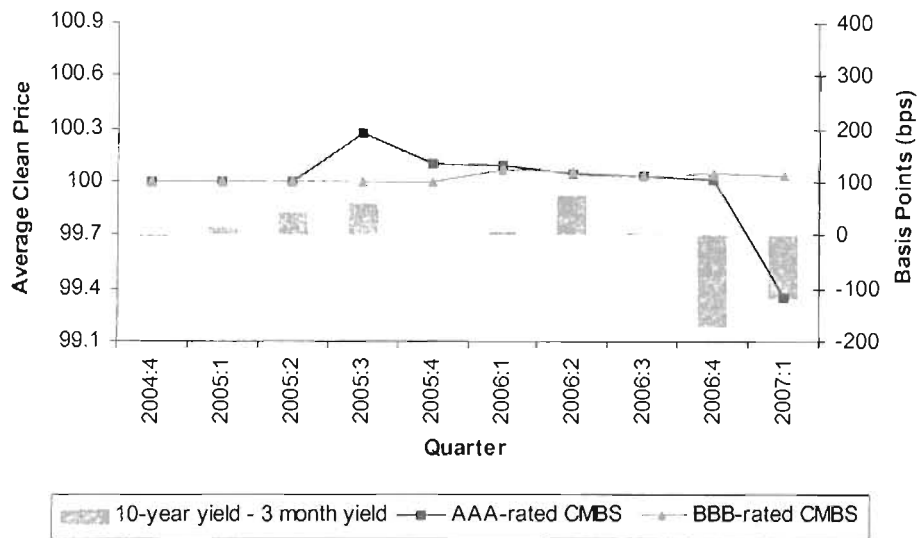
Source: Bond Exchange of South Africa

Figure 4.9. Slope of Bond Exchange Yield Curves from fourth quarter 2004 to first quarter 2007.

Figure 4.10 illustrates how the average price of AAA- and BBB-rated South African CMBS is related to the difference between the 10-year Government Bond and 3-month Government Bond yield. As predicted by Maris and Segal (2001), a flatter and/or inversely related yield curve is predicted to result in CMBS spreads trading at narrower levels.

The commercial mortgages backing CMBS issues are secured by properties. The expected performance of the property market should therefore be an important factor considered when pricing these securities. Recent research on CMBS pricing has investigated whether demand and supply dynamics in the property market affect spreads. Maris and Segal (2002), as well as Harding et al. (2004), included a property index variable in their regressions to control for property market fundamentals. They found that spreads widen when the probability of a property recession increases.

Average AAA-rated CMBS Price and BESAYield Curve Shifts



Source: Bond Exchange of South Africa

Figure 4.10. CMBS AAA-rated prices and the slope of the yield curve from fourth quarter 2004 to first quarter 2006. Average clean price is measured as the average AAA-rated CMBS prices per quarter. The slope of the BESASA yield curve is the difference between the 10-year Government Bond yield – 3-month Government Bond Yield.

Maxim and Fisher (2001) asserted that a traded property index, such as *NAREIT* best reflects movements in the property market because it does not suffer from the “*smoothing bias*” seen in other property value indices. A similar equity index in South Africa is the JSE Actuaries Property Loan Stock index (PLS), which is a market value weighted index of property loan stock companies listed on the JSE Stock exchange.

Figure 4.11 shows the levels that the PLS index traded over the 2004-2006 period. The PLS index has increased sharply from 2005 which can be attributed to solid fundamentals in the property market and strong growth in the South African economy. Profit taking and reassessment of valuations could be attributed to the index falling back during the third quarter of 2006. By the end of the first quarter 2007, the index had rebounded and continued surging to record levels. With property loan stock companies dominating the issuance of CMBS transaction, we anticipate the expected performance of the PLS index to influence pricing.

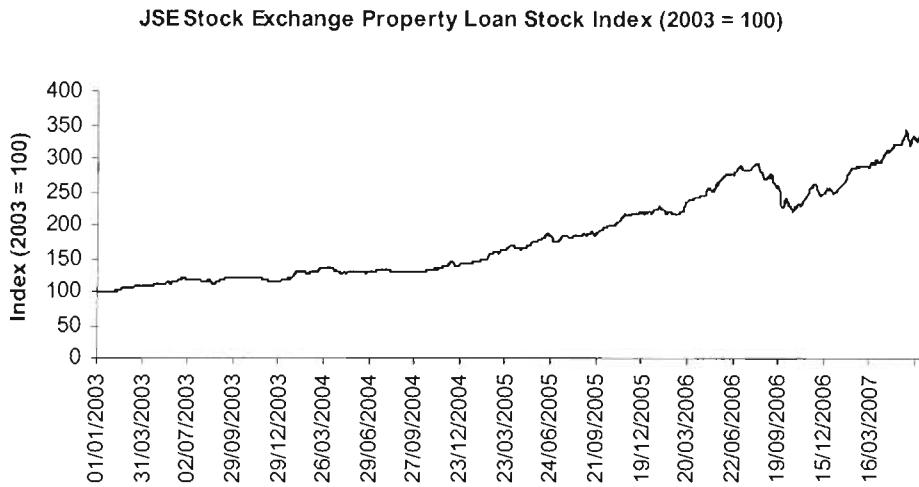


Figure 4.11. JSE Stock Exchange Property Loan Stock Index (2003 = 100)

Figure 4.12 shows that CMBS prices are directly related to the property index. This confirms the results of earlier work that found prices (spreads) to be positively (negatively) correlated to the level of a listed property index.

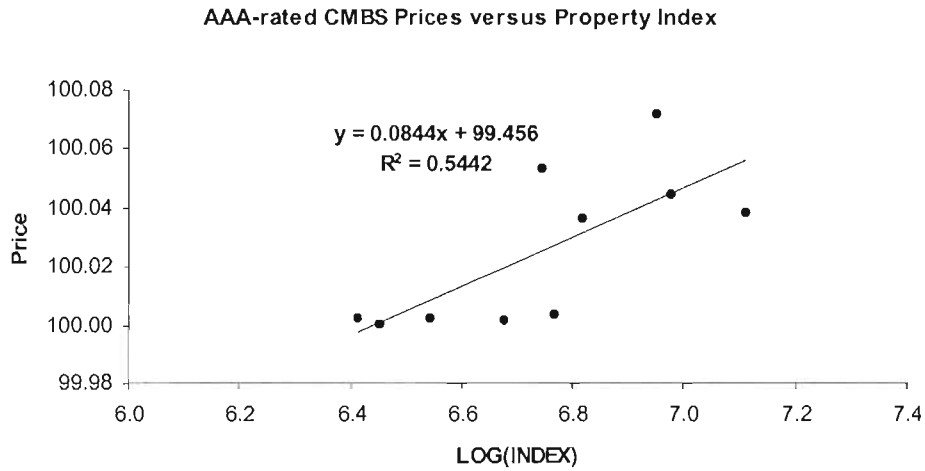


Figure 4.12. AAA-rated CMBS prices versus JSE Stock Exchange Property Loan Stock Index from 4th quarter 2004 to 1st quarter 2007. Prices are end of the day clean bid quotes from the Bond Exchange of South Africa. The property index is a market value weighted index.

4.2.3. Variables Describing Deal Structure

Harding and Sirmans (1997) take account of the WAL of each tranche in their spread model. They found spreads to be positively related to the average life of the tranche. Harding et al. (2004) confirmed these results in a study that assessed pricing in the U.S. conduit market.

Figure 4.13 highlights this pricing relationship for South African floating-rate CMBS tranches. It appears from the graphical plot and “best fit” linear regression line that pricing is not influenced by the WAL of the tranche. We test the measure in both the spread and subordination regression models, because it is possible that the WAL variable is interrelated with other risk factors at issuance date.

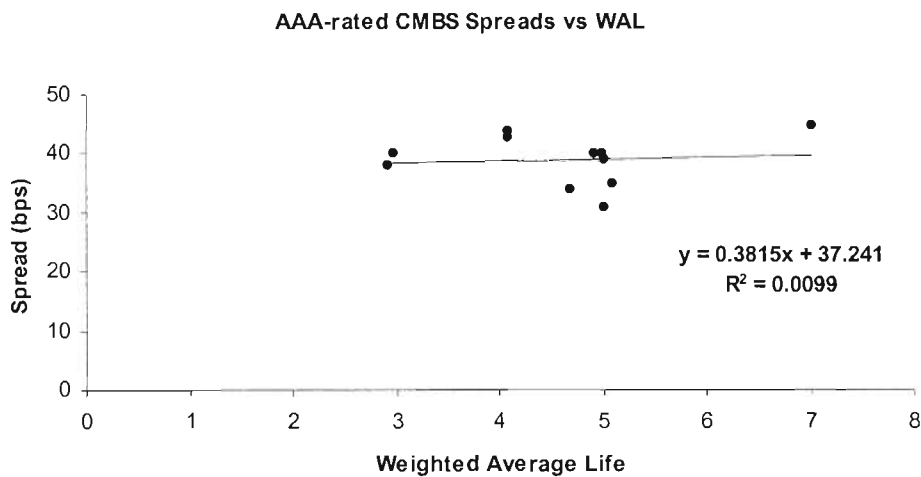


Figure 4.13. AAA-rated spreads versus weighted average life of tranches from South African floating-rate deals listed on the Bond Exchange of South Africa from 4th quarter 2004 to 1st quarter 2007. Spreads are measured in basis points (bps). Weighted average life of each bond class is measured in years.

Harding and Sirmans (1997) also found tranche order to be a significant pricing variable for AAA- and BBB-rated tranches. They were able to explain the effect of pricing differences of tranches within the same rating categories. Jacob and Gichon (1999) also included tranches that had split ratings and found the factor to be uncorrelated with pricing spreads. South African CMBS

tranches are commonly subdivided. The GPT1, PC1, PRP1, and VIP1 deals all contain bond classes of the same rating category that have been subdivided and rank *para passu*. The relationship between tranche order and pricing is empirically tested in the spread regression model presented in Section 4.4.

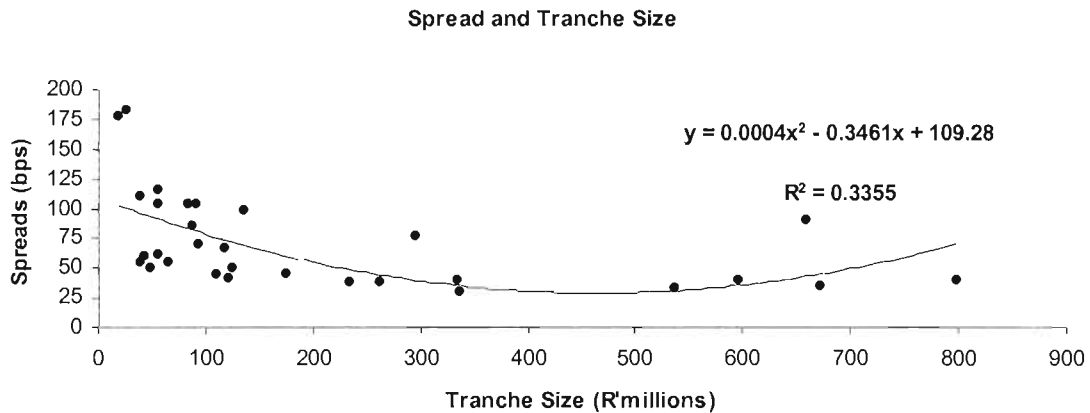


Figure 4.14. CMBS spreads versus tranche size on floating-rate CMBS listed on the Bond Exchange of South Africa from the 4th quarter 2004 to 1st quarter 2007. Spread is defined as the credit yield spread at time of issue over the 3m-Jibar benchmark. Tranche size is defined as the size of the CMBS tranche at time of issue.

According to Harding et al. (2004), the size of a CMBS deal can have contradicting effects on pricing. Increased tranche size translates into increased liquidity in the secondary market. Fabozzi (2001; 2004) showed that liquidity is positively related to pricing and hence inversely related to yield spreads. However, supply/demand dynamic through a glut of issuance in the primary market for an asset class will reduce security prices. Specifically, as the total value of sold securities increases, the issuer may have to increase pricing spreads in order to attract investors and move excess inventory. To date this quadratic relationship has yet to be empirically tested in the literature on CMBS pricing. Maris and Segal (2002) found that tranche size has a greater effect on yield spreads than does the total deal size. For this reason, the size of the tranche is also included to measure which of these competing effects is empirically related to yield spreads. A higher order size term is included to allow for the effect of size on yield spreads to vary with the size of individual issues. Figure 4.14 shows that a positive polynomial relationship

(second order) is evident for tranches and initial pricing spreads. The tranche and deal size of each CMBS security is included in the spread regression model to control for liquidity risk.

4.2.4. Variables Measuring Diversification and Property Mix Concentrations

Investors are participating in both the bond and property markets when investing in CMBS securities. It has been shown that intrinsic property risk is an important risk element associated with investing in CMBS securities. Mathew and Katz (1999) define property risk as the reduction in the property's income generating capacity. This income (rental) enables the borrower to meet the debt obligations under the loan agreements.

Corcoran (1999) sets out a framework for analyzing the risks of each of the major property types. The framework points to the following factors as important property quality issues for bond investors: (1) current sustainable cash flows, (2) sensitivity of property performance to the business cycle, (3) future demand for space, and (4) the relationship between the property values and replacement costs in the property's local market. As highlighted in Section 2.5, rating agencies will investigate the diversification of the collateral by property type and geographical location. A loan pool backed by diversified properties is seen as having lower default risk. Accordingly, rating agencies will lower subordination requirements when assigning credit ratings.

A dispersion of properties by type and geographical location is attractive to CMBS investors since changes in property values tend to be influenced by the performance of regional property markets and sectors. Harding and Sirmans (1997) included the number of properties, the number of borrowers, and the percentage of the total loan pool backed by major property categories in their pricing model which forecasts issuance spreads. Similarly, Jacob and Gichon (1999) also consider diversification by property type in their research on relative value in the U.S. CMBS market. Lancaster (2001) noted that geographical distribution can reduce the credit risk of a transaction. Figure 4.15 shows the geographical breakdown of South African CMBS issues by provincial distribution. In the U.S. market, concentration of 40 percent or higher in any single state

is considered a significant concentration. In contrast, South Africa is divided into only nine provincial regions. Significant geographical concentration is expected in the strongest economic regions (Provinces) of South Africa. These provinces include Gauteng, Kwazulu-Natal, Western Cape, and to a lesser extent the Eastern Cape. A portfolio with a provincial concentration of 75 percent or higher would be considered excessive. With a distribution by open market value of 78.01% and 76.08% found in the Gauteng Province at issuance date, the loan pool of both the GPT3 and PRP1 deals contains significant diversification risk. Currently, the VIP1 deal is the most geographically diversified CMBS listed on BESA.

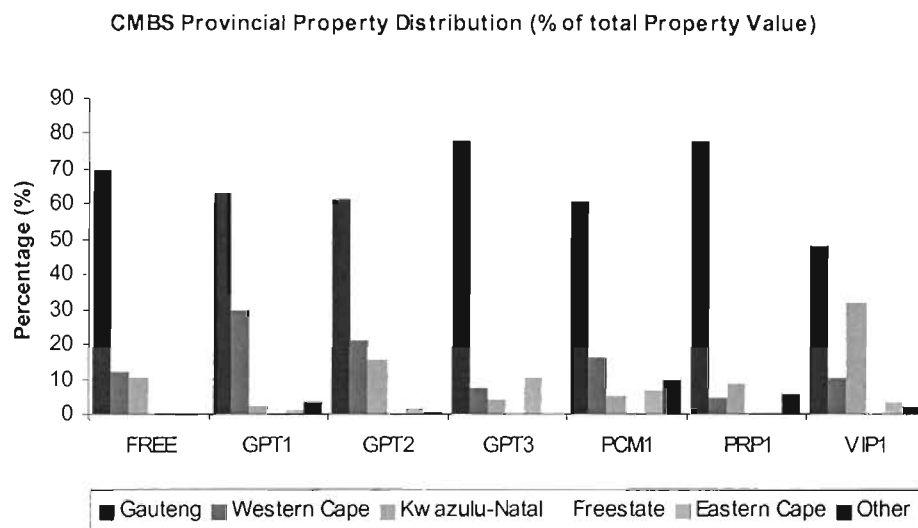


Figure 4.15. Breakdown of South African CMBS deals by Provincial distribution of underlying properties from fourth quarter 2004 to first quarter 2007.

In a broad discussion on the performance of CMBS deals, Gordon and Gibson (2001) drew attention to the property type mix of the underlying collateral. They asserted that a large concentration to a property sector reduces diversification and increases property risk of the loan pool. Financial strength of retail properties are determined by the strength of tenants and pose turnover risk. In contrast, office and industrial properties benefit from less cash flow uncertainty because of long-term nature of leases. Using multiple regression analysis, Jacob and Gichon (1999) showed that property type in U.S. CMBS was not helpful in explaining the variation in CMBS spread and did not do anything to the model. The results of their study confirmed the early

work of Harding and Sirmans (1997) on the effect of diversification on CMBS pricing. Harding and Sirmans included the four major categories of property type (multi-family, office, hotel, and retail) found in the U.S. property market into a spread regression model. In a later study, Harding et al. (2004) included variables measuring the percentage of the loan pool of U.S. conduit deals backed by property types in the subordination regression model. They found property type concentration to be an important factor considered by rating agencies.

Figure 4.16 shows the collateral concentration by property type for South African CMBS deals. The Growthpoint Note Issuer Company (Pty) Ltd Programme has two issues concentrated by property type. Specifically, Series 2 is concentrated with industrial properties, while Series 3 has a large retail component. The other CMBS issues are diversified across all property types. Investors should determine which property types have experienced much of the increase in value because the upside in value of these sub-sectors may be less than others.

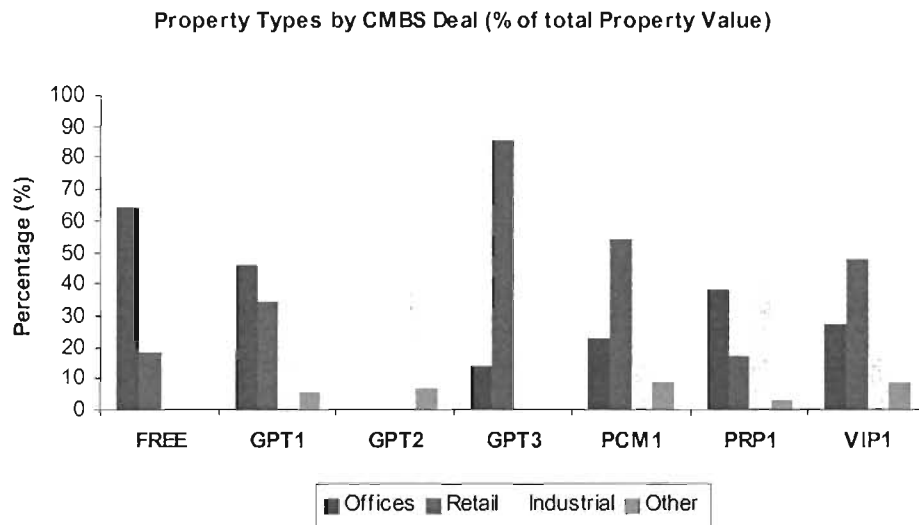


Figure 4.16. Breakdown of South African CMBS listed on BESA from fourth quarter 2004 to first quarter 2007 by property type. Property type breakdown is measured as a % of total property value of each CMBS deal.

Harding and Sirmans (1997) included the number of properties in a data set that was used to study the pricing of new CMBS issues. Their results for diversification do not show any effect on initial pricing. This is further confirmed in a study by Jacob and Gichon (1999). Furthermore,

Harding et al. (2004) found that investors in multi-borrower conduit deals are willing to give up spread for a diversified loan pool. Figure 4.17 shows CMBS deal diversification as measured by the number of properties. Investec's PC1 deal, a multi-borrower/conduit transaction, was backed by a pool of 148 individual properties. Of the single-borrower/multi-property (large loan) CMBS transactions, it appears that the GPT2 and GPT3 were the least diversified of all South African CMBS deals at issuance.

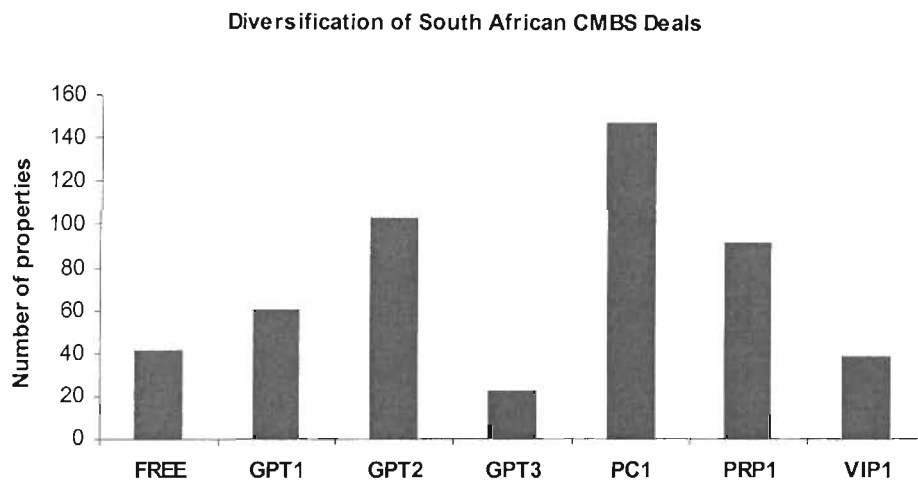


Figure 4.17. Diversification of South African CMBS deals issued on BESA from 4th quarter 2004 to 1st quarter 2007. Diversification is measured by the number of properties backing the loan pool.

4.3. DATA DESCRIPTION

4.3.1. Descriptive Statistics

Table 4.3 presents the data set that will be used to empirically investigate CMBS pricing in South Africa. The data set for the regression models can be found in the database that contains information on South African CMBS deals at issuance (see Appendix 1). For the empirical analysis of spreads and subordination, all CMBS deals listed on BESA from fourth quarter 2004 to first quarter 2007 are used. The database was populated by extracting pricing information from both primary and secondary sources. The Programme Memorandum and Series Supplement of each transaction were the main sources for obtaining property level, bond level, and structural

level information. Other important sources included Pre-Sale reports distributed by rating agencies, historical statistics from the Bond Exchange of South Africa and financial databases of Bloomberg, Datastream, and Reuters.

The panel data set for this study is constructed as follows: Firstly, below investment-grade tranches (BB-rated and below) are excluded from the sample as they require additional analysis beyond the scope of this research and could produce downward bias on pricing. Secondly, fixed-rate tranches for any dependent variable in the model issued during the sample period are dropped. Excluding fixed-rate tranches is necessary because they are assigned fixed coupons at pricing and have different benchmarks referenced to yield spreads. Finally, from the remaining tranches, only those that contain all cross-sectional independent variables during the sample period were chosen. These criteria have provided us a total of 36 tranches, which represents a total of 1,044 observations.

Using the mean, median, and mode of each variable described in Table 4.3, inferences about the normality requirements can be made. If the distribution is symmetrical and unimodal, then the three measures of central location will coincide (normal distribution). The distribution is skewed if it is not symmetrical. **LTV**, **GAUTENG**, **OTHER**, **RETAIL**, **COUNT**, **WAL**, **MAT**, and **STDEV** all have fairly normal distributions. A mean value less (greater) than the median is an indication of negative (positive) skewness (Gujarati, 2003). The distribution of **SPRD**, **YIELD**, **CURVE**, **DSIZE**, **OFFICE**, and **WCAPE** are negatively skewed, or skewed to the left, since they have long tails to the left and a short tail to the right. These skewed distributions could cause violations of the multiple regression analysis assumptions discussed in Section 4.4. The remaining distributions are positively skewed, or skewed to the right, with varying degrees of severity.

TABLE 4.3
Descriptive Statistics for South African Floating-Rate CMBS Tranches (N = 36)

	Mean	Standard Error	Median	Mode	Standard Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
SPRD	73.667	7.207	57.500	105.000	43.242	2.072	1.559	169	31	200
SUB	18.012	2.579	17.615	0.000	15.472	-1.125	0.341	49.040	0.000	49.040
LTV	57.348	1.074	57.950	57.950	6.441	-0.358	0.110	21.140	47.660	68.800
YIELD	8.333	0.090	8.140	9.116	0.542	-1.492	0.365	1.386	7.730	9.116
STDEV	0.351	0.038	0.293	0.293	0.226	0.182	1.150	0.714	0.100	0.814
CURVE	87.922	13.704	108.950	178.300	82.222	-0.606	-0.828	230.900	-52.600	178.300
INDEX	210.711	9.224	202.652	133.333	55.345	-0.522	0.244	175.000	133.333	308.333
MAT	8.133	0.632	6.997	7.005	3.795	2.092	1.837	12.164	4.915	17.079
WAL	4.602	0.180	4.915	5.003	1.081	0.565	0.238	4.093	2.912	7.005
TSIZE	210.667	36.728	109.500	55.000	220.371	0.876	1.444	780	18	798
DSIZE	1159.861	76.225	1000.000	1774.000	457.349	-1.640	0.189	1274	500	1774
OFFICE	32.979	2.752	38.219	45.971	16.510	-0.029	-0.153	64.318	0.000	64.318
RETAIL	28.484	3.067	34.410	34.410	18.399	-1.200	-0.128	54.000	0.000	54.000
IND	33.916	4.825	16.365	14.004	28.949	0.421	1.369	79.106	14.000	93.106
TYPE	5.800	0.472	5.615	5.615	2.830	-0.640	-0.544	9.000	0.000	9.000
GAUTENG	65.346	1.729	63.052	63.052	10.377	-0.947	-0.203	29.748	48.309	78.057
WCAPE	15.049	1.551	12.277	29.798	9.306	-1.073	0.584	25.091	4.707	29.798
KZN	10.896	1.678	8.692	2.436	10.070	0.511	1.371	29.118	2.436	31.554
ECAPE	2.881	0.549	1.254	0.000	3.296	0.279	1.162	10.500	0.000	10.500
OTHER	5.828	0.587	5.883	3.461	3.525	-1.008	-0.215	11.000	0.000	11.000
COUNT	75	6.426	61.000	61.000	38.557	-0.511	0.639	125	23	148

Note : Range refers to interquartile range

4.3.2. Pearson Correlation Matrix and Simple Linear Regression Analysis

Violation of the normality assumption of the dependent and independent variables is tested using the data set in Table 4.3. Using mean, median, mode, kurtosis and skewness outputs, it appears that several of the variables have either a positive or negatively skewed distribution around the mean. A Pearson correlation matrix is also constructed with the correlation coefficient in the lower triangle and the test statistics in the upper triangle (see Table 4.4). A test statistic that is italic and bordered is significant, indicating that there is overwhelming evidence that the two variables are linearly related. In addition, the linear regression analysis of both **SPRD** and **SUB** against a single independent variable is shown in Table 4.4 (i). The coefficient, *t*-statistic, *p*-value, and coefficient of determination are highlighted for each independent variable.

As predicted in the scatterplot (see Figure 4.3), a large negative correlation exists between spread (**SPRD**) and the amount of subordination (**SUB**) determined by international credit rating

agencies. The correlation coefficient is negative 0.72 and significant at the one percent level. Moreover, the single independent variable regression equation has a coefficient of determination of 72 percent and a t-statistic of negative 6.05 (see Table 4.1 (ii)). Investors appear to require approximately 2 basis points less spread at issuance for every percent of additional subordination allocated by rating agencies. It is clearly evident that subordination and CMBS pricing are jointly determined.

TABLE 4.4 (i)

Pearson Correlation Matrix (coefficient of correlation lower triangle / test statistic for testing $\rho = 0$ upper triangle)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29				
1 SPRD	1.00																																
2 SUB	-0.72	1.00																															
3 LTV	0.20	-0.28	1.00																														
4 YIELD	0.14	-0.11	0.07	1.00																													
5 STDEV	0.14	0.01	0.51	-0.44	1.00																												
6 CURVE	0.06	-0.11	-0.27	0.80	-0.82	1.00																											
7 INDEX	-0.13	0.09	0.31	-0.78	0.68	-0.92	1.00																										
8 MAT	0.12	-0.11	0.84	-0.49	0.72	-0.63	0.71	1.00																									
9 WAL	-0.12	0.06	-0.34	-0.09	-0.44	0.29	-0.07	0.08	1.00																								
10 DSPLT	0.03	-0.05	-0.07	0.30	-0.26	0.38	-0.29	0.04	0.55	1.00																							
11 TSIZE	-0.44	0.44	-0.02	-0.20	0.23	-0.38	0.31	-0.01	-0.18	-0.14	1.00																						
12 DSIZE	-0.04	-0.06	0.31	-0.46	0.30	-0.48	0.40	0.22	-0.21	0.02	0.29	1.00																					
13 DSIZE	0.16	-0.13	0.72	-0.45	0.83	-0.70	0.72	0.98	-0.20	-0.11	0.04	0.28	1.00																				
14 OFFICE	-0.03	-0.11	-0.18	-0.03	-0.51	0.24	-0.25	-0.33	-0.05	0.10	-0.14	0.01	-0.31	1.00																			
15 RETAIL	0.05	0.00	-0.01	-0.74	0.42	-0.53	0.81	0.84	0.16	0.11	-0.02	0.36	0.58	0.00	1.00																		
16 IND	-0.01	0.06	0.13	0.81	-0.02	0.28	-0.28	-0.30	-0.12	-0.15	0.10	-0.31	-0.28	-0.80	-0.80	1.00																	
17 OTHER	-0.01	0.11	0.01	-0.52	0.52	-0.48	0.49	0.58	0.26	0.04	0.11	0.35	0.48	-0.89	-0.88	-0.14	1.00																
18 GAUTENG	0.20	-0.21	0.41	0.64	-0.10	0.34	-0.48	-0.25	-0.68	0.00	-0.09	-0.15	-0.14	0.35	-0.83	0.23	-0.81	1.00															
19 WCAPR	-0.21	-0.02	0.14	-0.41	-0.10	-0.25	0.38	0.05	0.15	-0.02	0.23	0.82	0.01	0.06	0.14	-0.17	0.24	-0.32	1.00														
20 KZN	-0.10	0.25	-0.71	-0.08	-0.15	0.16	-0.11	-0.12	0.45	0.04	-0.10	-0.59	-0.27	-0.36	0.18	0.07	0.40	-0.63	-0.43	1.00													
21 ECAPR	0.05	0.04	0.30	-0.67	0.77	-0.74	0.77	0.66	0.08	-0.08	0.10	0.27	0.84	-0.50	0.79	-0.32	0.84	-0.63	0.08	0.18	1.00												
22 PROV	0.28	-0.14	0.37	-0.09	0.64	-0.28	0.17	0.53	-0.25	0.01	-0.18	-0.24	0.82	0.16	0.40	-0.39	-0.06	0.30	-0.63	-0.12	0.35	1.00											
23 COUNT	0.35	-0.24	0.93	0.13	0.81	-0.23	0.28	0.71	-0.26	-0.04	-0.08	0.11	0.77	-0.44	0.05	0.24	0.22	0.27	-0.09	-0.42	0.45	0.44	1.00										
24 DSIZE	-0.07	0.15	-0.68	-0.22	-0.15	0.15	-0.09	-0.02	0.59	0.16	-0.17	-0.39	-0.18	-0.22	0.45	-0.24	0.52	-0.75	-0.25	0.92	0.30	-0.07	-0.42	1.00									
25 DSIZE	-0.20	0.16	-0.15	0.07	-0.23	-0.10	0.26	-0.22	-0.03	-0.04	0.35	0.16	-0.30	0.11	-0.42	0.28	-0.29	0.03	0.40	-0.17	-0.30	-0.51	-0.35	-0.24	1.00								
26 DSIZE	0.16	-0.12	0.72	-0.45	0.83	-0.70	0.72	0.98	-0.20	-0.11	0.04	0.28	1.00	-0.31	0.58	-0.26	0.48	-0.14	0.01	-0.27	0.84	0.82	0.77	-0.18	-0.30	1.00							
27 DSIZE	-0.21	0.24	-0.09	0.00	-0.04	0.02	-0.01	-0.06	0.04	-0.04	-0.37	-0.05	-0.07	-0.01	-0.03	0.02	-0.01	-0.04	-0.02	0.08	-0.02	-0.05	-0.08	0.06	0.05	-0.07	1.00						
28 DSIZE	0.27	-0.59	-0.05	0.00	-0.04	0.02	-0.01	-0.06	0.04	-0.04	-0.13	-0.05	-0.07	-0.01	-0.03	0.03	-0.01	-0.04	-0.02	0.08	-0.03	-0.05	-0.08	0.06	0.05	-0.07	-0.38	1.00					
29 DSIZE	0.78	-0.45	0.21	0.10	0.01	0.08	-0.71	0.04	-0.10	0.05	-0.30	0.15	0.07	0.03	0.01	-0.06	-0.07	0.19	0.05	-0.25	-0.05	0.09	0.17	-0.18	-0.13	0.07	-0.25	-0.25	1.00				

It appears that an important indicator of asset quality, the LTV ratio, has been incorrectly considered by both rating agencies and investors. Subordination is inversely related to **LTV** with a small negative correlation coefficient, while spreads are positively related with a small positive pricing relationship. The model predicted a negative correlation coefficient of 0.66 which is statistically significant at the one percent level. To interpret the relationship, a one percent increase in LTV is associated with a 0.66% reduction in the required subordination. However, this relationship contrasts with the findings of Harding et al. (2004). The coefficient of determination indicates that 28 percent of the variability in subordination is accounted for by the model. Using kernel density estimation, Maxam and Fisher (2001) showed that the LTV ratio is negatively related to issuance spreads. Contrasting to their results, the regression equation specifies a positive but insignificant pricing relationship. A one percent increase in LTV will require an additional 1.34 basis points at pricing. Regression analysis using LTV as a pricing determinant explains approximately 24% of the variation in the dependent variable.

Prepayment and extension risk are important pricing factors because it introduces cash flow uncertainty into the underlying deal structure. Specifically, the level and volatility of prevailing interest rates are directly related to a borrower's option to either prepay or extend a loan facility. The correlation coefficient for the level of the 10-year government bond spot rate (**YIELD**) has a small positive correlation coefficient with issuance spreads. The coefficient in the regression equation is insignificant at all levels. Similarly, the regression coefficients for the variables that proxy the volatility of interest rates (**STDEV**) and the shape of the yield curve (**CURVE**) are insignificant at all levels. The Pearson correlation matrix shows that all these market indicator variables are significantly interrelated. This highlights the importance of including all these variables when investigating CMBS pricing using multiple regression models. Exploratory multiple regression analysis is conducted in section 4.4 and the relationships are further investigated. Nonetheless, the reliability of the results is limited because of the lack of cross-sectional observations available to market participants. Rating agencies assess the likelihood of the ultimate return of the outstanding principal balance and are less concerned with cash flow

uncertainty, i.e. the timing of the return. Consequently, proxies for market indicators are not important in their assessment of subordination levels.

The expected performance of the commercial property market, as proxied by the JSE Property Loan Stock Index (**INDEX**), does not influence the determination of spreads at pricing and subordination levels. Although the pricing relationship is correctly predicted to be negative, it is insignificant at all levels in the regression analysis. This independent variable needs to be interacted with additional independent pricing factors to accurately determine the impact on CMBS pricing. The correlation coefficient between the weighted average life (**WAL**) and spreads has a small negative relationship. This insignificant relationship is also confirmed in the simple linear regression equations. The maturity of each tranche is slightly positively correlated with spreads at issuance date. On the other hand, tranches that have been split with different maturities, but rank para passu, have no impact on pricing. Interestingly, the correlation matrix indicates that these variables should be interacted with the market indicator variables within a multiple regression pricing model.

Important structural variables include both the aggregate size of outstanding notes (**DSIZE**) and the individual size of each tranche (**TSIZE**). **TSIZE** is statistically significant at the one percent level. For every ZAR100 million increase in spreads at pricing date, investors are prepared to relinquish 8.6 basis points to the issuer. It is evident that investors are considering the premium for illiquidity in the secondary bond market when pricing CMBS. **DSIZE** is insignificant at all levels of significance, although it does exhibit a slightly negative relationship. Exploratory analysis is carried out in section 4.4 to determine if a quadratic relationship exists for the size of each CMBS tranche. It is expected that tranche size acts as a proxy for the liquidity risk premium required by investors, i.e. increased tranche size translates into increased liquidity in the secondary market. However, there exists a point where the tranche reaches its optimal size to sustain tight pricing. At this point, the issuer may therefore be required to pass on additional spread to sustain investor demand.

Credit risk is an important consideration priced into issuance spreads by investors and all the investment-grade rating categories are significant in the regression analysis presented in Table 4.4 (ii). However, it was shown that AA-rated tranches require 29 basis points less credit margin than AAA-rated tranches, which contrast with the predicted sign. It appears that investors are redistributing spread throughout the deal structure at issuance for this rating category. Investors possibly believe that rating agencies are incorrectly assessing the credit risk of the higher-rated bond categories. As theorized, the A- and BBB-rated tranches require additional spread compensation for bearing greater credit risk, i.e. the risk of term default.

Variables measuring diversification and property mix concentrations are expected to be important components in the pricing of multi-tranche CMBS. An initial investigation of the correlation matrix reveals that diversification, property type and provincial concentrations are not correlated with spreads at issuance. The regression analysis reveals that these independent pricing factors are insignificant at all levels. Credit rating agencies carry out considerable due diligence on the underlying properties prior to assigning rating categories. Investors are possibly relying on this due diligence in their assessment of the overall quality of the asset pool. It is therefore expected that these variables will be important determinants of subordination levels, however, none of the variables are significant. It is important to include diversification and asset quality variables within a multiple regression framework to determine any complex interactions.

All the risk categories contain variables that are either correlated between themselves or with other risk factors. The fact that the time-coefficients are significantly correlated with other variables will further limit the reliability of the **SPRD** and **SUB** panel regression models. Investors must be aware of this inherent problem before developing proprietary CMBS pricing models. While the Pearson correlation matrix indicates the strength of a relationship between two variables, its value alone may not be sufficient to investigate the complex pricing relationships. Single regression analysis with one independent variable has therefore been used to test the

reliability of pricing relationships. As highlighted in Section 3.5.3.2, multicollinearity is a common regression violation. Before performing exploratory multiple regression modeling, the correlations between variables in the structure, interest rate, and diversification risk categories will be considered.

TABLE 4.4.(ii)
Simple Linear Regression Analysis

	Variable	Coefficient	t-statistic	p-value	R ²
Spread Model					
1	SUB	-2.01	-6.05	0.00	0.72
2	LTV	1.34	1.19	0.24	0.04
3	YIELD	11.25	0.83	0.41	0.14
4	STDEV	27.12	0.84	0.41	0.14
5	CURVE	3.27	0.36	0.72	0.06
6	INDEX	-29.08	-1.08	0.29	0.18
7	WAL	-4.81	0.71	0.48	0.12
8	TSZE	-0.09	-2.85	0.01	0.44
9	DSIZE	0.00	0.23	0.82	0.04
10	D _{AA}	-29.17	-1.88	0.07	0.31
11	D _A	26.08	1.66	0.11	0.27
12	D _{BBB}	93.75	6.83	0.00	0.58
20	COUNT	0.28	1.52	0.14	0.25
Subordination Model					
1	LTV	-0.66	-1.66	0.10	0.28
2	INDEX	6.99	0.72	0.48	0.12
3	D _{AA}	8.06	1.42	0.17	0.24
4	D _A	-20.08	-4.26	0.00	0.34
5	D _{BBB}	-20.05	-29.80	0.01	0.20
6	COUNT	-0.09	-1.42	0.17	0.24

4.4. RESULTS OF MULTIPLE REGRESSION ANALYSIS

Using the initial findings presented in section 4.3, multiple regression analysis is used to perform an exploratory analysis of CMBS pricing and subordination determination. The reliability of the regression results is problematic because of the limited number of cross-sectional observations available in the bond market. However, it is important to initiate the investigation of CMBS pricing

within a multivariate framework to demonstrate how future proprietary models should be implemented in practice by investors.

Several regression approaches are followed, specifically, cross-sectional regression and panel data regression models of both **SPRD** and **SUB** on the various explanatory variables, which consist of observations on the same cross-sectional units over several time periods. Gujarati (2003) identifies several advantages of using panel data models over cross sectional data models. Firstly, they increase the sample size considerably. Secondly, by studying repeated cross-section observations, panel data are better suited to study the dynamics of change. Finally, panel data enables us to produce a more complicated model for identifying the determinants of spreads at issuance and required subordination levels. However, despite these advantages, the above empirical methods used in our analysis are expected to have several estimation and inference problems, namely heteroscedasticity and autocorrelation, because our panel data models consist of a cross-sectional dimension, a time dimension and higher order variables.

The panel data regression models that we employ are the pooled cross-sectional time-series regression model and fixed effects regression model. The cross-sectional time-series regression model assumes the intercept and slope coefficients are constant across time and space and that the error term captures differences over time. These restrictive assumptions distort the true picture of the relationship between the dependant variable, **SPRD**, **SUB**, and the explanatory variables across all the tranches in our sample. Conversely, the fixed effects approach accounts for the specific nature of all tranches, by assuming the slope coefficients are constant with only the intercepts varying over the individual variables.

4.4.1. Spread Model

The methodology employed by Harding and Sirmans (1997), Harding et al. (2004), Jacob and Gichon (1999); Maris and Segal (2002); Maxim and Fisher (2001) is used to empirically estimate CMBS spreads. A quadratic relationship between **SPRD** and tranche size (**TSIZE**) is used. A

linear relationship is employed for estimating the remaining variables. Pooling, or combining, all the observations, the spread function is written as follows:

$$SPRD_{it} = \beta_0 + \sum \beta_k X_{kit} + \varepsilon_i$$

There are a maximum of 36 cross-sectional observations and a maximum of 4 time periods (years). As the numbers of tranche-year observations differ among panel variables, the model is considered an unbalanced panel. Different specifications of the following linear and quadratic model are tested

$$\begin{aligned} SPRD_i = & \beta_0 + \beta_1 SUB_i + \beta_2 LTV_i + \beta_3 YIELD_i + \beta_4 STDEV_i + \beta_5 CURVE_i + \beta_6 INDEX_i \\ & + \beta_7 MAT_i + \beta_8 WAL_i + \beta_9 DSPLIT_i + \beta_{10} TSIZE_i + \beta_{11} TSIZE_i^2 + \beta_{12} DSIZE_i + \\ & \beta_{13} DSIZE_i^2 + \beta_{14} DCONDUIT_i + \beta_{15} OFFICE_i + \beta_{16} RETAIL_i + \beta_{17} IND_i + \\ & \beta_{18} OTHER_i + \beta_{19} GAUTENG_i + \beta_{20} WCAPE_i + \beta_{21} KZN_i + \beta_{22} ECAPE_i + \\ & \beta_{23} PROV_i + \beta_{24} COUNT_i + \beta_{25} D_{2005i} + \beta_{26} D_{2006i} + \beta_{27} D_{AAi} + \beta_{28} D_{Ai} + \\ & \beta_{29} D_{BBBi} + \varepsilon_i \end{aligned}$$

In summary, the predicted signs of the coefficients in the regression model are expected to be positive for, $\beta_2, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{11}, \beta_{13}, \beta_{14}, \beta_{16}, \beta_{17}, \beta_{18}, \beta_{19}, \beta_{25}, \beta_{26}, \beta_{27}, \beta_{28}, \beta_{29}$, and negative for $\beta_1, \beta_3, \beta_{10}, \beta_{12}, \beta_{15}, \beta_{20}, \beta_{21}, \beta_{22}, \beta_{23}, \beta_{24}$, and β_{21} .

Table 4.5 (i) and Table 4.5 (ii) show the results of pooled cross-sectional time-series regressions (unbalanced panel) of spreads on explanatory variables for all commercial mortgage-backed securities listed on BESA from forth quarter 2004 to first quarter 2007. The columns report the estimated coefficient and *t*-statistic. The pooled panel data regression models to estimate Equation (1) through (6) is used. The models explain a substantial portion of the overall variability in each dependent variable, although unconditional heteroskedascity and multicollinearity is present to some extent. The adjusted R^2 measures range from 0.80 through to 0.86, and the *F*-statistic is significant at the one percent level for all models.

TABLE 4.5 (i)

Regressions of Spreads on Explanatory Variables for 7 CMBS Deals

		Pooled Data Panel Regression Models					
		(1)		(2)		(3)	
Independent Variables	Predicted Effect	coef.	t-stat	coef	t-stat	coef	t-stat
Intercept		127.45***	3.352	214.103***	3.237	222.416***	2.817
SUB	-	-0.967***	-3.706	-0.947***	-3.664	-0.982***	-3.497
SUB_AAA							
LTV	+	-1.1032*	-1.824	-2.524*	-1.837		
YIELD	-						
STDEV	+	94.078***	3.348	52.239*	1.887	54.829***	3.016
CURVE	+						
INDEX	+					-27.176*	-1.741
MAT	+						
WAL	+	1.298	0.415				
D _{SPLIT}	+						
TSIZE	-	-0.217***	-3.011	-0.236***	-3.415	-0.043*	-1.978
TSIZE ²	+	0.000**	2.590	0.000***	-2.884		
DSIZE	-						
DSIZE ²	+						
D _{CONDUIT}	+			-21.739	-1.104		
OFFICE	+						
RETAIL	? / + / -						
IND	? / + / -						
OTHER	? / + / -						
GAUTENG	? / + / -						
WCAPE	? / + / -						
KZN	? / + / -						
ECAPE	? / + / -						
PROV	? / + / -						
COUNT	-			0.447*	1.880		
D ₂₀₀₅	-						
D ₂₀₀₆	-						
D _{AA}	+	-24.161**	-2.679	-26.020***	-2.903	-16.789*	-1.780
D _A	+						
D _{BBB}	+	51.081***	4.863	50.422***	4.822	57.516***	5.169
Number of Observations		36		36		36	
F-statistic		22.805		23.390		23.755	
p-value		0.000		0.000		0.000	
Adjusted-R ²		0.849		0.852		0.796	

Asterisks indicate significance at 1% (***), 5% (**), 10 (*) levels in a two-tail test.

TABLE 4.5 (ii)

Regressions of Spreads on Explanatory Variables for 7 CMBS Deals

		Pooled Data Panel Regression Models					
		(4)		(5)		(6)	
Independent Variables	Predicted Effect	coef.	t-stat	coef	t-stat	coef	t-stat
Intercept	+	78.037***	2.535	-141.632	-1.608	-131.894***	4.634
SUB	+	-0.933***	-3.619	-0.912***	-3.655	-0.949***	-3.766
SUB_AAA							
LTV	+	0.309	0.629			0.210	0.448
YIELD	-			25.102***	2.839		
STDEV	+			98.388***	3.616		
CURVE	+						
INDEX	+						
MAT	+						
WAL	+			8.816**	2.060		
D _{SPLIT}	+			-13.829*	-1.690		
TSIZE	-	-0.226***	-3.090	-0.238***	-3.410	-0.232***	-3.282
TSIZE ²	+	0.000***	2.573	0.000***	2.740	0.000***	2.877
DSIZE	-						
DSIZE ²	+						
D _{CONDUIT}	+						
OFFICE	+					-0.463**	-2.571
RETAIL	? / + / -	0.558***	2.400				
IND	? / + / -	0.469**	2.273				
OTHER	? / + / -						
GAUTENG	? / + / -						
WCAPE	? / + / -	-0.672*	-1.954			-0.732**	-2.230
KZN	? / + / -						
ECAPE	? / + / -						
PROV	? / + / -						
COUNT	-			-0.252*	-1.943		
D ₂₀₀₅	-						
D ₂₀₀₆	-						
D _{AA}	+	-26.753***	-2.955	-28.204***	-3.287	-25.902***	-2.947
D _A	+						
D _{BBB}	+	51.156***	4.862	50.900***	4.987	51.611***	5.022
Number of Observations		36		36		36	
F-statistic		23.391		21.725		27.553	
p-value		0.000		0.000		0.000	
Adjusted-R ²		0.852		0.856		0.858	

Asterisks indicate significance at 1% (***), 5% (**), 10% (*) levels in a two-tail test.

The Pearson correlation matrix (see Table 4.4) shows that some of the loan quality, market indicators, diversification, deal, and control variables are correlated between each other (multicollinearity). The hypotheses that the coefficients of all variables are equal to zero are tested using stepwise regression techniques. In all the equations, subordination, AA-rated notes, BBB-rated notes, and tranche size all significantly influence spreads.

The **DUMMY_{CONDUIT}** variable is used to control for the cross-sectional effect, i.e. the security is associated with either a single-borrower/multi-property or multi-borrower/conduit deal. As indicated in Equation (2), commercial mortgage-backed security issued within a conduit structure is expected to trade on average 21.7 basis points lower. The yearly time-series effect (**DUMMY₂₀₀₅**; **DUMMY₂₀₀₆**) that controls for year of origination and the “learning effect” are not statistically significant for any of the equations. Spreads are expected to narrow because of the “learning effect” that occurs when investors become more knowledgeable about a new asset class. Alternatively, the time effect could be captured in the variables that are used as proxies for interest rate risk. The fixed effects (time-series) panel data regression models are therefore not tested in the spread model.

The variable that controls for loan quality, the loan-to-value (**LTV**) ratio, is statistically significant at the one percent level in Equation (1) and (2). The sign of the coefficient is negative, indicating that investors are prepared to receive between 1.1 and 2.5 basis points less for a 1.0 percent increase in the LTV ratio. This contrasts with the literature on pricing which predicts a positive relationship between CMBS spreads and the LTV ratio. It is assumed that investors believe rating agencies accurately capture loan quality (default risk) in ratings and subordination. A slight negative effect could be attributed to a pricing adjustment for excessive stress testing performed by rating agencies.

The correlation matrix indicates significant correlation among the market indicator variables. Selective joint-testing is used to avoid multicollinearity and violations of multiple regression assumptions. The yield level (**YIELD**) and interest rate volatility (**STDEV**) measures are jointly tested and significant at the one percent level in Equations (5). Interest rate volatility is positively related to spreads, which is possibly attributed to the increase in value of the embedded prepayment and extension options available to the borrower. However, the coefficient of the 10-year Government bond yield is positive and differs significantly from the predicted direction. According to the model, an increase in the yield is associated with an additional 25.1 basis point spread requirement. The property index (**INDEX**) is jointly tested in Equation (3). The coefficient is negative and significant at the one percent level. This is consistent with the argument that expected performance of the commercial property market is already incorporated in spreads at pricing. Market indicator variables that are insignificant in the spread model include the shape of the yield curve. It is tested and found to be insignificant at all levels. This is attributed to multicollinearity between to the market indicator variables (see Table 4.4).

The six variables that measure diversification are not jointly significant. The number of properties and/or loans is significant at the one percent level in Equation (2) and (5). The sign differs from the predicted negative sign only in Equation (2). In Equation (4) and (6), the geographical concentration variable that measures the percentage of the property portfolio located in the Western Cape (**WCAPE**) is negative and statistically significant at the five percent and ten percent level respectively. The coefficient suggests that tranches from deals with holdings diversified across the **WCAPE** are priced lower at issuance. Interestingly, the remaining provinces are not considered important from a portfolio diversification standpoint. This could be attributed to the positive relationship found between **WCAPE** and **SUB**.

The four variables measuring property type are not jointly significant. This is possibly attributed to investors assuming that rating agencies are performing comprehensive due diligence on the underlying collateral. The office holdings variable (**OFFICE**) is statistically significant at the five

percent level in Equation (6). Because the coefficient is negative, it is assumed that investors favor office properties because of the current strong economic fundamentals in this sector of the property market. They are most likely to be pricing future expected performance through lower spread requirements at issuance. In Equation (4), investors appear to require additional spread for industrial (**IND**) and retail (**RETAIL**) properties.

The tranche size variable (**TSIZE**) enters the spread model in all equations with a negative and statistically significant coefficient. Consistent with our liquidity risk arguments, issues are initially priced tighter to the 3m-Jibar curve as the tranche size increases. The square of tranche size (**TSIZE**²) is positive and significant at both the one and five percent levels. Issuers of larger deals appear to attract investors through spread compensation. This study is the first known regression spread model to test this quadratic relationship empirically. Tranche order (**D_{SPLIT}**) is a significant pricing variable in Equation (5). The estimated effect is negative 13.8 basis points for tranches that are subdivided into further individual bond classes. Weighted average life (**WAL**) is significant at the five percent level in Equation (5) and (6). The effect ranges from +8.8bps to +11.8 for each additional year. Other structural indicators that do not contribute to the variation in spreads include maturity and the overall size of the CMBS issue. As rational decision makers, investors should be incorporating these variables in their evaluation of CMBS pricing.

The dummy variables for the AA-rated (**D_{AA}**) and BBB-rated (**D_{BBB}**) are significant. Interestingly, the AA-rated tranche is negative and significant for all equations. This contrasts with the sign theorized in Section 3.8. This is possibly attributed to the illusion of the triple-A rating (Kochen, 1996). Rating agencies assign ratings on the likelihood of the ultimate return of principal and not on the timing of the return. As predicted, the **D_{BBB}** coefficient is significant at the one percent level and positive. Tranches within this category trade approximately 50 basis points wider. Finally, pricing and structure appear to be jointly determined. Required subordination levels (**SUB**) significantly affect pricing in each regression equation. Investors are prepared to give away spread for additional subordination. The sign of the coefficients in all equations are negative and

overwhelmingly significant at the one percent level. Regressions of subordination on explanatory variables are presented in the next section.

4.4.2. Subordination Model

Again, the methodology presented by Harding et al. (2004) is used to empirically estimate the determinants of subordination levels. A linear relationship between **SUB** and independent variables is employed for estimation. Pooling, or combining, all the observations, the subordination function is written as:

$$SUB_{it} = \beta_0 + \sum \beta_k X_{kit} + \varepsilon_i$$

There are a maximum of 36 cross-sectional observations and a maximum of 4 time periods (years). As the numbers of tranche-year observations differ among panel variables, an unbalanced panel is used. Different specifications of the following linear model are tested

$$\begin{aligned} SUB_i = & B_0 + \beta_1 SPRD_i + \beta_2 LTV_i + \beta_3 INDEX_i + \beta_4 WAL_i + \beta_5 D_{CONDUIT_i} + \\ & \beta_6 OFFICE_i + \beta_7 RETAIL_i + \beta_8 IND_i + \beta_9 OTHER_i + \beta_{10} GAUTENG_i + \\ & \beta_{11} WCAPE_i + \beta_{12} KZN_i + \beta_{13} ECAPE_i + \beta_{14} PROV_i + \beta_{15} COUNT_i + \\ & \beta_{16} D_{INDUSTRIAL_i} + \beta_{17} D_{OFFICE_i} + \beta_{18} D_{RETAIL_i} + \beta_{19} D_{2005_i} + \beta_{20} D_{2006_i} + \\ & \beta_{21} D_{2007_i} + \beta_{22} D_{AAA_i} + \beta_{23} D_{AA_i} + \beta_{24} D_{A_i} + \varepsilon_i \end{aligned}$$

In summary, the predicted signs of the coefficients in the regression model are expected to be positive for, $\beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_{10}, \beta_{16}, \beta_{17}, \beta_{18},$ and β_{21} , and negative for $\beta_1, \beta_7, \beta_8, \beta_9, \beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15}, \beta_{19}, \beta_{20}, \beta_{22}, \beta_{23},$ and β_{24} .

Table 4.6 shows the results of the fixed effects (cross-sectional) and fixed effects (time-series) regressions (unbalanced panels) of subordination on explanatory variables for all commercial mortgage-backed securities listed on BESA from forth quarter 2004 to first quarter 2007. The columns report the estimated coefficient and *t*-statistic. Equation (1) and (2) use subordination

assigned to each individual tranche at issuance, while Equation (3) uses subordination available to the AAA-rated bond class. We use the fixed effects (cross-sectional) data panel regression model for Equation (1) through (2) and estimate Equations (3) using fixed effect (time-series) regression models.

TABLE 4.6
Regressions of Subordination on Explanatory Variables for 7 CMBS Deals

Independent Variables	Predicted Effect	Fixed Effects (cross-section)		Fixed (time) Effects Model			
		(1)		(2)		(3)	
		coef.	t-stat	coef	t-stat	coef	t-stat
Intercept	+	62.356***	5.896	61.187***	37.518	1.496***	7.464
SPRD	-	0.056	0.969	0.055	0.977	0.000	0.369
LTV	+	-0.550***	-3.063	-0.537**	-3.068	-0.021***	-5.495
INDEX	+						
WAL	+					-0.015***	-2.121
D _{SPLIT}	-	-1.085	0.638				
OFFICE	+						
RETAIL	? / + / -						
IND	? / + / -						
OTHER	? / + / -						
GAUTENG	? / + / -						
WCAPE	? / + / -					0.004***	3.509
KZN	? / + / -					0.011***	4.213
ECAPE	? / + / -						
PROV	? / + / -						
COUNT	-						
D _{INDUSTRIAL}	+	6.355	1.642	6.745*	1.808		
D _{OFFICE}	+						
D _{RETAIL}	+	7.375*	1.821	7.894**	2.053		
D ₂₀₀₅	-					-0.333***	-3.255
D ₂₀₀₆	-					0.001	0.052
D ₂₀₀₇	+					0.119***	2.762
D _{AA}	+	-11.490***	-4.136	-11.410***	-4.173	-16.789*	-1.780
D _A	+	-34.042***	-8.309	-33.949***	-8.413		
D _{BBB}	+	-36.461***	-5.002	-36.415***	-5.067	57.516***	5.169
Number of Observations		36		36		36	
F-statistic		25.31196		29.717		35.907	
p-value		0.000		0.000		0.000	
Adjusted-R ²		0.8474		0.852		0.889	

Asterisks indicate significance at 1% (***), 5% (**), 10 (*) levels in a two-tail test.

In addition, we introduce property type concentration variables for a property type representing 75 percent (or greater) of the total properties backing the loan pool by open market value ($D_{INDUSTRIAL}$, D_{OFFICE} , and D_{RETAIL}). The models explain an overwhelming portion of the overall variability in each dependent variable, with adjusted R^2 measures ranging from 0.847 through 0.889. Unconditional heteroskedascity and multicollinarity is a detected problem because of the limited number of deals listed on BESA and the short time period that the CMBS market has been in existence.

Because all the subordination equations are estimated using similar independent variables, the results are discussed together. The coefficients for spreads ($SPRD$) are insignificant for all models and there is no definitive positive or negative sign. This does not provide support for the view that required spreads are an important consideration for rating agencies.

As discussed in the spread model, the coefficient for the loan-to-value (LTV) ratio is negative and statistically significant at the one percent level in Equations (1) and (3), and statistically significant at the five percent level in Equation (2). However, the sign was predicted to be positive and in section 2.5 it was shown that the LTV ratio is the most important proxy for default risk used by rating agencies in their assessment of credit risk. The coefficient can be interpreted for Equations (1) and (2) as follows: a 10 percent increase in the LTV ratio corresponds to an approximately 55 basis point decrease in required subordination level.

Weighted average life (WAL) is a significant subordination determinant for subordination levels in Equation (3). Interestingly, the coefficient is negative and significantly at the one percent level. Prior research has suggested that rating agencies are only concerned with the ultimate return of principal and not with the timing (Harding et al., 2004). Theoretical literature has found that risk changes as a function of the remaining balloon date (Jacob and Fatovsky, 1999). As time passes, the greater the possibility that LTV can deviate from current levels (possibility of declining property values). A possible explanation for the opposite effect in our subordination model is that

further the balloon date, the lower the potential outstanding principal balance at the time of the balloon.

In South Africa, the major property types consist of residential, retail, office, and industrial. Combinations of these were jointly tested in Equation (1) through (3). Although these variables were intercorrelated with each other, we found no significant relationships. However, we did test concentration of property types greater than 75% of total aggregate value of all the properties by open market value. In particular, the industrial $D_{INDUSTRIAL}$ and retail (D_{RETAIL}) concentration variables had positive coefficients that were statistically significant. As shown in Figure 4.16, GPT2 is concentrated with industrial properties backing the loan pool, while GPT3 has a large retail component. Rating agencies have penalized these transactions by requiring additional credit enhancement in the form of subordination.

The industrial market has already realised solid growth from the bottom of the market fundamentals over the past few years. According to Rode (2006), this is attributed to increased economic activity in the South African market. On the other hand, the office (**OFFICE**) coefficient (not shown) was negative, but statistically insignificant owing to multicollinearity. This could be attributed to the expected performance of the sector over future periods. Schneider (2006) found that take up of existing stock in the office market is increasing countrywide. He attributes this to high building costs and limited serviced land availability.

Geographic concentration is measured by the percentage of properties from a CMBS deal that are located in one of the nine South African Provinces (regions). The model predicts regional concentration to be an important consideration for rating agencies. Specifically, the variables, **KZN** and **WCAPE** are statistically significant at the one percent level in Equation (3). Interestingly, rating agencies appear to penalize issuers with properties located outside Johannesburg and Pretoria.

Dummy variables representing the ratings categories are included in Equations (1) and (2). As theorized, subordination required for each individual tranche is inversely related to the credit rating assigned by the rating agencies. All the coefficients that proxy each ratings category are negative and significant at the one percent level. The **DAA**, **DA**, and **DBBB** coefficients can be interpreted as follows: an AA-, A-, and BBB-rated tranche requires approximately 11 bps, 34 bps, and 36 bps less subordination at issuance date respectively. These relationships confirm our discussion in Section 2.5.

The year of origination dummy variables (**D₂₀₀₅**; **D₂₀₀₆**; **D₂₀₀₇**) are included in Equation (3) to capture the time-series effect in the fixed effects model. **D₂₀₀₅** and **D₂₀₀₇** are each significant. As expected, the time coefficient representing deals issued in 2005 is positive. This provides some support to our view that the “learning” effect was present in the early stages of the CMBS market. The time coefficient representing the first quarter of 2007 also captures the deal type effect, specifically, the only deal brought to market over this period was a multi-borrower/conduit transaction. Again, a positive sign could indicate additional structural risk introduced by this deal type and/or the “learning” effect. The **D₂₀₀₆** regression coefficient is insignificant and attributed to the presence of multicollinearity. When we ran a The Pearson correlation matrix indicates that **SPRD** and **D₂₀₀₆** are significantly negatively correlated. **D_{CONDUIT}**, a variable that describes the deal type, was insignificant in all equations. Other provincial diversification and concentration variables that were not significant in the model included **OTHER**, **GAUTENG**, **ECAPE**, and **PROV**. Once more, we attribute this to multicollinearity among the independent variables. The number of properties (**PROP**) was also insignificant. We attribute this to the significant positive correlation with the **LTV** independent variable (see Table 4.4). Finally, the market indicator that proxies the property cycle (**INDEX**) does not feature significantly in any of the equations. A possible explanation is that rating agencies consider the isolated performance of each property type and/or default risk is captured in the diversification and concentration variables.

4.5. RISK AND RELATIVE VALUE ANALYSIS OF SOUTH AFRICAN CMBS MARKET¹³

The lack of cross-sectional observations available in the South African market limits the ability of investors to use multivariate regression equations in the implementation of relative value trading models in practice. Therefore, this section develops a theoretical framework that institutional investors can use when the market achieves the necessary depth and liquidity required to implement these active investment strategies. It is important to highlight that the reliability of the regression outputs reduces the applicability of the relative value trading models presented in this chapter.

To interpret the regression models presented in Table 4.5, the data collected on South African CMBS securities is inserted back into the equations. Equation (5) is used to assess the relative value when comparing deals because it does not include any “irrational” priced risk factors. An example of an “irrational” pricing relationship is evident in Equation (1) and (2) where it was found that **LTV** is inversely related to spread. For Equation (5), the coefficient of determination is 85.6% and the *F*-statistic is 21.725, which is significant at the 1% level. In addition, important pricing factors such as subordination (default risk), yield volatility (interest rate risk), tranche size (liquidity risk), diversification, and credit ratings (credit risk) were able to explain the variation in CMBS spreads. The LTV ratio, property index, deal type, property type, property geographical distribution, and dummy time effect variables were not important for explaining the variation in spread. Equation (5) is presented as follows:

$$\begin{aligned} SPRD_i = & - 141.63 - 0.91SUB_i + 25.10YIELD_i + 98.39STDEV_i + 8.81WAL_i - \\ & 13.83D_{SPLIT_i} - 0.24TSIZE_i + 0.00SIZE_i^2 - 0.25COUNT_i - 28.20D_{AA_i} + \\ & 50.9D_{BBB_i} + \epsilon_i \end{aligned}$$

Based on the above model, we would predict the following relationships:

¹³ This section uses the CMBS relative value methodology presented by Jacob and Gichon (1999, pp. 314-316).

- The *subordination* coefficient can be interpreted as follows: notes from CMBS deals that have 10% greater subordination will be priced *9.1bps tighter*.
- The *10-year spot rate on the BESASA Curve* coefficient can be interpreted as follows: if the spot rate increases by 100 bps, then notes will be priced *25.1bps wider*.
- The *volatility of 3m-Jibar* coefficient can be interpreted as follows: for a 10 bps increase in volatility, spread is *wider* by *9.8bps*.
- The *weighted average life* coefficient can be interpreted as follows: for every 1 year longer, investors require *8.8bps more* in spread.
- The *dummy tranche splitting* coefficient can be interpreted as follows: if the tranche is split, then the lower numbered tranche will trade *13.8bps lower*.
- The *tranche size* coefficient can be interpreted as follows: for every R100 million added to a tranche, investors are willing to *give 23.8bps* back to the issuer. However, investors require additional spread for exceedingly larger tranches (quadratic function).
- The *number of properties (diversification)* coefficient can be interpreted as follows: for every additional property collateralizing the loan pool, spread will trade *0.25bps lower*.
- The *rating category* coefficients can be interpreted as follows. AA-rated investors *require 28.2bps less spread*, while BBB-rated investors require compensation for credit risk in the form of *an additional 50.9bps at pricing*.

By inserting the parameter values for each CMBS security listed on BESA at issuance date, the spread required by investors for assuming the risk inherent in each tranche from a CMBS deal is computed (see Table 4.7 and Table 4.8). By comparing the spread predicted by the model with the actual spread, an investor or dealer can determine whether or not the spread at pricing date is relatively high (cheap) or low (rich). Table 4.7 separates each of the 37 floating-rate CMBS tranches listed on BESA by deal. The columns include the current trading spreads at the end of the first quarter 2007, the spreads predicted by the model, and the actual spreads at issuance for each tranche.

The cheapest of the five CMBS programmes presented in Table 4.7 was Series 1 from the Growthpoint Note Issuer Company (Pty) Ltd SPE and to a lesser extent the Freestone Finance Company (Pty) Ltd deal. The initial spreads of the highest-rated tranches from the GPT1 deal are considered cheap compared to other Series' issued from the same programme and other deals. These tranches offered strong subordination levels, competitive tranche sizing, and were issued during a period of lower interest rate risk (volatility). However, an efficient secondary market is required for investors to capture the relative value and/or any perceived opportunities in the CMBS market.

According to the model, the richest programme is Investec's Private Commercial Mortgages (Pty) Ltd. Of the five investment-grade classes issued, only the BBB-rated PC1D1 class was classified as cheap, with the model predicting a spread of 163 basis points. Compared to the actual spread of 200 basis points, the tranche was undervalued by 37 basis points at issuance, i.e. it offered relative value compared to the other classes issued from the same deal (Series 1). The first Vukile Investment Property Securitisation (Pty) Ltd deal was fairly priced compared to other issues. The spreads predicted by the model closely reflected the actual spreads at time of issuance. In addition, Table 4.8 indicates that on average the lower-rated bond classes offered relative value compared to their prime and high-grade counterparts.

It is important to highlight that these spread regression equations do not provide for fundamental valuation of CMBS. Rather, these models provide a relative valuation and give an indication of how market participants are pricing important risks. We have not considered if South African commercial mortgage-backed securities are being fairly priced and offer relative value compared to other sub-sectors of the bond market. An option adjusted spread (OAS) approach would need to be used to determine a fundamental valuation of CMBS securities and measure their relative value to other fixed-income securities (Fabozzi, 2001).

TABLE 4.7

Relative Value of Floating-Rate CMBS Deals and Tranches at Issue Date

BESA Bond Code	Issue Date	Current Trading Spread	Actual Spread at Time of Issuance	Model Spread at Time of Issuance	Active Spread (Alpha)	Relative Value
Freestone Finance Company (Pty) Ltd						
FREEA1	19-Jun-06	31	31	25	6	cheap
FREEB1	19-Jun-06	50	50	47	3	cheap
FREEC1	19-Jun-06	67	67	83	-16	rich
Grow thpoint Note Issuer Company (Pty) Ltd						
GPT1A1	28-Nov-05	34	34	15	19	cheap
GPT1A2	28-Jun-06	35	35	20	15	cheap
GPT1B1	28-Nov-05	51	51	33	18	cheap
GPT1B2	28-Jun-06	42	42	32	10	cheap
GPT1C1	28-Nov-05	85	85	77	8	cheap
GPT1C2	28-Jun-06	71	71	74	-3	rich
GPT1D1	28-Nov-05	105	105	142	-37	rich
GPT1D2	28-Jun-06	105	105	134	-29	rich
GPT2A1	07-Sep-06	40	40	39	1	cheap
GPT2B1	07-Sep-06	45	45	55	-10	rich
GPT2C1	07-Sep-06	77	77	84	-7	rich
GPT3A1	10-Nov-06	40	40	52	-12	rich
GPT3B1	10-Nov-06	46	46	46	0	
GPT3C1	10-Nov-06	90	90	82	8	cheap
Prime Realty Obligors Packaged Securities						
PRP1A1	02-Nov-04	23	38	49	-11	rich
PRP1A2	02-Nov-04	35	40	43	-3	rich
PRP1B1	02-Nov-04	43	55	66	-11	rich
PRP1B2	02-Nov-04	47	62	66	-4	rich
PRP1C1	02-Nov-04	95	111	105	6	cheap
PRP1C2	02-Nov-04	106	116	105	11	cheap
PRP1D1	02-Nov-04	168	178	165	13	cheap
PRP1D2	02-Nov-04	178	184	167	17	cheap
Vukile Investment Property Securitisation (Pty) Ltd						
VIP1A1	07-Nov-05	39	39	35	4	cheap
VIP1A2	07-Nov-05	45	45	51	-6	rich
VIP1B1	07-Nov-05	55	55	51	4	cheap
VIP1B2	07-Nov-05	60	60	60	0	
VIP1C1	07-Nov-05	99	99	93	6	cheap
VIP1C2	07-Nov-05	105	105	105	0	
Private Commercial Mortgages (Pty) Ltd						
PC1A1R	27-Mar-07	44	44	59	-15	rich
PC1A2	28-Mar-07	43	43	51	-8	rich
PC1B1	29-Mar-07	60	60	71	-11	rich
PC1C1	30-Mar-07	104	104	106	-2	rich
PC1D1	31-Mar-07	200	200	163	37	cheap

Source: Absa Capital's Bond Matrix; Bond Exchange of South Africa

TABLE 4.8
Relative Value of Floating-Rate CMBS by Ratings Category

BESA Bond Code	Issue Date	Current Trading Spread	Actual Spread at Time of Issuance	Model Spread at Time of Issuance	Active Spread (Alpha)	Relative Value
AAA-rated						
FREEA1	19-Jun-06	31	31	25	6	cheap
GPT1A1	28-Nov-05	34	34	15	19	cheap
GPT1A2	28-Jun-06	35	35	20	15	cheap
GPT2A1	07-Sep-06	40	40	39	1	cheap
GPT3A1	10-Nov-06	40	40	52	-12	rich
FRP1A1	02-Nov-04	23	38	49	-11	rich
FRP1A2	02-Nov-04	35	40	43	-3	rich
VIP1A1	07-Nov-05	39	39	35	4	cheap
VIP1A2	07-Nov-05	45	45	51	-6	rich
PC1A1R	27-Mar-07	44	44	59	-15	rich
PC1A2	28-Mar-07	43	43	51	-8	rich
AA-rated						
FREEB1	19-Jun-06	50	50	47	3	cheap
GPT1B1	28-Nov-05	51	51	33	18	cheap
GPT1B2	28-Jun-06	42	42	32	10	cheap
GPT2B1	07-Sep-06	45	45	55	-10	rich
GPT3B1	10-Nov-06	46	46	46	0	
FRP1B1	02-Nov-04	43	55	66	-11	rich
FRP1B2	02-Nov-04	47	62	66	-4	rich
VIP1B1	07-Nov-05	55	55	51	4	cheap
VIP1B2	07-Nov-05	60	60	60	0	
PC1B1	29-Mar-07	60	60	71	-11	rich
A-rated						
FREEC1	19-Jun-06	67	67	83	-16	rich
GPT1C1	28-Nov-05	85	85	77	8	cheap
GPT1C2	28-Jun-06	71	71	74	-3	rich
GPT2C1	07-Sep-06	77	77	84	-7	rich
GPT3C1	10-Nov-06	90	90	82	8	cheap
FRP1C1	02-Nov-04	95	111	105	6	cheap
FRP1C2	02-Nov-04	106	116	105	11	cheap
VIP1C1	07-Nov-05	99	99	93	6	cheap
VIP1C2	07-Nov-05	105	105	105	0	
PC1C1	30-Mar-07	104	104	106	-2	rich
BBB-rated						
GPT1D1	28-Nov-05	105	105	142	-37	rich
GPT1D2	28-Jun-06	105	105	134	-29	rich
FRP1D1	02-Nov-04	168	178	165	13	cheap
FRP1D2	02-Nov-04	178	184	167	17	cheap
PC1D1	31-Mar-07	200	200	163	37	cheap

Source: Absa Capital's Bond Matrix; Bond Exchange of South Africa

4.6. SUMMARY

This chapter began by empirically investigating the relationships between the independent pricing variables and the dependent variables. A comprehensive discussion of each risk category was provided, including graphical representations and references to the presented literature on CMBS pricing. After theorizing correlations and examining descriptive statistics, the results of our simple spread and subordination models were presented. An exploratory analysis using a multivariate regression framework was then used to assess the relative value of South African CMBS securities. By inserting the parameters from the CMBS database (see Appendix 1) into the model, the expected spread at issuance was computed. This was compared against the actual spreads on each investment-grade floating-rate note listed in the Bond Exchange of South Africa and demonstrated how investors could implement a relative value trading framework in practice.

In the next chapter, conclusions are provided as to the validity of the hypotheses presented in Chapter 1, after considering prior research and the results of our regression models. The limitations highlighted in Section 1 are also briefly analyzed and extended. In addition, implications for theory, practice, and future research are discussed.

5. CONCLUSION AND IMPLICATIONS

5.1. INTRODUCTION

In this contribution to the theory and practice of pricing commercial mortgage-backed securities, risk characteristics and pricing relationships of these securities in an emerging market have been assessed. The South African bond market has seen the rapid growth of commercial mortgage-backed securitization (CMBS) structures, including single-borrower/multi-property and multi-borrower/conduit deals. The first public single-borrower/multi-property and multi-borrower/conduit deal was listed on the Bond Exchange of South Africa in 2004 and 2007 respectively. By first quarter 2007, five programmes and seven deals had been listed on the Bond Exchange of South Africa, with total issuance volume exceeding R7.8 billion. Property loan stock companies have been the dominant players in the market by reducing their borrowing costs through the securitization of their commercial property portfolios into single-borrower/multi-property CMBS deals (large loan). With commercial banks starting to provide innovative property finance through the use of multi-borrower/conduit deal structures, alternative deal types are expected to add further depth to the primary market and much needed liquidity to the secondary market.

This continued expansion of new issues has been stimulated by innovation, strong institutional investor demand, and strong fundamentals in the South African property market combined with important legislation changes. All CMBS issues have achieved tight pricing and a trend emerged towards a compression in spreads. A number of studies have suggested that this could be attributed to a number of factors, including learning, improved liquidity, and demand and supply dynamics. However, these securities still face competition from other bond instruments listed on the Bond Exchange of South Africa. For example, floating-rate CMBS deals issues have seen tighter pricing compared to other bond sectors. By the end of 2006, CMBS issues were trading at a significant price premium to their corporate counterparts. The combination of narrow spreads and the commercial property market having already moved away from the bottom of the property cycle will be a cause of concern for investors, i.e. widening of spreads over future periods.

The analysis of the primary South African CMBS market currently centers on supply/demand dynamics of institutional investors. Although the relationship between supply/demand is an important factor in pricing, it is one of the many determinants. Increases in CMBS issuance should be associated with spread compression and strong relative returns for investors in existing issues, i.e. increasing bond prices in the secondary market. Bond prices and yield spreads are inversely related. For example, an investor favours a tightening spread in credit (bond) instrument because the narrow spread will cause the price of the bond to increase. An Investor will benefit from additional return in the form of bond price appreciation, however, this additional performance is only realised if the bond is sold in the secondary market. In the investment-grade credit market, Fabozzi (2004, p. 137) confirms our argument by asserting that "*heavy supply often compresses spreads and boosts relative returns for credit assets as new primary valuations validate and enhance secondary valuations.*"

Utilizing the statistical techniques of correlation analysis and simple linear regression analysis, it has been shown that investment-grade South African commercial mortgage-backed securities are sensitive to default risk, liquidity risk, subordination and to a lesser extent interest rate risk and volatility risk (prepayment risk). The pricing models were unable to validate yield curve risk as a statistical significant risk factor considered in pricing these securities. Previous studies on the U.S. market found CMBS securities to be sensitive to changes in the slope of the yield curve (Maris and Segal, 2002; Maxam and Fisher, 2001; Harding et al., 2004). The research has shown using descriptive statistics that the collateral (properties) backing these CMBS are generally diversified by property type, provincial location, and number of properties. Although, some issues were concentrated geographically and/or by property type, the additional risk is to some extent being captured in pricing. In addition, an exploratory analysis using a multivariate pricing framework for issuance spreads found that they are influenced by subordination, current market indicators (interest rate risk), deal type, tranche size, weighted average life, loan quality, and other control variables such as credit ratings category. Despite the fact that the variables were significant, some of the regression coefficients are not consistent with their predicted signs. On

the whole, the findings suggest that South African CMBS securities are to some extent being *rationaly* priced at issuance, although the reliability of the multivariate pricing framework is uncertain because of the limited number of cross-sectional observations. This research did not confirm if these securities offer relative value to other credit sectors.

The CMBS market could offer opportunities for investors to pursue "asset differential" pricing between deals and rating categories. Having developed a theoretical relative value framework, it has been shown that some bond classes across deals and within the same ratings category are possibly being priced more competitively than others. This offers future opportunities for investors to implement relative value trading strategies when the CMBS market has developed sufficient depth in primary (new transactions) issuance. Adequate cross-sectional tranche observations are required to use this framework within a proprietary trading environment. It has also been shown that it may be necessary for investors to start monitoring their positions in CMBS for the possibility of trading in the secondary CMBS bond market. Interest rate movements can cause the underlying *credit fundamentals* to change very quickly in a regional market (Kochen, 1996). In other worldwide markets, the profile of these securities is inherently volatile and demands continuous monitoring.

This chapter begins by considering the findings presented in Chapter 4 in the context of prior research presented in the literature review. Conclusions for either accepting or rejecting the hypotheses theorized in Section 1.2.3 are considered in Section 5.2. Following our conclusions, Section 5.3 and Section 5.4 provide a discussion of the implications of the findings on theory and investment practice. Limitations of the research are outlined in the next section. Section 5.6 suggests further research on pricing commercial mortgage-backed securities. This final section focuses specifically on the needs and implications of future research on the South African CMBS market.

5.2. TESTING THE CONCLUSIONS ABOUT HYPOTHESES

5.2.1. Hypothesis (i)

The first hypothesis asserted that *the risks of commercial-mortgage-backed securities issued in South Africa are being correctly priced by investors*. This hypothesis was tested in Section 4.3 and 4.4.1 by regressing issuance spreads on either single or multiple explanatory variables for all CMBS deals currently listed on the Bond Exchange of South Africa (BESA). The regression models were supported by graphical outputs, descriptive statistics and correlation analysis. However, the availability of cross-sectional tranche observations limited the reliability of the multivariate equations because of possible measurement errors. Only investment-grade floating-rate tranches were considered in our empirical investigation.

The credit rating process, specifically subordination determination and rating assignment, impact pricing. Although the level of subordination and pricing are found to be jointly determined in the simple linear regression models, the coefficients of rating categories conflict with their theorized signs. This relationship was attributed to investors either correcting ratings methodology used by agencies or the *illusion* that senior-rated tranches are free from default risk. Changes in spreads overtime is explained by both credit risk and other risks introduced by cash flow uncertainty. Several market indicators were interacted within an exploratory multivariate spread model and showed that individual coefficients of the level of interest rates, volatility of interest rates, and a listed property index are possibly considered in CMBS pricing. However, the number of cross-sectional observations limit the reliability of the predictions. The loan-to-value (LTV) variable used to proxy loan quality was not a consistent determinant of pricing and had conflicting pricing directions. Again, investors could be redistributing spread according to their view of the rating agency's assessment of underlying credit risk.

The results for diversification, as measured by property type distribution, provincial distribution, and number of properties, did not show an effect on pricing when using correlation analysis and

simple linear regression. Intrinsic diversification of the collateral is an important default risk element assessed when investing in CMBS securities. The exploratory investigation using multiple regression analysis confirmed prior literature that asserted the need for investors to develop a property market framework for pricing (Mathew and Katz, 1999; Corcoran, 1999; Lancaster, 2001). However, the regression results of this research disagree with the earlier research of Harding (1997) and Jacob et al. (1999). Their models showed that property mix concentrations were not useful in explaining the variation in CMBS spread. Interestingly, recent research on conduit pricing by Harding et al. (2004) supported our empirical results.

Other structural variables that were significant in the multiple regression spread models included weighted average life (WAL) of the tranche, size of the tranche, and sub-divided bond classes. WAL and size enter the equations with their predicted coefficients (Maris and Segal, 2002; Harding and Sirmans, 1997; Harding et al., 2004). This research is the first known study to show that the tranche size (liquidity risk proxy) follows a positive second order quadratic relationship that has a unique turning point for larger CMBS issues. The coefficient of split tranches was significantly negative and conflicted with previous research. A possible explanation is that investors are capturing this effect in the WAL variable. Generally these tranches are subdivided into a short average life and long average life. Kochen (1996) postulated that tranche splitting can introduce additionally cash flow uncertainty with respect to the timing of principal repayments.

From the simple spread regression outputs with a single explanatory variable, the hypothesis is rejected. Exploratory multiple regression analysis of the interactions between the independent pricing factors showed that it likely that these risks are to some extent being correctly priced by investors at issuance. However, the reliability of the multivariate equations is limited because of the lack of depth in the primary CMBS market. Although the validity of the generalisations will be affected by the number of variables in relation to the number of observations in the data set, it is likely that the analysis will identify a reduced number of key variables that might be used in a subsequent analysis which would then have greater validity. Nevertheless, it is anticipated that

the available cross-sectional tranche observations will increase substantially over future periods along with CMBS volumes. Therefore, the hypothesis that *the risks of commercial-mortgage-backed securities issued in South Africa are being correctly priced by investors* is rejected.

5.2.2. Hypothesis (ii)

The second hypothesis asserted that *investors are performing value asset differential pricing between different South African CMBS issues and bond classes*. This hypothesis was tested in Section 4.5 by inserting parameters values for each investment-grade floating-rate CMBS securities listed on BESA into the multiple regression models used to test the first hypothesis and computing the expected (predicted) spread at issuance date. The relative value of these securities were assessed by comparing the predicted spread to both the current trading spread and actual spread at date of issuance.

The relative value framework developed using the exploratory multiple regression equations confirmed earlier work by Jacob and Gichon (1999). It was found that several deals and bond classes were either overvalued (rich) or undervalued (cheap), however, the reliability of the results are uncertain because of the limited number of CMBS transactions available for comparative analysis. As shown in the results of the spread model, bond classes of the same ratings category will produce different performance results and should be priced accordingly (see Table 4.4). The theoretical framework has shown that by differentiating between deals and bond classes, future investors in the CMBS market can possibly take advantage of cheap securities by generating an active alpha through secondary trading. However, it appears institutional investors are still following a passive buy-and-hold strategy within the South African CMBS market. Lack of depth and liquidity in the secondary market limits the investor's ability to pursue these active trading strategies to take advantage of mispriced commercial mortgage-backed securities. Although the validity of the generalisations are affected by the number of variables in relation to the number of observations in the data set, the analysis identifies a reduced number of key variables that might be used in a subsequent analysis which would then have greater validity.

Therefore, the hypothesis that *it is possible for investors to perform "asset differential" relative pricing between different South African CMBS issues and bond classes* is rejected.

5.2.3. Hypothesis (iii)

The third hypothesis asserted that *investors are purchasing commercial mortgage-backed securities issued in South Africa according to their credit rating rather than for their interest rate risk and liquidity risk*. The simple linear regression spread models presented in Section 4.3 are used as explanatory tools to test the hypothesis.

Previous research on CMBS pricing have found that pricing models that focus exclusively on credit risk are missing a fundamental and dynamic relationship, specifically, the inverse relationship between cash flow risk and credit risk. Harding and Sirmans (1997) showed that reductions in credit risk come at the expense of increases in other risks. These risks included interest rate risk, yield curve risk, liquidity risk, volatility risk, etc. Further research on CMBS pricing has overwhelmingly confirmed this relationship (Harding et al, 2004; Maris and Segal, 2002, Maxam and Fisher, 2001, Riddiough and Polleys, 1999).

The simple spread regression equations of this research showed that liquidity risk is an important pricing determinant for commercial mortgage-backed securities. Although the AA- and BBB-ratings categories that are used as default risk proxies are significant, loan quality, interest rate risk (including volatility risk), diversification and other risk factors are not important to investors. In addition, it was shown that some AA-rated tranches are priced at narrower spreads than AAA-rated tranches from other issues (see Table 4.2). Kochen (1996) refers to this as the "*triple-A illusion*". As highlighted in Section 2.5, the credit ratings assigned by credit rating agencies address the likelihood of timely payment of interest and *ultimate* return of principal (see Section 2.5). A rating agency does not endeavor to determine the timing of the return of principal and their credit analysis also focuses predominantly on static data.

Interest rate risk, specifically volatility in the level of interest rates, has shown that borrower optionality (prepayment, extension, etc.) is just as important as default risk. Kochen (1996, p. 111) asserted that “*deal structure has a material affect on liquidity*”. Furthermore, Harding et al. (2004) showed that the structure of the deal, the diversification and concentration of the underlying collateral are critical to assessing risk, including liquidity. However, it was shown that the variation in a cross-section of these explanatory factors in the multiple regression equations explain the variation in yield spreads. However, it has not been possible to validate that investors will be able to sell their holdings in a volatile interest rate environment and/or liquidity crunch, i.e. forced to sell their position at significantly discounted prices.

Although the validity of the generalisations will be affected by the number of variables in relation to the number of observations in the data set, it is likely that the analysis will identify a reduced number of key variables that might be used in a subsequent analysis which would then have greater validity. Based on the results of the simple regression models and because of the reliability issues with the multiple regression equations, the hypothesis that *investors are purchasing commercial mortgage-backed securities issued in South Africa according to their credit rating rather than for their interest rate risk and liquidity risk* is accepted. It is concluded that other risk factors do not influence investors' decision to invest in the South African CMBS market.

5.2.4. Hypothesis (iv)

The forth hypothesis asserted that *rating agencies are correctly assessing credit risk inherent in South African commercial mortgage-backed securities*. This hypothesis was tested in section by regressing subordination (AAA-rated bond classes) against explanatory variables theorized to be important to rating agencies when assessing CMBS deals (see Table 4.4.1 and Table 4.6).

Loan quality, diversification, deal type, rating categories, and property mix variables were all tested for significance. Countering our empirical hypotheses, several property mix geographical

diversification variables were not important in determining subordination schedules. These relationships did not confirm Franzetti's (1999) assertion that rating agencies deem property type diversification and geographical distribution to be important elements in their assessment of the credit risk of a loan pool. However, these variables were found to be important considerations in the exploratory multiple regression equations. It was also found in the multiple regressions that the weighted average life (WAL) of a CMBS tranche was significant and negatively related to subordination, however, the regression coefficient was theorized to be positive. This could be attributed to either violations in the regression assumptions or the lower risk of a lower refinancing balance at balloon maturity date. Spreads at issuance were also insignificant in the subordination models. As highlighted in the literature review, the view that rating agencies are solely concerned with investigating credit risk factors is maintained.

The loan-to-value (LTV) ratio was used as a proxy for loan quality and found to be inversely related to subordination in the regression model. This contrasted with the positive theorized sign for LTV. Using similar methodology, Harding, Sirmans and Thebpanya (2004) found a significant positive relationship between their estimated LTV slope coefficient and actual subordination levels. Their data set differs in that it only covers conduit issues in the U.S. CMBS market over the 1997-2001 period. Conduit deal types usually have higher loan-to-value ratios than single-borrower/multi-property (large loan) transactions. The subordination model highlighted these interacting terms with a positive and statistically significant conduit deal type coefficient. Trepp and Savitsky (1999) explained that the LTV indicator is one of the most commonly reviewed indicators during the initial credit analysis phase. This was confirmed in Section 4.4 and 4.5 where the major credit risk analysis approaches used by rating agencies when determining required subordination and credit ratings were reviewed. Subordination is LTV driven because a deal with a lower ratio is considered more credit worthy and contains less default risk (Jacob, Hong, and Lee, 1999).

Although the validity of the generalisations will be affected by the number of variables in relation to the number of observations in the data set, it is likely that the analysis will identify a reduced number of key variables that might be used in a subsequent analysis which would then have greater validity. Based mainly on the results of the simple regression models and the limited availability of cross-sectional observations, the hypothesis that *rating agencies are correctly assessing credit risk in South African commercial mortgage-backed securities* is rejected. Important default risk factors such as LTV ratios appear not to be correctly incorporated into rating agencies' credit analysis and subsequent subordination schedules. In addition, investors appear to be redistributing spread through rating categories.

5.3. IMPLICATIONS FOR THEORY

To date, prior research on CMBS pricing has focused exclusively on the pricing characteristics of these securities in the developed markets of Europe, Asia, and the U.S. This research has provided the first known analysis of the risk/return characteristics of commercial mortgage-backed securities in an emerging market. In addition, it builds on previous work that investigates the interaction between subordination and pricing. Utilizing the statistical techniques of multiple regression analysis, it has been shown that investors in emerging markets have the ability to correctly assess the inherent risks in CMBS. The results reported in Sections 4.3 and 4.4 should be interesting to all investors participating in an emerging bond market. While credit ratings are very important, similarly rated tranches are possibly being *rationaly* priced very differently from one another. The variations in pricing, moreover, are possibly predictable according to the underlying mortgage pools and deal structure.

However, it has been found that limited cross-sectional observations and the required "*learning*" in a fledging market may be impediments for rating agencies in their evaluation of credit risk. It has also been shown that there are inference problems when using databases with limited cross-

sectional tranche observations in such markets. This is attributed to CMBS being a relatively new asset class and the fact that the time periods they reflect are quite short. Previous research has also questioned if the initial beginnings of a CMBS market is filled with “*irrational exuberance*”. Although limited access to information is a setback in the investment decision process, it has been shown that CMBS in an emerging market can reflect the necessary risks to rationalize their spreads at issuance. Efficiency in developed markets has made it harder for investors in these markets to find mispriced securities. Emerging countries with an efficient bond market (including trading platforms) will encourage these foreign investors to diversify their holdings and pursue opportunities outside their domestic markets.

Distinct from other studies investigating CMBS pricing, the first look at the opportunities provided by these securities in South Africa has been provided. There appears to be a number of risk elements beyond those which are reflected in basic option-adjusted spread analysis. In addition, the lack of diversity and depth are obstacles facing investors when looking to take advantage of differential asset pricing by pursuing active trading strategies. Size and liquidity constraints are also barriers for foreign investors looking to diversify their global portfolios, but financial innovation and improvements in infrastructure will encourage the development of the secondary market and increase trading.

5.4. IMPLICATIONS FOR INVESTORS AND OTHER MARKET PARTICIPANTS

In the U.S. CMBS market, a compression of yield spreads occurred over the 1992-1997 period. This trend only reversed with the financial market crisis of 1998. During this downturn, investors were reluctant to purchase lower-rated bond classes that were used by CMBS issuers to credit enhance senior-rated tranches. Maris and Segal (2002, pp. 247-248) suggested that the market might have reflected a behavioral bias, a degree of internal “*financial contagion*”. In addition, they state that “*investors were influenced by actions of other investors in a manner with lasting consequences for CMBS yield spreads and issuance volume*”. This chronic market inefficiency is referred to as herding behavioral bias and occurs when investors are influenced by other

investors because of the fear of being left behind by their peers. Furthermore, Maris and Segal questioned whether interaction effects between investors also contributed to the compression of CMBS yield spreads.

Kochen (1996) stated that key features of the U.S. securitization market are being oversold. Specifically, the initial performance presented appeared to be "*running ahead of ultimate historic reality*". Contrasting with the U.S. experience, South African CMBS has achieved extremely tight pricing and a compression of yield spreads, with many new issues several times oversubscribed at pricing. It appears institutional investors, fearing being left behind and sharing the same views, could be keeping their investment decisions in line with their peers. There could also be additional bias and influence from the strong performance of this new innovative financial product in other international markets to date. This behavioral bias, commonly referred to as "irrational exuberance", could possibly be taking over rational decision making, where investors would assess the opportunities presented by an investment in a risk/return framework (Jacob and Gichon, 2006). Fabozzi (2004, p. 141) stated that "*the worst investment decisions emanate from stale views based on dated and anachronistic constraints*". It has been shown that assessing risks in the commercial mortgage-backed securities are important when investors are considering the opportunities presented by these new structured products. Market participants should recognize the potential for additional risks that were not considered at initial pricing to eventually feed back into the CMBS market through a widening of spreads. Widening (Narrowing) spreads are associated with a decrease (increase) in bond prices (Fabozzi, 2004).

Like the early stages of development in the other international CMBS markets, the South African market has also grown on the back of strong fundamentals in the domestic property market (Rode, 2006). Reviewing the November 2005 *Securitization and Debt Capital Markets Conference*, Rushton and Els (2005, p. 3) remarked that "*the asset class is yet to really be tested by a significant downturn*" in the property market. In addition, the market has yet to be tested against a global financial crisis. It has been shown that AAA-rated classes have inherent risks

greater than the rating-category (credit risk) implies. Although prepayment risk is mitigated through penalty provisions, defaults can still occur and will introduce reinvestment risk. Investors in the CMBS market will be misled if they assume senior-rated notes contain no measure of default risk. Kochen (1996, p. 113) refers to this as the "*triple-A rating illusion*".

Rushton and Els (2005) also noted that institutional investors practice a buy and hold strategy in the South African securitized market. This bias will have little impact on the development of a secondary market for commercial mortgage-backed securities. Active strategies that identify inefficiencies in the market can only be pursued with further development of the primary and secondary market. An efficient secondary market is needed by investors to implement active (relative value) trading strategies to capture additional spread (also referred to as *alpha*) by exploiting market mispricings. The prices of commercial mortgage-backed securities need to adjust to reflect all new information that is made available subsequent to issuance if investors are to pursue an active strategy. We have shown that the underlying collateral and deal structure both have a significant impact on pricing and liquidity of an investor's holdings. Interest rate movements can also affect marketability and spreads at pricing. Volatile interest rate environments can cause the loans and properties to suffer from further lack of liquidity. The commercial mortgage-backed securities should therefore be more liquid than the underlying collateral, however, the market has yet to be tested (Rushton and Els, 2005). Investors may have been lulled into the "*illusion of liquidity*". When commenting on the U.S. securitization from an investors view, Kochen (1996, p. 112) remarked: "*Sure they're (commercial mortgage-backed securities) are liquid, unless you actually have to sell them!*" With further issuance on the horizon, the depth of the primary market will continue to improve. Although erratic in nature, investors are also beginning to perform marked-to-market (Bond Exchange of South Africa, 2007) on their positions, which could see a structural shift away from a strictly passive buy and hold strategy.

5.5. LIMITATIONS OF RESEARCH

An underlying limitation of this research is the limited data set because of the limited number of cross-sectional tranche observations available for analysis. In addition, the unavailability of detailed information relating to South African CMBS deals from a centralized database provided by an independent financial vendor. As discussed in Section 1.5.2, reporting on CMBS issues usually remains proprietary information of the arrangers, issuers, and investors. The research is therefore restricted to investigating CMBS deals at issuance date, limiting our ability to assess performance over time. Moreover, transaction documentation which is made available to the public is not standardized across all programmes. As a result, information had to be collected from a variety of sources and a basic South African CMBS database constructed. The data collection methods increased model risk through potential input errors. The 2006 Deloitte survey, *South African Securitisation Market: Top 10 Issues for 2006*, confirmed non-standard documentation as a major concern for investors participating in the securitization market.

The regressions show signs of both heteroskedasticity and multicollinearity. These violations in the regression assumptions limited the validity and predictability of our model. As highlighted in the Pearson correlation matrix presented in Section 4.3, combinations of factors (independent variables) are highly correlated with each other. With multicollinearity, it has not been possible to represent all the pricing characteristics in a single spread model. Spread regression equations that attempted to replicate previous research resulted in an overall model that was significant as indicated by the F -statistic and coefficient of determination. However, because of multicollinearity, the regression coefficients were not individually significant. This limited the usefulness of the model as an explanatory and forecasting tool.

“Data-snooping” and “look-ahead bias” is also an important consideration when analyzing the results of the regression equations presented in Section 4.4. “Data-snooping bias” can occur because the research is based on empirical results of previous studies investigating CMBS pricing. This research has investigated pricing patterns that other researchers have theorized in

an attempt to replicate their methodologies. In an attempt to limit biased inferences, new data on the South African property market has been considered, correlations between factors have been meticulously investigated and new relationships have been tested. A quadratic (polynomial) function between tranche size and spreads is an example of such a relationship. “Look-ahead bias” is also present because the model uses data on CMBS pricing which would not have been available to investors at issuance date. Finally, time-period bias could also be present if the time period used (forth quarter 2004 to first quarter 2007) makes the results of our regression model time-period specific, i.e. limits the drawing of inferences on future CMBS issues. The database compounds these biases because it systematically excludes commercial mortgage-backed securities which are not issued with a floating coupon rate and/or assigned an investment-grade rating (BBB-rated or above).

Finally, the hypothesis testing can lead to two possible errors: **Type I error** and **Type II error**. Type I error occurs when the null hypothesis is rejected when it is actually true, while a Type II error occurs when the researcher fails to reject the null hypothesis when it is actually false. However, decreasing the probability of making a Type I error through improved statistical testing makes it more difficult to reject the null hypothesis when it is true. However, Pinto et al. (2001) noted that this comes at the expense of increasing the probability of making a type II error because the hypothesis is rejected less frequently, even when it is in fact false. The limited sample size increases the probability of both Type I and Type II errors.

5.6. IMPLICATIONS FOR FUTURE RESEARCH

As suggested by Harding et al. (2004), it would be useful to determine if initial pricing spread differences persist throughout the lives of CMBS issues and bond classes. In an efficient market, investors would identify mispriced (cheap) bond classes and pursue relevant relative value investment strategies. Trading in the secondary market would cause price corrections for both undervalued (long strategy) and overvalued (short strategy) securities. This analysis is only

possible if the primary issuance volume increases over future periods and the number of cross-sectional observations available to market participants increases substantially.

Moreover, it would also be useful to conduct research to see how the changing quality of the asset pool over time impacts pricing (spreads) in the secondary market. However, such research would be limited until the primary market for CMBS develops sufficient depth to support a liquid secondary market. It would also be necessary to obtain regular collateral performance updates from the arranger/issuer in order to perform cross-sectional analysis of all CMBS issues. To date this information remains private and is usually only made available to investors. It would be more realistic to carry out a time-series analysis using a CMBS issue as a single case study. This would allow the researcher to isolate the impact of principal paydowns on performance, especially considering the protection afforded by prepayment and/or extension penalties.

It would also be interesting to investigate if the South Africa CMBS market offered better relative value than other sectors of the bond market. For example, what is the value of a commercial mortgage-backed security that contains prepayment penalties compared to an option-free corporate bond issue. This could be achieved by using a contingent-claims theoretic framework and applying option pricing methodology to commercial mortgages and their related securities. The option-adjusted spread would need to be calculated and compared to other securities listed on the Bond Exchange of South Africa. Finally, it would be worthwhile applying fundamental and relative valuation techniques to determine the pricing characteristics of residential mortgage-backed securitization (RMBS).

REFERENCES

- Abraham, J. M. and Theobald, H. S. (1997), A simple prepayment model of commercial mortgages, *Journal of Housing Economics*, **6**, 31-59.
- Baranick, D. & Quraishi, S. H. (1999), Performing financial due diligence associated with commercial mortgage securitizations, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 397-416.
- Baron, N. D. (1996), The role of rating agencies in the securitization process, in Kendall, L. T. & Fishman, M. J. (eds.), *A Primer on Securitization*, Michigan Institute of Technology, pp. 45-54.
- Baum, S. P. (1996), The securitization of commercial property debt, in Kendall, L. T. & Fishman, M. J. (eds.), *A Primer on Securitization*, Michigan Institute of Technology, pp. 45-54.
- Boyer, L. G., Follain, J. R., Ondrich, J. & Piccirillo, A. (1997), A hazard model of prepayment and claim rates for FHA insured multifamily mortgages, Paper presented at the AREUEA Annual Meeting, January.
- Cantwell, D. M. (1996), How public corporations use securitization in meeting financial needs, in Kendall, L. T. & Fishman, M. J. (eds.), *A Primer on Securitization*, Michigan Institute of Technology, pp. 56-66.
- Capone, C. A., Jr. & Goldberg, L. (1998), Motivating and modeling multifamily mortgage prepayment rates, *Paper presented at the AREUEA Annual Meeting*, January.
- CFA Institute, *Managing Investment Portfolios, A Dynamic Process*, 3rd ed. (Forthcoming)
- Chadakoff, R. L., Fisher, M. R. and Stein, J. (2002), A guide to commercial mortgage transactions in the USA, *Briefings in Real Estate Finance*, **2**(4), 341-361.
- Chance, D. M. (2003), *Analysis of Derivatives for the CFA Program*, Association for Investment Management and Research, Charlottesville, Virginia.
- Cheng, D., Cooper, A. R. & Huang, J. (1999), Understanding prepayments in CMBS deals, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 93-112.

Commercial Mortgage Alert Database, Retrieved: 3 April 2007, from <http://www.cmalert.com>.

Corcoran, P. (1999), A property market framework for bond investors, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 13-52.

Corcoran, P. & Kao, D. L. (1999), Assessing credit risk of CMBS, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 247-112.

Corcoran, P. & Phillips, J. (2001), CMBS in Japan, in Fabozzi, F. J. (ed), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

Corcoran, J. & Phillips, J. (2001), Floating-rate commercial mortgage-backed securities, in Fabozzi, F. J. (ed), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

Corcoran, P. J. and Yuriko, I. (2002). CMBS loan defaults, *The Journal of Fixed Income*, December, 53-59.

Gichon, G. (1999), The CMBS market: Past, present, and future, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 3-12.

Daingerfield, E. (1995). *Multifamily project securities*, In F. Fabozzi et al., *The Handbook of Mortgage-Backed Securities*, 4th ed., Chicago, Probus Publishing.

Davis, S, Cook, K. & Della Sala, F. (1999), The role of the trustee, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 381-396.

Defusco, R. A., McLeavey, D. W., Pinto, J. E. & Runkle, D. E. (2001), *Quantitative Methods for Investment Analysis*, Association for Investment Management and Research, Charlottesville, Virginia.

DeMichele, J. F. & Rudenstein, A. P. (1999), Commercial mortgage-backed securities, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 73-92.

Dunlevy, J. N. (1999), Structural considerations impacting CMBS, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 113-128.

Elmer, P. J., & Haidorfer, A. E. (1997), Prepayments of multifamily mortgage-backed securities, *The Journal of Fixed Income*, **6**(4), pp. 55-63.

Ervolini, M. A., Haig, H. J. & Megliola, M. A. (1999), Credit-driven prepayment and default analysis, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 266-274.

Fabozzi, F. J. (2004), *Fixed income readings for the Chartered Financial Analyst Program*, 2nd ed., Frank J. Fabozzi Associates, U.S.

Follain, J. R. & Scott, L. O. (1992), Micofoundations of a mortgage prepayment function, *Journal of Real Estate Finance and Economics*, **5**(2), pp. 197-217.

Follain, J. R., Huang, W-V. & Ondrich, J. (1999), Pay or walk away: A hazard rate analysis of FHA-insured multifamily mortgage terminations, *Paper presented at AREUEA Annual Meeting*, 1999.

Follain, J. R., Ondrich, J. & Sinha, G. (1997), Ruthless prepayment? Evidence from multifamily mortgages, *Journal of Urban Economics*, **41**, pp. 78-101.

Foster, C. & Van Order, R. (1990), Estimating prepayments, *Mortgage Markets*, **7**(4), pp. 24-26.

Franzetti, J. C. (1999), Rating of commercial mortgage-backed securities, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 193-246.

Golub, B. W. & Reilly, M. M. (1999), CMBS: Developing a risk management framework for a new asset class, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 171-182.

Gordon, R. & Gibson, L. (2001), Structure, valuation, and performance of CMBS, in Fabozzi, F. J. (ed), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

Gujarati, D. N. (2003), *Basic Econometrics*, 4th ed., McGraw-Hill, New York.

Hair, J. F., Money, A. H., Samouel, P. & Page, M. (2007), *Research Methods for Business*, John Wileys and Sons Limited, United Kingdom.

Harding, J. P. & Sirmans, C. F. (1997), Commercial mortgage-backed securities: An introduction for professional investors, *Real Estate Finance (Euromoney Institutional Investor PLC)*, **14**(1), Database: Business Source Premier.

Harding, J. P., Sirmans, C. F. & Thebpanya, S. (2004), CMBS pricing: Evidence from modern conduit issues, *The Journal of Fixed Income*, June, 69-87.

Jacob, D. P. & Fastovsky, P. (1999), Understanding and managing the balloon risk of commercial mortgages in CMBS, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 275-286.

Jacob, D. P., Gichon, G., Lee, D. & Tong, L. (1999), A framework for risk and relative value analysis of CMBS: Theory, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 289-304.

Jacob, D. P. & Gichon, G. (1999), A framework for risk and relative value analysis of CMBS: Practice, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 305-316.

Jacob, D. P. & Patel, J. (2001), The efficient frontier for CMBS and commercial mortgages using a risk-return framework, in Fabozzi, F. J. (ed), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

Jacob, D. J. & Tong, L. (1999), How structuring impacts the performance of the bond classes, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 129-146.

Jungman, M. (1996), The contribution of the Resolution Trust Corporation to the Securitization Process, in Kendall, L. T. & Fishman, M. J. (eds.), *A Primer on Securitization*, Michigan Institute of Technology, pp. 68-80.

Kau, J. B., Keenan, D. C., Muller III, W. J. & Epperson, J. F., (1987). The valuation and securitization of commercial and multifamily mortgages. *Journal of Banking and Finance*, **11**, pp. 525-546.

Keller, G. & Warrack, B. (1999), *Statistics for Management and Economics*, 5th ed., Duxbury, Pacific Grove, California.

Kelly, A. & Slawson, V. C. (2001), Time-varying mortgage prepayment penalties, *Journal of Real Estate Finance and Economics*, **23**(2), pp. 235-254.

Kendall, L. T. (1996), Securitization: A new era in American Finance, in Kendall, L. T. & Fishman, M. J. (eds.), *A Primer on Securitization*, Michigan Institute of Technology, pp. 1-16.

Kumar, R. (2005), *Research methodology: A step-by-step guide for beginners*, 2nd ed., Sage Publications Ltd., London, United Kingdom.

Lancaster, B. P. (2001), Introduction to commercial mortgage-backed securities, in Fabozzi, F. J. (ed.), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

Liebowitz, M. L. (2005), Alpha hunters and beta grazers, *Financial Analysts Journal*, September/October.

Madhaven, A., Treynor, J. L., and Wagner, W. H. (2007), Execution of portfolio decisions, *Managing Investment Portfolios: A Dynamic Process*, 3rd ed., CFA Institute. Charlottesville, United States.

Maris, B. A. and Segal, W. (2002), Analysis of yield spreads on commercial mortgage-backed securities, *Journal of Real Estate Research*, **23**(3), 236-251.

Mathew, J. & Katz, E. (1999), Investing in subordinate CMBS bonds, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 159-168.

Money, A. (2004), The research proposal, *Henley Management College*, lecture slides.

Natrass, N., Muradzikwa, S. & Wakeford, J. (2001), *Macroeconomics: Theory and policy in South Africa*, 3rd ed. (revised), David Philip Publishers, Cape Town, South Africa.

Nothaft, F.E., and Freund, J. L. (1999), Recent developments in multifamily mortgage markets: The increasing role of securitization. Working paper, April.

Obazee, P. O. (2001), Valuation and analysis of credit-sensitive CMBS tranches, in Fabozzi, F. J. (ed), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

Pappadopoulos, G. J. & Fisher, J. (1999), Evaluating the risk of commercial mortgage-backed securities, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 183-192.

Phillips, S. M. (1996), The place of securitization in the financial system: Implications for Banking and Monetary Policy, in Kendall, L. T. & Fishman, M. J. (eds.), *A Primer on Securitization*, Michigan Institute of Technology, pp. 45-54.

Pindyck, R. S. & Rubinfeld. (1998), *Econometric Models and Economic Forecasts*, 4th ed., McGraw-Hill, Singapore.

Riddiough, T. J. & Polleys, C. (1999), Commercial mortgage-backed securities: An exploration of innovation, product design and learning in financial markets, Working Paper, July.

Rode, E. & Johnson, J. (eds.) (2004), *Rode's Report 2004:4*, Rode & Associates CC, Cape Town.

Rode, E. & Johnson, J. (eds.) (2005), *Rode's Report 2005:2*, Rode & Associates CC, Cape Town.

Rode, E. & Johnson, J. (eds.) (2005), *Rode's Report 2005:3*, Rode & Associates CC, Cape Town.

Rode, E. & Johnson, J. (eds.) (2005), *Rode's Report 2005:4*, Rode & Associates CC, Cape Town.

Rode, E. & Johnson, J. (eds.) (2006), *Rode's Report 2006:1*, Rode & Associates CC, Cape Town.

Root, D. (2004), *Research Methodology* (lecture slides), Department of Construction Economics and Management, University of Cape Town, Rondebosch.

Sanders, A. B. (2001), The commercial mortgage-backed securities deal, in Fabozzi, F. J. (ed), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

Schneider. (2006), *EPROP Research*. Retrieved: November 4, 2006, from <http://www.eprop.co.za>

Schwartz E. S. & Torous, W. N. (1989). Prepayment and the valuation of mortgage-backed securities. *Journal of Finance*, **44**(2), pp. 375-392.

South African securitisation industry - Top ten issues for 2006, (2006), Deloitte.

Titman, S. and Torous, W. (1989), Valuing commercial mortgages: An empirical investigation of the contingent-claims approach to pricing risking debt, *The Journal of Finance*, **44**(2), 345-373.

Trepp, R. C. & Savitsky, J. D. (1999), An investor's framework for modeling and analyzing CMBS, in Fabozzi, F. J. & Jacob, D. P. (eds), *The Handbook of Commercial Mortgage-Backed Securities*, Wiley, pp. 93-112.

Tu, C. & Eppli, M. J. (2002), Extension risk in commercial mortgages, *Real Estate Finance (Euromoney Institutional Investor Plc)*, **18**(4), Database: Business Source Premier.

Vestewig, R. P. (2003), A review of commercial mortgage loan servicing best practice in the USA, *Briefings in Real Estate Finance*, **3**(1), 35-49.

Yin, R. K. (1994), *Case study research: design and methods*, 2nd ed., Sage Publication, Inc., California, United States of America.

Youngblood, M. (2001), Valuating the prepayment and credit risks of commercial mortgage-backed securities, in Fabozzi, F. J. (ed), *Investing in Commercial Mortgage-Backed Securities*, Frank J. Fabozzi Associates, New Hope, Pennsylvania, pp. 93-112.

APPENDIX 1.

DATABASE OF SOUTH AFRICAN FLOATING-RATE CMBS TRANCHES

	SPRD	SUB	LTV	YIELD	STDEV	CURVE	INDEX	MAT	WAL	D _{SRLIT}	TSIZE	OSIZE	D _{CONDUIT}	OFFICE	RETAIL
FREEA1	31	33.00	55.35	8.21	0.10	96.1	236	7.01	5.00	0	335	500	0	64.32	18.69
FREEB1	50	23.40	55.35	8.21	0.10	96.1	236	7.01	5.00	0	48	500	0	64.32	18.69
FREEC1	67	0.00	55.35	8.21	0.10	96.1	236	7.01	5.00	0	117	500	0	64.32	18.69
GPT1A1	34	31.85	57.95	7.755	0.25	78.7	197	6.68	4.68	0	537	1774	0	45.97	34.41
GPT1B1	51	17.98	57.95	7.755	0.25	78.7	197	6.68	4.68	0	125	1774	0	45.97	34.41
GPT1C1	85	7.78	57.95	7.755	0.25	78.7	197	6.68	4.68	0	88	1774	0	45.97	34.41
GPT1D1	105	0.00	57.95	7.755	0.25	78.7	197	6.68	4.68	0	55	1774	0	45.97	34.41
GPT1A2	35	31.85	57.95	8.588	0.12	137.8	206	7.10	5.10	1	672	1774	0	45.97	34.41
GPT1B2	42	17.98	57.95	8.588	0.12	137.8	206	7.10	5.10	1	121	1774	0	45.97	34.41
GPT1C2	71	7.78	57.95	8.588	0.12	137.8	206	7.10	5.10	1	93	1774	0	45.97	34.41
GPT1D2	105	0.00	57.95	8.588	0.12	137.8	206	7.10	5.10	1	83	1774	0	45.97	34.41
GPT2A1	40	40.50	60.42	8.832	0.36	103.3	225	6.99	4.99	0	595	1000	0	0.00	0.00
GPT2B1	45	29.50	60.42	8.832	0.36	103.3	225	6.99	4.99	0	110	1000	0	0.00	0.00
GPT2C1	77	0.00	60.42	8.832	0.36	103.3	225	6.99	4.99	0	295	1000	0	0.00	0.00
GPT3A1	40	49.04	49.99	7.837	0.61	-50	261	4.98	2.98	0	798	1566	0	14.15	0.00
GPT3B1	46	42.00	49.99	7.837	0.61	-50	261	4.98	2.98	0	109	1566	0	14.15	0.00
GPT3C1	90	0.00	49.99	7.837	0.61	-50	261	4.98	2.98	0	659	1566	0	14.15	0.00
RRP1A1	38	29.00	59.21	9.116	0.29	178.3	133	4.92	2.91	0	234	800	0	38.22	17.38
RRP1A2	40	29.00	59.21	9.116	0.29	178.3	133	4.92	4.92	1	334	800	0	38.22	17.38
RRP1B1	55	17.25	59.21	9.116	0.29	178.3	133	4.92	2.91	0	39	800	0	38.22	17.38
RRP1B2	62	17.25	59.21	9.116	0.29	178.3	133	4.92	4.92	1	55	800	0	38.22	17.38
RRP1C1	111	5.50	59.21	9.116	0.29	178.3	133	4.92	2.91	0	39	800	0	38.22	17.38
RRP1C2	116	5.50	59.21	9.116	0.29	178.3	133	4.92	4.92	1	55	800	0	38.22	17.38
RRP1D1	178	0.00	59.21	9.116	0.29	178.3	133	4.92	2.91	0	18	800	0	38.22	17.38
RRP1D2	184	0.00	59.21	9.116	0.29	178.3	133	4.92	4.92	1	26	800	0	38.22	17.38
VIP1A1	39	43.51	47.66	8.069	0.26	114.6	200	7.01	5.00	0	261	770	0	27.22	47.50
VIP1A2	45	43.51	47.66	8.069	0.26	114.6	200	9.01	7.01	1	174	770	0	27.22	47.50
VIP1B1	55	29.48	47.66	8.069	0.26	114.6	200	7.01	5.00	0	65	770	0	27.22	47.50
VIP1B2	60	29.48	47.66	8.069	0.26	114.6	200	9.01	7.01	1	43	770	0	27.22	47.50
VIP1C1	99	0.00	47.66	8.069	0.26	114.6	200	7.01	5.00	0	136	770	0	27.22	47.50
VIP1C2	105	0.00	47.66	8.069	0.26	114.6	200	9.01	7.01	1	91	770	0	27.22	47.50
PC1A1R	44	20.01	68.80	7.73	0.81	-52.6	308	17.08	4.07	0	658	1469	1	23.00	54.00
PC1A2	43	20.01	68.80	7.73	0.81	-52.6	308	17.08	4.07	1	277	1469	1	23.00	54.00
PC1B1	80	14.02	68.80	7.73	0.81	-52.6	308	17.08	4.07	0	88	1469	1	23.00	54.00
PC1C1	104	8.51	68.80	7.73	0.81	-52.6	308	17.08	4.07	0	81	1469	1	23.00	54.00
PC1D1	200	3.74	68.80	7.73	0.81	-52.6	308	17.08	4.07	0	70	1469	1	23.00	54.00

	IND	TYPE	GAUTEN G	WCAFE	KZN	ECAPE	OTHER	COUNT	D2005	D2006	D2007	DAA	DA	DBBB
FREEA1	16.99	0.00	70.18	12.28	10.13	0.00	7.41	42.00	0	1	0	0	0	0
FREEB1	16.99	0.00	70.18	12.28	10.13	0.00	7.41	42.00	0	1	0	1	0	0
FREEC1	16.99	0.00	70.18	12.28	10.13	0.00	7.41	42.00	0	1	0	0	1	0
GPT1A1	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	0	0	0	0	0
GPT1B1	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	0	0	1	0	0
GPT1C1	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	0	0	0	1	0
GPT1D1	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	0	0	0	0	1
GPT1A2	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	1	0	0	0	0
GPT1B2	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	1	0	1	0	0
GPT1C2	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	1	0	0	1	0
GPT1D2	14.00	5.61	63.05	29.80	2.44	1.25	3.46	61.00	0	1	0	0	0	1
GPT2A1	93.11	6.89	61.39	21.13	15.43	1.64	0.42	103.00	0	1	0	0	0	0
GPT2B1	93.11	6.89	61.39	21.13	15.43	1.64	0.42	103.00	0	1	0	1	0	0
GPT2C1	93.11	6.89	61.39	21.13	15.43	1.64	0.42	103.00	0	1	0	0	1	0
GPT3A1	93.11	6.89	78.01	7.42	4.07	10.50	0.00	23.00	0	1	0	0	0	0
GPT3B1	93.11	6.89	78.01	7.42	4.07	10.50	0.00	23.00	0	1	0	1	0	0
GPT3C1	93.11	6.89	78.01	7.42	4.07	10.50	0.00	23.00	0	1	0	0	1	0
RRP1A1	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	0	0	0
RRP1A2	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	0	0	0
RRP1B1	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	1	0	0
RRP1B2	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	1	0	0
RRP1C1	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	0	1	0
RRP1C2	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	0	1	0
RRP1D1	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	0	0	1
RRP1D2	41.39	3.00	78.06	4.71	8.69	0.00	8.54	92.00	0	0	0	0	0	1
VIP1A1	16.36	8.91	48.31	10.54	31.55	3.71	5.88	39.00	1	0	0	0	0	0
VIP1A2	16.36	8.91	48.31	10.54	31.55	3.71	5.88	39.00	1	0	0	0	0	0
VIP1B1	16.36	8.91	48.31	10.54	31.55	3.71	5.88	39.00	1	0	0	1	0	0
VIP1B2	16.36	8.91	48.31	10.54	31.55	3.71	5.88	39.00	1	0	0	1	0	0
VIP1C1	16.36	8.91	48.31	10.54	31.55	3.71	5.88	39.00	1	0	0	0	1	0
VIP1C2	16.36	8.91	48.31	10.54	31.55	3.71	5.88	39.00	1	0	0	0	1	0
PC1A1R	14.00	9.00	61.00	16.00	5.00	7.00	11.00	148.00	0	0	1	0	0	0
PC1A2	14.00	9.00	61.00	16.00	5.00	7.00	11.00	148.00	0	0	1	0	0	0
PC1B1	14.00	9.00	61.00	16.00	5.00	7.00	11.00	148.00	0	0	1	1	0	0
PC1C1	14.00	9.00	61.00	16.00	5.00	7.00	11.00	148.00	0	0	1	0	1	0
PC1D1	14.00	9.00	61.00	16.00	5.00	7.00	11.00	148.00	0	0	1	0	0	1