A Study of Canadian Corporate Obligors:

Credit Quality Evolution, Return Drivers, and Volatility Components

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ABSTRACT

This thesis first examines the one-year rating migration behavior of Canadian corporate debt issuers rated by Standard and Poor's between January 1981 and December 2001. Obligors are sorted into three industry groups – financials, industrials and utilities. The studied period is divided between years of expansion and recession. The corresponding conditional rating migration patterns are compared with unconditional estimates in order to assess the reliability of the latter, which are traditionally used to evaluate credit risk. Our unconditional results show that the average credit quality of Canadian corporate obligors has deteriorated over the studied period, in particular during the 1981-1982 and 1990-1992 recession years. On average, issuers in the industrials sector underwent the deepest credit quality deterioration and highest rating activity ratio. Furthermore, we find that industry- and economy-conditioned rating migration dynamics significantly differ from their unconditional estimates. However, the one-year rating transition matrix is weakly influenced by the stage in the business cycle or by the obligor's industry.

Secondly, we compare the performance for Canadian corporate bonds between February 1993 and May 2002. We find that the term structure of interest rates is a major determinant of bond returns regardless of the bond rating class, maturity bucket or industry.

Finally, we show that the total volatility of Canadian corporate bonds has slightly decreased over the 1993 to 2002 period. Following Campbell, Lettau, Malkiel and Xu (2001), we examine the market, industry and firm-specific volatility components of bond returns. We find that the relative and absolute levels of market volatility remain fairly low and steady over the sample period. However, the relative level of firm-specific volatility has sharply increased. Simultaneously, the industry volatility level has decreased. Augmented Dickey-Fuller tests provide no evidence of deterministic trends in these volatility components.

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I dedicate my thesis to my parents, my grandmother, and my sisters Sophie and Charlotte, for their love and faith in me. And to my hero: Alexandre.

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1. INTRODUCTION

1.1. DEFINITION AND RELEVANCE OF CREDIT RATINGS

Bond credit ratings provide a relative measure of issuers' creditworthiness. In this thesis, they reflect "Standard and Poor's assessment of an obligor's ability and willingness to meet its financial commitments on a timely basis" (Brady and Bos, 2002). In Canada, ratings are regularly published by Standard and Poor's (S&P's), Moody's Investor Services and the Dominion Bond Rating Services. Alternatively, institutions can create an internal rating system by gathering the information they believe is most relevant to assess a debt issuer's financial health. Indeed, credit ratings reflect the likelihood of payment, as well as the nature of the obligation's provisions and protection in case of bankruptcy. Credit ratings are a major input in numerous credit risk models and remain the most popular metrics of obligors' relative credit quality. Investment-grade bonds have ratings between AAA and BBB, while bonds rated below BBB are considered speculative issues. Bonds that have defaulted are rated D.

1.2. PURPOSE OF THE THESIS

The first objective of this thesis is to describe the rating migration behavior of Canadian long-term corporate issuers using S&P's proprietary database, "CreditPro", for the January 1981 to December 31, 2001 period. Average rating migration probabilities are computed for a one-year tracking horizon. The direction and volatility of rating changes are quantified with annual rating drift and activity ratios. These calculations are also conditioned on the stage in the business cycle and on the obligor's industry. Differences between unconditional and conditional rating migration patterns assess the importance of accounting for the level of economic activity and obligor industry to evaluate credit risk.

The second objective of this thesis is to examine the historical performance of Canadian corporate bonds for the February 1993 to May 2002 period. We present a regression model of corporate bond return determinants that allow us to compare the return sensitivity of bonds in various industries, maturity buckets and rating classes to credit and market risk factors.

Our final objective is to decompose the return volatility of a Canadian corporate bond into a market, an industry and a firm-specific component following Campbell, Lettau, Malkiel and Xu (2001). We analyze the historical evolution of the absolute and relative levels of each volatility component between February 1993 and May 2002. The nature of potential trends in each volatility component is examined with augmented Dickey-Fuller tests.

1.3. CONTRIBUTION AND MAJOR FINDINGS

This thesis focuses on Canadian corporate bonds and bond issuers, while most empirical research regards U.S. data. The first part examines migration patterns conditioned on the economic context and obligor industry. Thus, it complements the studies of Ménard (2001) and Kryzanowski and Ménard (2001) regarding the unconditional rating migration behavior of long-term bonds issued by Canadian corporations between 1973 and 1998. We present chi-square statistics that support the hypothesis of homogeneity in the rating migration probabilities computed for recession and expansion years and bring mixed support to the difference in rating migration behavior for obligors in various industries.

Our dataset comes from Standard and Poor's proprietary database "CreditPro" and differs somewhat from previous Canadian studies, as we will explain later in this paper. We cover more recent trends in the credit quality evolution of Canadian debt issuers with data up to December 2001.

The second part of our study shows that Canadian corporate bonds outperformed domestic stocks and Treasuries for the period from February 1993 to May 2002. This finding is partly due to the survival bias induced by the data available for this thesis, and the decline in interest rates over much of this period. Furthermore, the term structure of interest rates is a major determinant of bond returns, regardless of the bond industry, maturity bucket or rating class, while measures of credit risk provide little explanatory power.

The last part of this thesis uses Campbell et al.'s (2001) "market-adjusted" model to examine the volatility pattern of Canadian corporate bond returns for the February 1993 to May 2002 period. We document a slight decrease in the total volatility of bond returns, while the absolute and relative levels of market volatility remain low and fairly stable over the studied period. Also, the relative levels of firm-specific and industry volatilities have markedly increased and decreased, respectively. Finally, unit-root tests uncover no systematic volatility trends in bond returns.

2. LITERATURE REVIEW

2.1. Overview of the Canadian bond market evolution

In recent years, a favorable macroeconomic context, coupled with the collapse in equity returns, has favored bond markets in North America as well as in Europe. In the meantime, credit risk management has become the main risk management challenge because of massive defaults in emerging bond markets and the change in the lending strategies of commercial banks (Altman, Caouette and Narayanan, 1998; Altman, 2001). The Basle Accord (2001) embodies the first concerted effort on behalf of international financial organizations to establish efficient procedures toward the consideration of credit risk.

Since the late nineties, the Canadian bond market has become more active, as a result of low inflation, reduced public sector borrowing, and low long-term interest rates. Until then, federal and provincial bond issues dominated the Canadian bond market bringing high liquidity and high credit quality. Compared to their U.S. counterparts, Canadian non-investment grade firms have traditionally relied on the very competitive lending business of banks to access financing capital. In 1998, the Bank of Canada reported that net new issues of corporate bonds in Canada exceeded long-term debt issues by the various levels of government for the first time since 1973 (Miville and Bernier, 1999). The credit quality of Canadian bond issuers deteriorated during the 1990's, while it improved over the 1970's and 1980's (Ménard, 2001).

2.2. UNCONDITIONAL RATING MIGRATION PATTERNS

2.2.1. Differences in the computation of rating migration probabilities

The unit of study for rating migrations reported in this thesis is the corporate bond issuer as opposed to the amount or number of debt issues issued. This is crucial as the sample construction method ultimately has an impact on the estimates of rating migration probabilities. Altman (1998) notes that a transition matrix computed from a sample of bond issues, not issuers, implicitly accounts for the bonds' year of issuance. Indeed, the length of time the bond has been outstanding impacts its likelihood to change rating or to default, hence the estimates of migration probabilities. Ratings are rarely reviewed in the first years after issuance. In the short run, this greater tendency for rating changes on older bonds relative to newly issued ones implies a downward bias on rating stability. Altman and Kao (1992) explicitly account for the bonds' age in order to observe how long this aging effect persists. Their analysis of bonds up to ten years after issuance reveals that the aging effect persists over one year, but disappears for a five-year horizon.

The literature observes wide fluctuations in aggregate default rates over the years. Fons (1991) identifies the aging effect of bonds as one major driver of defaults. The marginal default/mortality rates start out quite low in the first year after issuance, increase considerably to the third year and then level off for the most part. Therefore, the length of time that risky bonds are outstanding influences the default rate. In order to mitigate this aging effect, most studies, including Menard (2001) and Kryzanowski et al. (2001), use senior unsecured ratings that reflect solely the issuers' creditworthiness. As outlined by

Bangia et al. (2000), the use of issuers' ratings recorded in CreditPro can best erase the aging effect from estimates of rating transition matrices.

Empirical studies were made for various sample periods and countries. Ménard (2001) and Kryzanowski et al. (2001) examined the rating migration behavior of Canadian obligors for the 1973-1998 period, while Carty et al. (1993) and Altman et al. (1992) used US data for the 1970-1990 period. As we later explain, this study is based on static pools of Canadian obligors for the 1981-2001 period. Therefore, it will be more relevant to compare our results to those of Ménard (2001) and Kryzanowski et al. (2001).

2.2.2. Rating transition matrices

Ratings are forward-looking and may change due to shocks in the business cycle or to event risk. Carty and Fons (1993) noticed that although the credit paths of rated firms were not predetermined, unconditional transition matrices revealed historical patterns. A rating transition matrix exhibits the credit quality movements of bond issuers over a chosen time horizon. Each cell entry, with the exception of the "default" column, is an equal-weighted average percentage of issuers who held the row rating at the beginning of the time period and the column rating at the end of the time period (Carty, 1997).

Diagonal probabilities stand for the likelihood that an obligor maintains his credit quality, and thus retains his rating unchanged. Non-diagonal probabilities represent the frequency of upgrades and downgrades, respectively, due to the improvement and deterioration of obligors' credit quality.

For a one-year tracking horizon, major findings indicate that issuers are unlikely to undergo a rating migration. Large credit quality changes are rare as 98% of rating changes occur within two rating classes (Carty et al., 1993). Lowe (2002) and Gordy (2001) view this rating stability as the consequence of agencies' aversion to review ratings too often, while Carty et al. (1993) stress that sharp rating adjustments are avoided thanks to frequent reviews. Furthermore, high-quality ratings seem more stable than lower rating classes (Altman and Kao, 1992; Carty et al., 1993; Carty, 1997). Brady et al. (2002) find a clear correlation between credit quality and default remoteness.

Depending on the country and time period under study, the literature reports slightly different estimates of rating migration probabilities. Over the 1973-1998 period, Menard (2001) reports 87% and 76% annual average diagonal probabilities for Canadian issuers in the AAA and BBB rating classes, respectively. Over the 1923 to 1993 period, Carty et al (1993) find that respectively 90% and 85.3% of U.S. obligors retained their AAA and BBB ratings for a one-year tracking horizon. When the sample period is slightly extended to 1920-1996, Carty (1997) reports diagonal probabilities of 88% for AAA and 82.5% for BBB-rated bonds. Rating migration probabilities also differ depending on the rating data source. Ménard (2001) attributes the discrepancies in the rating migrations dynamics reported to the different coverage of corporate issuers done by Moody's and Standard and Poor's in Canada.

Kryzanowski et al. (2001) report rating transition matrices for longer horizons, from two to ten years. They find that the probability of retaining a specific rating decreases substantially as the horizon lengthens. For instance, AAA-rated bonds exhibit 87%, 76%, 66%, 47% and 20% diagonal probabilities over a one-, two-, three-, five- and ten-year tracking horizon, respectively. Similarly, all issuers are more likely to undergo a rating quality movement as the horizon lengthens. Consistent with empirical findings regarding U.S. obligors, Kryzanowski et al. (2001) find that the probability of a downgrade for highly graded issuers becomes more likely as the tracking horizon becomes longer. In contrast, BBB+ to B-rated issuers exhibit an increased tendency to be upgraded. Moreover, Canadian investment-grade bonds had a higher probability of changing rating than of maintaining their initial rating over a five-year horizon (Ménard, 2001). This is true for US bonds only after 10 years (Carty, 1997).

2.2.3. Bond ratings and maturity

Previous research found a non-monotonic relation between debt maturities and bond ratings. Stoks and Mauer (1996) confirm Guedes and Opler's (1994) findings that larger, less risky companies with longer-term asset maturity typically borrow at the short and long end of the maturity spectrum. Debt time to maturity is either less than ten years or more than thirty years. As for firms with speculative grades, they typically borrow in the middle of the maturity spectrum. Also, the literature finds an inverse relationship between a bond's credit quality and its rating migration frequency. Carty et al. (1993) found a 10-year and a 4-year life expectancy, respectively, for Aaa and B ratings. Furthermore, the lower an obligor's original rating, the shorter the time it normally takes to default. According to Brady et al. (2002), the mean life of a defaulting B-rated company is 3.8 years, while A-rated firms defaulted within 11.9 years from their initial rating.

Because CreditPro records the rating histories of long-term issuers, it tends to focus on high-quality issuers. Hence, our estimates could underestimate the actual level of rating activity on the Canadian corporate bond market. Indeed, top-rated issuers typically exhibit the highest rating stability. We would also expect newly issued medium-term bonds to be of lower credit quality and undergo more frequent rating migrations compared with newly issued short- and long-term bonds. Thus, in subsequent analysis, bonds are sorted by maturity bucket and the resulting portfolios contain new as well as already outstanding issues. Also, bonds migrate from one cohort to the other as time elapses. Hence, the medium and short-term cohorts will contain issues of all credit quality levels, and the subsequent analysis of corporate bond performance will be free from such bias.

2.3. MEASURES OF LONG-TERM TRENDS IN CREDIT QUALITY EVOLUTION

Credit risk models such as the reduced-form model of Jarrow, Lando, and Turnbull (1997) assume that the transition matrix is a time-homogenous Markov chain. Empirical evidence suggests, however, that rating migrations are dependent and change over time (Altman et al., 1992; Carty et al., 1993; Carty, 1997; Altman, 2001; Lando and Skodeberg, 2002). Carty et al (1993) measure the instability in rating migrations with rating drift and rating activity ratios. The rating drift summarizes the overall increase or decrease in credit quality of the rated universe. The rating activity captures both the effect of multiple rating changes for a single issuer within a given year and the relative sizes of rating changes. Carty et al. (1993) find evidence of a prolonged deterioration in the credit quality of US issuers since 1980 with a negative 9% average drift, coupled with peaks in rating activity. For the 1920-1996 period, Carty (1997) reports annual average rating drift and activity ratios of -6% and 15%, respectively. Both studies conclude that this deterioration in corporate credit quality corresponded to an increased uncertainty in the bond market and in the economy as a whole. In Canada, Ménard (2001) reported an improvement in long-term obligors' credit quality between 1975 and 1980, followed by a deterioration over the 1982-1983 and 1990-1993 periods. Kryzanowski et al. (2001) note that the level of economic activity is an important determinant of bond rating activity. Reported peaks in the rating activity ratios in 1982 (65%) and 1991 (76%) correspond to the last two economic recessions.

Consistent with Carty et al. (1993) and Carty (1997), Menard (2001) and Kryzanowski et al. (2001) find that investment-grade bond issuers are more likely to be downgraded than upgraded over a one-year horizon. Altman et al. (1998) report that 33 of the 112 bonds that defaulted over the 1970-1984 period originally held investment-grade ratings. Also, Brady et al. (2002) state that, among the 216 companies that defaulted worldwide in 2001, 21 originally held an investment-grade rating. Therefore, downgrade and default risks cannot be ignored for top-quality issues and portfolios of investment-grade issues are likely to contain fallen angels after a few years.

On a portfolio basis, previous research has reached two major conclusions. First, a positive correlation exists in the co-movements of issuers' credit quality (Carty, 1997; Ménard, 2001). Also, default rates and recovery rates are inversely related (Altman, 2001). Therefore, credit risk is not entirely diversifiable and the systematic risk component increases in times of stressful credit periods resulting in greater potential losses.

2.4. CONDITIONAL RATING MIGRATION PATTERNS

2.4.1. Impact of the business cycle

Ratings reflect industry risk and firm-specific information, such as size or profitability (Galil, 2002). The inherent difficulties in linking credit risk and the macroeconomy explain that ratings are usually not conditioned on the state of the economy despite its impact on obligors' creditworthiness (Lowe, 2002). Carty (1997) argues that the risk of a rating change varies from year to year, under changing macroeconomic and business conditions. Fons (1991) identifies the state of the economy, and more precisely declining corporate profits in downturns, as a source of increase in the annual default rate. Using Moody's data from 1970 to 1997, Nickell et al. (2002) examine the dependence of rating transition probabilities on the stage in the business cycle and on the obligors' industry and domicile. Their ordered probit approach reveals that the business cycle can best explain variations in rating migration probabilities.

Bangia, Diebold and Schuermann (2000) find that rating migration probabilities vary with the business cycle. In particular, downgrades (upgrades) are more likely in recessions (expansions). This is because key credit factors, such as the values and volatilities of obligations' underlying assets, are correlated with general economic indicators. Bangia et al. (2000) suggest that rating transition matrices reflect the linkage between the asset credit quality and the underlying macroeconomic conditions. Their framework for credit portfolio stress testing starts with the estimation of rating transition matrices for two economic states, expansion and recession. In contractions, downgrades and especially defaults are significantly more likely, while most upgrade probabilities remain constant or even decrease.

Bangia et al. (2000) conclude that the state of the economy is one of the major drivers of systematic credit risk. Consistent with Cornell et al. (1991), they observe that lower-rated bonds, with their shorter durations, are more sensitive to changes in economic activity. In recessions, the unconditional transition matrix understates the actual percentage of companies that are downgraded or defaulted. Bangia et al. (2000) further illustrate the business cycle effects on a portfolio's credit risk. Simulated portfolio value distributions are alternatively based on the unconditional and the two conditional transition matrices. The respective value-at-risk (VaR) figures, i.e. 1% maximum losses for a one-year horizon, more than double from an expansion to a contraction year. Also, the required level of economic capital in a contraction year is nearly 30% higher than for an expansion year.

2.4.2. Impact of the obligor's industry and domicile

Nickell et al. (2002) observe significant differences in the transition matrices when distinguishing between the obligor's domicile (US and non-US) and industry (banks vs. industrials). Their findings indicate that the business cycle has a stronger impact on lower-graded issuers. While banks' ratings were more volatile than industrials' ratings, large movements in ratings were just as likely, if not more likely, for industrials. Nickell et al. (2002) conclude that an unconditional average transition matrix provides an inaccurate assessment of a bond portfolio's credit risk.

As a matter of fact, rating agencies usually differentiate between industries in their regular publications. In particular, Brady et al. (2002) report that telecommunications was the industry hardest hit in 2001 with 32 defaults worldwide, representing 10.77% of all the industry rated obligors. Historically, the consumer/service and the leisure/media sectors have experienced the highest rates of default, with 18.27% and 16.96%, respectively. In contrast, less than 5% of the utilities, insurance, real estate companies and financial institutions have defaulted. Such differences motivate our investigation of potential differences in rating migration behavior of Canadian obligors in various industry sectors.

2.5. EVALUATION OF CANADIAN CORPORATE BOND PERFORMANCE

2.5.1. Characteristics of a corporate bond's return distribution

After we have described the rating migration patterns of Canadian corporate obligors, we turn to the analysis of corporate bond performance. The objective is to relate the historical movements in bond returns to the credit quality evolution of their issuers.

Several papers stress that the mean-variance analysis traditionally used to evaluate financial assets' performance is inappropriate for bonds. Indeed, bond return distributions are not normal but negatively skewed with fat tails, which increases the risk of extreme losses (Altman et al., 1998; Hull 1998). The value-at-risk (VaR) measures such downside risk by estimating the maximum loss that could occur over a chosen time horizon for a given level of confidence. The VaR can be used ex-ante based on estimates of the default probabilities and losses given default to determine the level of economic capital. Ex-post VaR reflects the actual losses from downgrades and deteriorated market conditions.

A number of studies have examined the risk-adjusted performance of U.S. corporate bonds. Blume and Keim (1987) find that equal-weighted portfolios of junk bonds had higher returns but a similar beta risk than higher-rated issues over the 1977-1986 period. Empirical studies led by Altman (1989) and Cornell and Green (1991) confirm that U.S. junk bonds produced higher and less volatile returns compared with investment-grade bonds for the 1970-1990 period. Blume, Klein and Patel (1991) attribute the anomalous low beta of speculative issues to their shorter duration. Indeed, they often have an embedded call premium and pay a higher coupon rate than an otherwise identical investment-grade bond. Adjusted for default-risk, Cornell et al (1991) and Blume et al. (1991) find that the returns of investment-grade and junk bonds are nearly equal. Therefore, no systematic mispricing for bonds issued in the US could be found. Zivney, Bertin and Torabzadeh (1993) re-examine the investment performance of junk bonds by adjusting returns for stock market and interest rates risks. In contrast, Blume et al. (1987), they report that lower-rated bonds did not produce significantly higher returns over the 1981-1988 period. Zivney et al. (1993) conclude that bond ratings cannot predict higher or lower realized returns.

2.5.2. Drivers of a corporate bond's return volatility

Credit risk models traditionally ignore market risk and focus on rating migrations and default probabilities (Jarrow, Lando and Turnbull, 1997). However, Crouhy, Galai and Mark (2001) insist that market and credit risks be jointly considered as they both impact bond prices and yields. Moreover, they are not independent but negatively correlated (Annaert and De Ceuster, 1999). Marked-to-market losses may occur even if default incidence remains low and credit risk remains unchanged depending on the direction of stock prices and interest rates.

Regarding the sensitivity of US corporate bonds to risk factors, Collin-Dufresne et al. (2001) report that high quality bonds behave like Treasuries while the returns of lower-rated bonds are more sensitive to stock returns than to interest rates variations. The latter result is due to the inclusion of both callable and non-callable bonds in the studied sample. Indeed, callable bonds are often of lower quality and their shorter duration results in a lesser sensitivity to interest rate changes (Altman et al., 1998). Furthermore, Chang and Hang (1990) examine the pricing of exchange-traded long-term corporate bonds. They find that a January dummy, the interest rate term structure, and the level of bond and stock prices predicts most of the excess returns on corporate bonds. Elton, Gruber, Agrawal and Mann (2001) develop relative asset pricing models using unanticipated changes in economic variables as predictors of securities returns. Five variables explain the times-series of bond returns and cross-sectional differences in returns. First, the excess returns on the stock market (S&P500) represent expectations about the future economic environment. Default risk is measured by the difference in return between corporate and government bonds. Then, the return differential between long-term and short-term government bonds constitutes a term premium. Finally, unexpected changes in inflation and GDP growth reflect the macroeconomic context.

2.5.3. Components of bonds' return volatility

In the last section of this paper, we examine the volatility trends of Canadian corporate bonds using Campbell, Malkiel and Xu's (2001) disaggregated model. Originally, Campbell et al. (2001) decompose the return of a typical stock into a market-wide component, an industry-specific residual and a firm-specific residual. In this thesis, we follow Campbell et al. (2001) to construct monthly time-series of each volatility components using daily bond returns within each month from February 1993 to May 2002. Our objective is to examine the volatility pattern of bond returns and subsequently to evaluate a bond portfolio's ability to achieve diversification.

Campbell et al. (2001) use firm-level return data in the CRSP dataset, including firms traded on the NYSE, AMEX and the Nasdaq. Individual firms are aggregated in 49 industries and the 30-day T-bill rate subtracted to obtain daily series of stock excess returns. The volatility components are estimated monthly between July 1962 and December 1997. Campbell et al. find that firm-level volatility was on average much higher that market and industry volatility components. Graphically, it exhibited a visible upward trend. Therefore, Campbell et al. (2001) conclude that the stock market has not become increasingly volatile, contrary to a widespread belief. Furthermore, the increasing level of firm-specific volatility implies that more stocks should be included in a portfolio to diversify idiosyncratic risk. Campbell et al (2001) also report that stock returns exhibited a cyclical behavior, with volatility peaks during recessions.

3. METHODOLOGY AND DATA

3.1. DATA AND SAMPLE PERIODS

3.1.1. Standard and Poor's CreditPro database

We analyze the rating migration patterns of long-term Canadian corporate debt issuers by tracking their senior unsecured debt ratings recorded in Standard and Poor's proprietary database, CreditPro 6.2. While the ratings and defaults of Canadian corporate obligors are available from January 1981 to May 2002 (when the database was last updated), we use this data only up to December 2001 to estimate one-year rating transition matrices and annual rating drift and activity ratios. The regression model of bond returns' determinants presented in the second part of this thesis refers to rating histories from February 1993 to May 2002.

The advantage of using S&P's CreditPro is that it converts bond ratings into issuer ratings. First, corporations with subsidiaries are gathered into economic entities which enhance the tracking of their credit quality evolution (Bangia et al., 2001). Secondly, S&P considers senior unsecured ratings that reflect the sole creditworthiness of obligors. Indeed, senior unsecured bonds have no particular collateral and have priority over junior bonds in case of default. Furthermore, rating histories are not associated with any maturity or issue dates. In contrast, Altman and Kao (1992) refer to issue-specific ratings to examine the impact of the time elapsed since issuance, and that remaining to bond maturity, on default and migration probabilities. Because the unit of the study in this thesis is the issuer and not the issue, such aging effect is not a concern.

Figure 1 depicts the growth in the number of Canadian corporate issuers rated by S&P's between 1981 and 2001. Our dataset contains a total of 1,586 obligor years of which 27 ended in default yielding an average 1.70% default rate. On average, 59.39% of the issuers under study hold an investment-grade rating.

The CreditPro database uses credit modifiers +/- resulting in 17 different rating categories. This refined classification is problematic because it reduces our sample size of issuers to levels where no reliable estimates can be made. Bangia et al. (2000) explain that the industry standard regarding published transition matrices is to ignore rating modifiers. Also, the research by Nickell et al. (2001) regarding the stability of rating transition matrices ignores modifiers. The authors argue that a finer categorization does not improve credit risk modeling. Consequently, rating modifiers can be disregarded. For instance, A- and A+ ratings are considered an "A" rating. Consequently, our paper refers to 8 rating classes, namely AAA, AA, A, BBB, BB, B, CCC, CC. In addition, D indicates defaulted issuers and NR stands for "not rated". The aggregate number of obligor-years per rating category is depicted in **Figure 2.** BBB represents the largest rating class (26%), while few ratings occur at the top and the bottom of the rating spectrum.

The CreditPro database recognizes 13 industry sectors based on S&P's Global Industry Sector Classification (GISC). To enhance the statistical significance of our results, these sectors are sorted into three industry groups. "Utilities" includes utilities, transportation and telecommunications. Financial institutions, insurance and real estate are assigned to "financials", and the rest to "industrials"[1]. S&P's coverage of Canadian issuers has

[1] Industrials: Energy & natural resources, Forest & building products / Homebuilders, Consumer services, Leisure & media, Healthcare / Chemicals, high technology / Computers / Office equipment, aerospace /Automobiles / Capital goods / Metals.

greatly evolved over the studied period as outlined by the changing industry composition depicted in **Figure 3**. Over the sample period, industrials represent the main group of obligors with an average weight of 62%. Their relative importance declines somewhat from 66.7% in 1981 to 46.3% in 1990, and then rebounds to 57% of rated obligors in 2001. Financials developed markedly fostered by the deregulation of the Canadian financial sector in 1986. From 8.3% of obligors in 1981, they represent 41.5% of the rated issuers in CreditPro in 1990. In 2001, they stand for 21.5% of the Canadian debt issuers rated by S&P. In contrast, utilities decline from 25% in 1981 to an average 11% between 1986 and 1992. Stabilizing around 15% in the late nineties, they represent 21.5% of Canadian obligors in 2001.

3.1.2. Characteristics of selected Canadian corporate bonds

In order to examine the risk-return profile of Canadian corporate bonds, we build a dataset of corporate issues that are non-callable, non-sinking fund and non-convertible, pay a fixed coupon and are denominated in Canadian dollars. This way, currency risk and variations in embedded option values or coupon rates are eliminated, ensuring the comparability of total returns across the bonds and over time (Duffee, 1998). Bonds with asset-backed or credit-enhancement features are also excluded. Hence, only the issuer's creditworthiness matters enhancing comparability across corporate bond returns. Furthermore, these filters allow the using of S&P's issuer ratings to describe individual issues' credit quality evolution.

The information on selected issues is retrieved from the Bloomberg financial station and includes the bond's CUSIP, daily mid-price and yield to maturity, coupon rate, issuance and maturity dates, amount outstanding, obligor's name and GICS industry sector. Since the price and yield histories of matured issues cease to be available from Bloomberg, our sample includes solely bonds still outstanding on the day of the data collection. We therefore concentrate on the February 1993 to May 2002 period in order to get samples of sufficient size and obtain statistically significant results. Also, we use rating histories available from CreditPro over the same period of time. Defaulted issues are included in the dataset if their price history is available. Our sample contains only one defaulted bond, indicating a cumulative default rate of 0.52% for the 1993-2002 period. However, Brady et al. (2002) report that nine Canadian issuers have defaulted over 2001 alone. Therefore, our dataset underestimates the actual default risk and puts an upward bias on reported performance.

3.1.3. Construction of bond portfolios and times-series of excess returns

The dataset consists of 192 corporate bonds whose return histories are used in the last part of this thesis to construct time-series of return volatility components following Campbell et al. (2001). In part two, the regression model used to identify bond return determinants includes ratings as a proxy for credit risk. Therefore, non-rated issues are removed from the studied sample, resulting in a dataset of 147 rated corporate bonds denoted henceforth the "total" portfolio. Excess total returns are computed for individual bonds as the daily difference between their total return and the 30-day T-Bill rate (obtained from the CFMRC). Total returns include accrued interest and capital gains/losses.

The composition of our dataset changes over the studied period with the inclusion of new issues. Similarly, Campbell et al. (2001) use the CRSP dataset where firm and industry composition changed dramatically over time. Bangia et al. (2000) insist that a fixed sample becomes outdated as some industries flourish while other decline, issuers emerge or default, and M&A's occur. Hence, the changing composition of our dataset can better reflect the evolution of the Canadian bond market.

The "total" portfolio of rated issues is divided into 12 equal-weighted portfolios, including three "industry", three "maturity" and five "rating" sub-samples. Bonds are organized in three industry groups similarly to obligors in CreditPro. Among the 147 issues, 51 are classified as financials, 34 as industrials and 62 as utilities. Annaert et al. (1999) insist that neglecting the maturity dimension fails to recognize an easy to capture risk dimension. Bonds are therefore sorted by maturity bucket following Duffee (1998). Short, medium and long-term portfolios contain bonds with more than 2 and less than 7, between 7 and 15, and over 15 years remaining to maturity, respectively. These "maturity" portfolios are rebalanced annually to account for the time elapsed. The credit quality evolution of each of the "total", "industry" and "maturity" portfolios is measured with a "rating score". The following scoring system, AAA is 1, AA is 2,..., C is 9, and D is 10 provides an annual average rating for the bonds included in a given portfolio. Finally, bonds are sorted by rating class. Each "rating" portfolio contains either AA, A, BBB, BB, or B-rated bonds and are rebalanced annually following the rating revisions in CreditPro. Indeed, AAA, CCC and CC-rated bonds are too few to yield statistically significant results, so were excluded from the "rating" portfolios.

The summary statistics in **Table 1** reports the absolute and relative sizes of the 11 bond categories created from the dataset and the total portfolio, as well as each portfolio's average features for the February 1993 to May 2002 period (average coupon rate, time to maturity, portfolio and issue size, and credit quality). In contrast with CreditPro, industrials represent the smallest industry group in terms of number of issues with 24% of the dataset and 23% of the "total" portfolio. They pay a slightly higher coupon rate (7.57%) than the "total" 7.45% average partly to compensate for their poorer credit quality (3.94 average rating score). Conversely, financials bear a lower coupon rate (7.36%) and exhibit the best average rating score (2.89). They appear more liquid with an average issue size that is 30% larger than that of industrials or utilities ($188 million per issue). On average, industrials are long-term with 21.5 years to maturity, financials are mid-term with 14.5 years to maturity, and "utilities" are short-term with 10 years to maturity.

Among "maturity" portfolios, long-term bonds have the highest coupon rate (7.60%) as well as the largest mean amount per issue ($177 million). Stoks and Mauer (1996) note that high-quality obligors issue both short and long-term bonds. Indeed, our long-term portfolio exhibits the best credit quality, with an average 3.02 rating score. However, the medium-term sample has a better mean credit quality than the short-term sample. A reason for that would be bonds moving from one sample to another as time elapses. On the one hand, highly rated bonds with a long-term to maturity move to the medium-term cohort, improving its average rating score. On the other hand, lower-quality bonds with a medium-term to maturity become short-term, deteriorating the latter cohort's average credit quality. From the features of the "rating" portfolios summarized at the bottom of

Table 1, it appears that the credit quality is positively related to the average amount issued and the time to maturity. AA and B-rated issues amount to 242 and 70 million dollars with average times to maturity of 13 and 7 years, respectively. As expected, the coupon rate is a decreasing function of the credit quality. On average, AA and B-rated bonds bear a 7.17% and 7.78% coupon rate, respectively.

Furthermore, **table 2** presents the annual evolution of each portfolio's features. The annual average rating score, drift and activity computed from the corresponding issuers' rating histories in CreditPro reflect the credit quality evolution of a given portfolio. Recall that a higher rating score implies a lower credit quality, and that the rating drift and activity measure the direction and the volatility of the rating migrations, respectively.

From panel A, it appears that the average time to maturity of Canadian corporate bonds diminishes from 16 to 10 years. Moreover, the decline in the average coupon rate reflects the downward trend in the Treasury yield. Over the studied period, the size of the "total" portfolio grows from 2.97 to 24.08 billion dollars due to a net inflow of bonds in the dataset and an increase in the average amount issued. In the meantime, the credit quality of Canadian corporate bonds has deteriorated over the 1993-2002 period with annual average rating scores of 2.99 in 1993 and 3.37 in 2002.

Panel B presents the annual evolution of the "industry" portfolios for the February 1993 to May 2002 period. The relative number of issues per industry has increased from 20% to 32% for financials, and decreased from 41% to 28% for industrials. The weight of utilities in the "total" portfolio remained stable around 40%. While financials and industrials exhibit the lowest and highest average rating scores, all three "industry" portfolios undergo a decline in credit quality over the studied period.

From panel C, it seems that the long-term portfolio has the best average credit quality as evidenced by a mean rating score of 3.02. Because bonds mature over time, long-term bonds migrate to the mid-term sample after some years. Therefore, the credit quality of the mid-term sample will increase over time if the net inflow of long-term bonds is positive and greater than the inflow of newly issued medium-term bonds. As a matter of fact, the credit quality of mid-term issues improves at the end of the studied period, when most long-term bonds became mid-term. In contrast, the credit quality of the short-term cohort deteriorated slightly with starting and ending scores of 3.33 and 3.66, respectively. Because no price history is available for issues already matured, the short-term portfolio can only cover the 1996-2002 period.

Panel D presents the evolution of "rating" portfolios. Surprisingly, AA and A-rated bonds bear the highest coupon rate in the first years of the studied period. One explanation could be the longer time to maturity of these issues. Indeed, AA and A-rated bonds bear an average 8.64% and 8.16% coupon rate in 1993 while they have 18 and 14 years to maturity, respectively. By 2002, the coupon rate of AA-rated issues has plunged to 6.05% while A and B-rated issues have an average 7.15% and 7.50% coupon rate, respectively. Over the studied period, the decrease in the average coupon rate occurs in all rating classes and reflects the decline in Treasury rates.

3.2. RATING MIGRATION PATTERNS

3.2.1. Computational methodology

A rating transition matrix depicts the average probability for an issuer to migrate from one rating category to another over a given period of time. Diagonal probabilities stand for the likelihood that the issuer will retain its initial rating at the end of the chosen horizon. Rating stability depends on the initial credit quality of the obligor, as higher quality ratings tend to be more stable than lower-quality grades.

Bangia et al (2000) argue that on the one hand, transition matrices estimated over short horizons, such as quarterly or monthly, best reflect the rating process, as fewer rating migrations are omitted, but tend to attenuate extreme movements. On the other hand, the noise inherent in the data can be smoothed over longer horizons. Therefore, a one-year tracking horizon for transition matrices seems a satisfying tradeoff. Moreover, rating drift and activity ratios add some information regarding the direction and volatility of rating changes within that period.

Carty (1997) stresses that accounting for the amount of debt issued or the number of debt issues would bias the results towards the characteristics of the largest issuers or those most active on the bond issuance market. Therefore, all the obligors have an equal weight in the computation of rating transition matrices. Furthermore, Brooks et al (2002) note that default rates obtained by dividing the number of defaults during a given period by all outstanding ratings would yield comparatively low default rates during periods of high rating activity. They recommend that calculations of rating migration probabilities be based on groupings called static pools.

Following Brady et al. (2002), a static pool of issuers is formed on the first day of each year between 1981 and 2001. To illustrate, the 1981 static pool comprises issuers with a rating outstanding on January 1, 1981. The 1982 pool is formed with obligors obtaining a first rating in 1981 and surviving members of that year's static pool. All rating changes are updated at the beginning of 1982. The same procedure is followed for the subsequent static pools, as well as when building static pools of issuers in a same industry. Because rating histories stop in May 2002, no static pool is formed for that year.

All the obligors are sorted into these pools and their ratings compared between the first and last day of the year. Hence, intermediate ratings are ignored. Ratings that have been withdrawn (NR for « not rated ») are followed in the same manner only to capture a potential default. Hence, the "NR" column reports the average percentage of issuers not rated at the end of a year. Note that these migrations are not included in the subsequent computation of rating drift and activity ratios as few of them (less than 13%) actually reflect a change in the credit quality of the obligor (Carty, 1997). Moreover, "Default" is recorded in CreditPro upon the first occurrence of non-payment on any financial obligation, rated or not rated, and is regarded as a terminal state. If a firm emerges from bankruptcy, and hence ceases to be in default at the end of the year, it is considered a new entity. The original firm is kept in the default category and removed from subsequent pools. Therefore, the "default" column presents the probability of defaulting within one year.

Based on the rating histories of issuers in each static pool, twenty-one matrices of migration counts are formed corresponding to year t=1981,...,2001. Each element in the matrix is the number of migrations from rating AAA,...,CC to rating AAA,...,D in year t. The rating transition matrix presents the ratios of migration counts in the number of issuers holding a rating AAA,...,CC at the beginning of the year. Only the « D » class shows a cumulative default rate.

Furthermore, the annual average rating migration probabilities are computed for two economic states, namely expansion and recession. To this end, the studied period is divided between years of recession and expansion. We use annual real GDP growth rates gathered by Statistics Canada corresponding to the studied period from 1981 to 2001 and obtain a 1.67% annual average growth rate. Years of recession exhibit an annual real GDP growth rate below the 1981-2001 average of 1.67%. Hence, the recession matrix is based on the matrices of counts corresponding to years t_R = 1981, 1982, 1986, 1989 to 1993, 1995, 1996 and 2001. The expansion matrix includes the matrix of counts for years exhibiting a real GDP growth rate above or equal to 1.67%, namely t_E = 1983, 1984, 1985, 1987, 1988, 1994, 1997 to 2000. Alternatively, industry-conditioned rating transition matrices are obtained by recalculating the 21 matrices of counts for industry-homogeneous samples of obligors, namely "utilities", "financials" and "industrials".

3.2.2. Unconditional rating migration patterns

3.2.2.1.Annual average transition matrix

The unconditional transition matrix exhibits the annual ratio of issuers ending the year in the AAA to D-rating class when beginning the year in one of the eight rating classes, from AAA to CC, listed in the matrix' left column. These average migration probabilities are based on the rating histories of all the Canadian debt issuers recorded in CreditPro in a given year between January 1981 and December 2001[2] and are reported in **Table 3.** On average, issuers are more likely to retain than change their credit rating over a one-year horizon, which is consistent with the existing literature. However, a Spearman-rank correlation coefficient of 35%, reported at the bottom of table 3, evidences a weak relation between ratings and diagonal probabilities. Among investment-grade issuers, the rating stability decreases as the rating class increases. In particular, BBB-rated issuers exhibit the highest rating stability (91.23%) while only 80.85% of AAA-rated obligors kept their rating over a one-year tracking horizon[3]. Other diagonal probabilities are 90.08% and 90.20% for AA and A-rated issuers, respectively. More consistent with the literature, non-investment grade issuers exhibit decreasing diagonal probabilities when holding a lower rating. To illustrate, we find that 84.36% and 77.53% of BB and B-rated issuers kept their grade over the following year.

Also consistent with previous papers, we find that most rating migrations occur in the close neighborhood of the starting rating class. Our results concerning the magnitude of rating migrations are particularly consistent with Carty (1997) who found that 98% of rating changes occurred within two rating classes. Magnitude is defined as the average number of rating classes a rating change spans. Over the January 1981 to December 2001 period, only 41 (i.e. 2.58%) of the rating migrations in CreditPro span more than two rating classes. The average magnitude of such migrations is 3.29 rating classes and

[2] CreditPro covers the January 1, 1981 to May 31, 2002. Ratings for 2002 allow calculating the migration probabilities for 2001, but not beyond as the data stops in May 2002.

[3] For the 1973-1998 period, Kryzanowski et al. (2001) report diagonal probabilities of 86.99% and 75.73% for AAA and BBB-rated issuers.

concerns only non-investment-grade issuers, i.e. BB and B-rated issuers. While AAA-rated obligors exhibit a surprisingly low rating stability of 80.85%, all the downgraded obligors ended with a AA rating.

3.2.2.2. Rating drift and activity

A rating transition matrix is a snapshot of the credit quality evolution of a pool of issuers but does not account for the dynamics of rating migrations. The levels of rating drift and activity measure such dynamics. Carty et al. (1993) propose the rating drift to measure the direction of a rated universe's credit quality evolution. It is computed as the aggregate number of upward letter rating changes, less the total number of downward letter rating changes, divided by the number of issuers rated at the beginning of a given year. Rating activity captures the effects of single issuers' multiple rating changes and the relative size of rating changes within a given period. Indeed, a migration from BBB to A represents one letter rating change, while a migration from BBB to AA represents two letter rating changes. The annual rating activity is computed by dividing the sum of all upward and downward letter-rating changes by the number of issuers outstanding at the beginning of a given year. The first two columns in the panel A of **Table 4** report the annual percentages of obligors upgraded and downgraded by S&P between January 1981 and December 2001. This data is used to compute the annual average drift and activity ratios presented in the two subsequent columns.

Over the studied period, the credit quality of Canadian obligors has deteriorated on average as evidenced by a –6.68% rating drift and 12.98% rating activity. Over the 1973-1998 period, Kryzanowski et al. (2001) report a 0.32% rating drift and a 32.79% rating activity for Canadian long-term debt issuers rated by CBRS, now S&P Canada. Consistent with Kryzanowski et al. (2001), we find that faster credit quality deterioration and peaks in rating activity correspond to recession years. On average, the rating drift ratios were -22.48% and –18.53% over the 1982-1983 and 1990-1992 periods. Also, peaks in the rating activity ratio are observed in 1982 (21.4%) and 1992 (19.2%). The GDP growth was indeed negative in 1982, 1990, 1991 and 1992. The credit quality of Canadian obligors showed some signs of improvement in 1984, 1985 and 1987 with an average 5.57% rating drift over those years. In 2001, the credit quality of Canadian issuers deteriorated again, as exhibited by an average –9.55% rating drift. We report an average 24.7% rating activity for that year, together with a record nine defaults. According to Brady et al. (2002), corporate defaults worldwide soared in 2001 due to a weak economy and the abundance of speculative debt issued in the late 1990s.

These findings support the intuition that credit risk increases in times of economic downturns, as evidenced by higher rating activity and larger negative rating drift. In other words, ratings are less stable and rating revisions are more likely to be downgrades than upgrades. To illustrate, we graph the annual rating drift and activity for all the obligors rated in CreditPro between 1981 and 2001 (**Figure 4**).

Panel B of **Table 4** presents the average rating drift and activity for the entire period (1981-2001) as well as for the eighties (1981-1989) and nineties (1990-1999). In addition, we examine the average rating dynamics over the 1983-1989 and 1993-1999 periods, which correspond to the eighties and nineties with the years of recession removed.

The 2000-2001 sub-period describes the most recent trends in migration dynamics. Consistent with Kryzanowski et al. (2001), the rating drift ratios reveal a faster deterioration in the credit quality of Canadian corporate issuers during the nineties (-7.16%) compared with the eighties (-6.23%). Also, we find a slight increase in rating activity from 11.11% in the eighties to 13.37% in the nineties. However, the magnitude of our ratios is noticeably inferior to Kryzanowski et al. (2001). Using CBRS ratings, they computed rating activities of 41.0% over the 1981-1989 period, and 31.50% over the 1990-1998 period. The authors attribute some differences in their own results to some differences in the coverage of issuers by Moody's and CBRS. Since our computations are based on CreditPro, the discrepancies between our results and theirs could just as well be due to different Canadian debt issuers recorded in Standard and Poor's database. Indeed, Brady et al. (2002) notice that their *Report on rating performance in 2001* "has led to outcomes that differ to some degree from those yielded by previous studies (because of) the ongoing enhancement of S&P's proprietary database (CreditPro) as well as the inclusion of companies previously excluded from the analysis".

Overall, our findings are consistent with Kryzanowski et al. (2001) as we find that periods of economic slowdown are characterized by an accelerated deterioration in credit quality and an increased rating activity. A look at average rating dynamics over the 1983-1989 and 1993-1999 periods, corresponding to the eighties and nineties without the years of recession, confirms these patterns. Rating drift ratios improve in these periods (-3.7% over the 1983-1989 period and -2.3% between 1993 and 1999) compared with the ratios for each full decade (–6.2% during the eighties and -7.2% during the nineties). Also, rating activity ratios drop from 11.1% during the eighties to 9.9% over the 1983-1989 period, and from 13.4% in the nineties to 8.6% over the 1993-1999 period.

To avoid a smoothing in rating migrations caused by the use of averages, we graph yearly rating drift and activity against the annual Canadian GDP growth rate. **Figure 5** shows the strong correlation between economic growth and migration dynamics. The level of economic activity is positively related with the rating drift and negatively related with the rating activity, as evidenced by correlation coefficients of 0.71 and –0.51, respectively. These figures confirm the impact of the macroeconomic context on rating migrations, although ratings primarily reflect the relative creditworthiness of an obligor in terms of industry and idiosyncratic risks. The significance of this relation is further investigated for transition matrices conditioned on the stage in the business cycle with chi-square tests of homogeneity.

3.2.3. Conditional rating migration patterns

3.2.3.1. Impact of the obligor industry

Rating drift and rating activity

We examine rating migration patterns by industry to see if the cyclical nature of an industry is reflected through greater rating volatility and downgrade probability in recessions. Most GISC (Global Industry Sector Classification) sectors considered as industrials are cyclical, such as automobiles, leisure goods, media, home construction and furnishing, and high technology. Among utilities, the airlines industry seems especially sensitive to the ups and downs of the business cycle. Although the performance of financial obligors is not directly linked to the level of economic activity, interest rate fluctuations play a huge role in the profitability of banks and insurance companies. Ederington and Lee (1993) explain that the government bond market is highly influenced by macroeconomic announcements. Indeed, a larger-than-expected increase in the GDP might be considered inflationary, causing the central bank to raise interest rates in order to slow growth. Conversely, an economic downturn may lead to lower interest rates to stimulate the economy. **Figure 6** gives a first insight into the cyclicality of industries' rating migration dynamics. Panel A shows that industrials follow particularly closely the ups and downs of economic growth. Such linkage is confirmed with correlation coefficients of 68% and -45% between industrials' rating drift and activity ratios and the real GDP growth rate, which is reported at the bottom of **Table 5**. Also, the financials' rating drift and activity ratios exhibit correlation coefficients of 46% and -47%, respectively, with the real GDP growth rate. Utilities appear somewhat less sensitive to the level of economic activity. The correlation coefficients with the GDP growth rate are 28% for the rating drift and -11% for the rating activity.

Table 5, panel A reports the annual rating drift and activity ratios per industry between January 1981 and December 2001. On average, industrials have exhibited the worst rating drift (-7.78%) and the highest rating activity (15.65%). At the other end of the spectrum, utilities show a slightly negative rating drift of -0.26% with a low 7.47% rating activity. However, utilities have undergone the most severe credit quality deterioration in 2001, as evidenced by an average –14.63% rating drift and 29.3% rating activity. The aftermath of September 11, 2001 was devastating for the transportation sector, in particular for airlines companies. Also, telecommunications were the hardest hit industry worldwide with nearly 11% of rated issuers defaulting over that year. Finally, financials exhibit a mean –6.51% rating drift and a modest 8.32% rating activity for the 1981-2001 period. The fact is that few financial obligors are included in Credit Pro before 1990. This results in flat migration dynamics over the eighties. Soon after they started to enter CreditPro around 1986, financials obligors underwent an average –21.82% rating drift accompanied by a massive rating activity (27.54%) corresponding to the 1990-1994 period.

An issue is to determine whether migration dynamics computed unconditionally differ significantly from estimates based on an industry-homogeneous sample. We test for the differences in mean and variance of unconditional and industry-conditioned rating drift and activity using t-tests and F-tests for the 1981-2001 period. The results of these tests can be found at the bottom of panel A of **Table 5**. The reported t-statistics confirm that the mean rating activities of financials and utilities significantly differ from the unconditional average at the 10% level. The difference in means between the unconditional and utilities rating drifts is also found to be non-zero at the 10% level, as indicated by a t-statistics of 1.91. Furthermore, the reported F-statistics indicate that the differences in variances between the unconditional and all three industries' rating activities are significant at the 10% level. The variances of the unconditional and utilities rating drift estimates also differ at the 10% level. Overall, these findings are consistent with the literature, which documents differences in the rating migration patterns of obligors in distinct industries.

Significance of differences in rating migration dynamics

Panel B in **table 5** uses the same period breakdown as in table 4 to evaluate the differences in means and variances between unconditional and industry-conditioned migration dynamics over various sub-periods using t-tests and F-tests. The breakdown distinguishes between the eighties (1981-1989) and nineties (1990-1999). Two additional sub-periods corresponding to the eighties and nineties without recession years, 1983-1989 and 1993-1999, respectively. These additional sub-periods are introduced to examine the hypothesis that rating dynamics across industry groups are less distinguishable in recessions. Indeed, Carty (1997) reports an increased correlation in obligors' credit quality movements during economic downturns.

Between 1981 and 1989, the credit quality of utilities has improved on average, while that of industrials deteriorated markedly, as evidenced by rating drifts of 3.7% and –9.3%, respectively. The t-statistics confirm the differences in the mean rating dynamics of financials and utilities compared with the unconditional estimates at the 5% and 10% levels. The F-test is also conclusive for the variance of industrials' rating activity at the 5% level.

Between 1990 and 1999, the credit quality deterioration is most severe for "financials" with a –12.9% mean rating drift, while those of industrials and utilities averaged -7.0% and –1.5%, respectively. Furthermore, the rating activity of financials (16.7%) is more than twice that of utilities (7.0%). Statistical tests regarding differences in rating migration dynamics across industry sectors are less conclusive for the nineties than for the eighties. The t-statistics are significant only at the 15% level for the mean rating drifts of financials and utilities, and at the 10% level for mean rating activity for utilities. Also, the F-statistics are insignificant at conventional levels of confidence.

Over the 1993-2001 period, the deepest credit quality deterioration is for financials. Rating drift ratios averaged –7.6% for financials, –2.2% for industrials, and –0.6% for utilities. The t- and F-statistics indicate that the mean and variance of financials' rating activity differ from their unconditional estimates at the 10% level. F-statistics are also significant at the 5% level for the variances of utilities' rating dynamics. Consistent with the literature, we find that the ratings of issuers in distinct industries behave differently. In other words, unconditional rating drift and activity only approximate the rating migration dynamics of a given industry. It is noteworthy that industry groupings, such as those we created to obtain samples of sufficient size, preserve such differences. Unconditional estimates remain useful to monitor the credit risk of a well-diversified portfolio. The use of industry-conditioned figures can be valuable to manage the sub-sectors of a portfolio.

Finally, we examine rating migration dynamics for the 1983-1989 and 1993-1999 periods. These periods correspond to the eighties and nineties without years of recession: 1981-1982 and 1990-1992. As expected, the credit quality deterioration of industrials and utilities is less severe in those sub-periods compared with the entire eighties and nineties. The credit quality of utilities on average improved, as evidenced by positive rating drifts of 4.8% and 2.7% in the two sub-periods. We hypothesize that rating migration dynamics are less correlated across industries in expansion as a result of the decreased correlation in obligors' credit quality movements (Carty, 1997). The null hypothesis is that the differences in migration patterns between the unconditional and industry groups are the same between 1983 and 1989 compared with the 1981-1989 period, and between 1993 and 1999 compared with the 1990-1999 period. Comparing the power of the respective F- and t-statistics tests this hypothesis. The significance of the t-tests and F-tests computed for the 1983-1989 and 1993-1999 sub-periods are expected to increase compared with the eighties and nineties, respectively. This would invalidate our hypothesis and imply that obligors' rating dynamics are less correlated during normal and expansion years compared to recessions. In other words, the unconditional rating dynamics can better reflect the true rating drift and activity of a given industry sample during an economic downturn.

Part of our results contradicts this hypothesis. Indeed, the statistical significance of tests for the rating dynamics of financials and utilities decreases for the 1983-1989 period, while those for industrials remain unchanged. In contrast, the 1993-1999 period shows increased power in the t-tests and F-tests for financials and industrials. Both statistics indicate significance in the difference of financials' rating dynamics at the 5% level, as well as in the rating drift of utilities at the 10% level. These results provide mixed evidence that the migration dynamics of obligors in distinct industries become more similar in recessions compared with normal and expansion times.

Conditional transition matrices

We now examine if bonds in different industries exhibit similar rating transition matrices. The average annual transition matrices computed for the industrials, financials, and utilities are presented in **Table 6.** Chi-square statistics, presented in **Table 9,** evaluate the differences between unconditional and industry-conditioned rating transition matrices.

For a one-year horizon, no industry group exhibits a consistently higher rating stability for all the rating classes. Among AAA-rated obligors, 100% of utilities kept their rating against only 81% of the financials and 78.3% of the industrials. Only 84.8% of utilities rated "AA" remained stable against 92.6% of the financials. Rating stability decreases with credit quality but not uniformly across industries. For instance, 81.6% of the financials and 95.4% of the utility obligors rated BBB maintain their rating over the next year.

3.2.3.2.Impact of the business cycle

Economic downturns reduce the viability of companies that would have shown more promise in expansion (Brady et al., 2002). This section examines the impact of the business cycle on rating migrations. Years of recession (expansion) have a real GDP growth rate inferior (superior or equal) to the annual average real GDP growth rate of 1.67% for the 1981-2001 period. Years of economic slowdowns are 1982-83, 1986, 1989-93, 1995-96 and 2001. Expansion years are 1981, 1984-85, 1987-88, 1994, and 1997 to 2000. Years of negative GDP growth rate include 1982, 1990, 1991 and 1992. **Tables 7** reports economy-conditioned rating drift and activity ratios together with tests of significance for their differences against the unconditional estimates. "Recession" and "expansion" transition matrices are shown in **Table 8**, and the chi-square tests of homogeneity are reported in **Table 9.**

Rating drift and rating activity

Table 7 and **Figure 7** present the annual letter-rating drift and activity ratios for years of economic expansion, recession, and negative GDP growth rates. Recession years exhibit higher rating activity and deeper credit quality deterioration than expansion years. We report average -12.6% and –0.2% rating drifts and mean 16.9% and 8.7% rating activity ratios for recessions and expansions, respectively. The difference in the mean rating drift is significant at the 5% level (t-value of 3.46). In contrast, the reported t-statistic of -1.68 shows no difference in the mean rating activity between a year of expansion and recession. Years of negative GDP growth rates exhibit even faster credit quality deterioration with annual average –19.26% rating drift and 23.80% rating activity. Compared with expansion years, differences in mean rating drift and activity ratios are both significant at the 5% level (respective t-statistics of 10.26 and -3.14).

Such discrepancies in migration dynamics across the business cycle call into question the reliability of unconditional estimates to characterize the likelihood and direction of a rating change. We compare the means and variances of migration dynamics measured unconditionally and for years of recession and expansion with t- and F-statistics reported at the bottom of **Table 7**. The t-statistics confirm a difference in means between the unconditional rating activity and those computed for years of expansion and negative GDP growth rates at the 10 and 5% levels, respectively. The variances of the rating activity computed for years of expansion, recession and negative GDP growth rates also differ from the unconditional estimate at the 5% level. The F-test is conclusive at the 5% for the variance of the rating drift computed over years of recession compared to the whole period. Finally, the t-tests infer that the mean rating drift computed from years of expansion, recession and negative GDP growth differ significantly from their unconditional estimates at the 5% and 10% levels. Recession years are characterized by significantly worse rating drift and higher rating activity ratio. It is therefore likely that the annual rating migration probabilities conditioned on the stage in the business cycle will also differ from their unconditional estimates. This issue is investigated in the next section.

Conditional transition matrix

Table 8 confirms that the obligors' mean rating stability decreases markedly during a recession year with the exception of BB-rated issuers. On average, 72.0% of AAA, 88.5% of AA, and 87.3% of A-rated issuers retain their grade over one recession year. These probabilities rise to 90.9 %, 91.2% and 92.0%, respectively, when computed for an expansion year. This pattern repeats itself for BBB and B-rated issuers' average diagonal probabilities estimated over an expansion year (92.8% and 79.5%, respectively) and a recession year (87.7% and. 72.6%, respectively). Over an expansion year, obligors holding CCC and CC ratings were on average 33% and 50% likely to default, while all defaulted in recession years. Consistent with Carty (1997), Bangia et al. (2000) and Nickell et al. (2001), we find some discrepancies in the rating migration probabilities computed for various stages in the business cycle. Chi-square tests of homogeneity are used to assess the significance of these differences.

3.2.3.3. Chi-tests of homogeneity

Computational methodology

We compare economy and industry-conditioned rating transition matrices with the unconditional matrix using chi-square tests of homogeneity. The null hypothesis is that differences in migration probabilities are negligible, implying that the unconditional matrix accurately reflects the probability of a rating change regardless of the economic context or portfolio's industry composition.

We denote the probability for an issuer to migrate from rating $j \in \{AAA, \ldots, CC\}$ to rating $k \in \{AAA, \ldots, D\}$ in year $t = \{1981, \ldots, 2001\}$ as $p_{jk}(t)$. The hypothesis of homogeneity is that unconditional rating migration probabilities $p_{jk}(t)$ are equal to rating migration probabilities for years of economic expansion, denoted t_E, and for recession years, denoted t_R. H_0 can be expressed as:

$$p_{jk}(\mathrm{t}) = p_{jk}(\mathrm{t_E}) \text{ and } p_{jk}(\mathrm{t}) = p_{jk}(\mathrm{t_R})$$

Similarly, the null hypothesis is that migration probabilities computed from industry-homogeneous samples cannot be differentiated from the unconditional estimates. In other words,

$$p_{jk}(\mathrm{t}) = p_{jk,FIN}(\mathrm{t})\ ;\ p_{jk}(\mathrm{t}) = p_{jk,IND}(\mathrm{t}) \text{ and } p_{jk}(\mathrm{t}) = p_{jk,UTI}(\mathrm{t})$$

The computations of chi-square statistics are presented in **Table 9** and **10** for economy-conditioned and industry-conditioned matrices, respectively. Each entry cell is the squared difference between the unconditional and the conditional rating migration probabilities, divided by the unconditional probability. These figures are summed by line to get the one-dimensional chi-square statistics. For each starting rating class j = {AAA,...,CC}, we accept the null hypothesis if the one-dimensional chi-statistic is inferior to its critical chi-value with (k - 1) = (10 - 1) = 9 degrees of freedom corresponding to the number of ending rating classes k = {AAA,...,D}. Then, we sum one-dimensional chi-square statistics to get the matrix chi-square statistic and compare it to the critical chi-square value with (j-1)(k-1) degrees of freedom, where j stands for the number of column-rating classes and k for the number of row-rating classes in the matrix. As we later explain, row-rating classes can be ignored to compute the chi-square statistics if they include too few observations to yield statistically significant results. The null hypothesis is rejected with a confidence level α if the computed statistics is greater than the critical value.

Homogeneity of rating migrations across the business cycle

The unconditional migration probabilities are compared to the estimates first for recession years, then for expansion years. As mentioned previously, the 1.67% annual average GDP growth rate computed for the 1981-2001 period in Canada is the criterion used to differentiate between the two categories. The chi-square tests of homogeneity reported for recession years in **Table 9** cannot reject the null hypothesis, as the χ^2-statistic of 40.18 is inferior to the critical value $\chi_{0.05,45}$ of 61.66. On a matrix-basis, average migration probabilities computed for a recession year do not significantly differ from the unconditional estimates. However, significant differences appear for AAA-rated issuers with a reported χ^2-statistic of 20.12, which is superior to the critical-$\chi^2_{0.01,9}$ of 16.92.

We find that the average rating migrations computed for a year of expansion do not significantly differ from the unconditional estimates. The χ^2-statistic of 11.88 is again inferior to the critical-χ^2 of 61.66. Similarly, no significant differences can be found among rating categories.

Over the studied period, the economic context had a moderate impact on the rating migration patterns for Canadian corporate issuers. Some of our findings support Nickell et al's (2002) view that the business cycle can best explain variations in the rating migration probabilities. We previously report significant levels of correlation between unconditional rating drift and activity measures and the real GDP growth rate. Furthermore, rating migration dynamics computed for recession and expansion years significantly differ from the unconditional measures as evidenced by the results from the t-tests and F-tests. Consistent with Bangia et al. (2000), economy-conditioned matrices reveal an increased probability of downgrade (upgrade) and a lower (higher) rating stability in recession (expansion). Differences in migration probabilities are still not significant between the economy-conditioned and unconditional rating transition matrices. This result supports Galil's (2002) conclusion that ratings ignore the economic context and reflect the industry and firm risks. The only conclusive result concerns AAA-rated obligors during economic downturns. In contrast, Bangia et al (2000) report that lower-rated bonds are more sensitive to changes in the business cycle. We find that the unconditional matrix underestimates the true risk of downgrade and default of CCC and

CC-rated obligors. However, these results lack significance due to too few obligors in those rating classes.

Homogeneity for rating migrations across industries

Similarly, we test the hypothesis of migration homogeneity across industries with chi-square statistics. The computations reported in **Table 10** exclude the CCC and CC rating categories because too few obligors hold such ratings. For the same reason, financials and utilities exclude obligors with B and AAA ratings, respectively.

Our findings indicate that the average migration probabilities in the financials matrix differ from the unconditional estimates at the 1% level. The reported χ^2-statistic of 90.73 is superior to the critical-$\chi^2_{0.01,36}$ of 58.62. Differences appear at the 1% level for A and BBB-rated issuers with respective χ^2-statistics of 37.89 and 27.14 that are both superior to the critical-$\chi^2_{0.01,9}$ of 21.67. Difference also appears for BB-rated bonds at the 5% level, where the χ^2-statistic of 20.63 exceeds the critical-$\chi^2_{0.05,9}$ of 16.92.

In contrast, the chi-square statistics obtained for the industrials and utilities matrices support the hypothesis of homogeneity in the rating migration probabilities. Moreover, none of the one-dimensional chi-square statistics exceeds the critical-$\chi^2_{0.05,9}$ of 16.92. We report a 21.03 χ^2-statistics for "industrials" that is inferior to the critical-$\chi^2_{0.05;45}$ of 61.66, and a 47.45 chi-value for "utilities" that is again inferior to the critical-$\chi^2_{0.05,36}$ of 51.00.

3.3. RISK-RETURN ANALYSIS OF CANADIAN CORPORATE BONDS

The remainder of this thesis examines the relative performance of corporate bonds from two standpoints. First, we analyze the drivers of corporate bonds' excess returns across industries, rating classes and maturity buckets. More precisely, we gauge the explanatory power of credit and market risk factors in addition to macroeconomic indicators. Secondly, the volatility of returns pattern of a typical Canadian corporate bond is examined using the Campbell, Lettau, Malkiel and Xu (2001) disaggregated model. More precisely, we decompose a bond return volatility into a market, an industry and an idiosyncratic component. Subsequently, we test for the existence of unit-roots in each of the volatility components. Our results suggest a change in the composition of bond return volatility. In particular, we examine the nature of any potential upward (downward) trend in the firm-specific (industry) volatility component using unit-root tests.

3.3.1. Relative performance of alternative investment classes

Table 11 presents the summary statistics of the distributions of monthly annualized returns for the TSE index, Canadian short and long-term Treasuries (respectively three-month and over 10-year Treasuries), and the "total" Canadian corporate bond portfolio over the February 1993 to May 2002 period.[4]

Among investment classes, corporate bonds exhibit the highest rate of return (7.22%) and the lowest standard deviation (1.19%). Three-month and over ten-year Treasuries

[4] TSE total returns and Treasuries returns are from the Canadian Financial Markets Research Centre (CFMRC) database.

returned 4.70% and 6.75% on a monthly-annualized basis with standard deviations of 1.34% and 1.24%, respectively. Over the studied period, stocks were the least profitable and most risky investment, yielding only an average 1.03% with a 4.84% standard deviation. In contrast with volatility, skewness indicates that Treasuries were less risky than corporate bonds. Indeed, corporate bonds' return distribution is peaked and negatively skewed, while those of the long and short-term Treasuries exhibit positive skewness. Stocks return distribution also exhibits negative skewness indicating a heavier left tail.

The Sharpe ratio is computed as the ratio of the difference between an asset's average return and the one-month T-bill rate on that asset's return standard deviation. At both ends of the risk-adjusted performance spectrum are corporate bonds and stocks with 2.13 and –2.80 Sharpe ratios, respectively. In between, long and short-term Treasuries present average 1.80 and 0.55 Sharpe ratios, respectively.

The value-at-risk (VaR) indicates that the rate of return that has a 1% maximum probability on the left tail. Reported VaR figures are –20.11% for the TSE index, while they are positive for long-term Treasuries (5.08%) and corporate bonds (5.62%). We remain cautious about this comparison given the exclusion of defaulted bonds from the studied sample. The challenge in computing a credit portfolio's VaR is to estimate the default probabilities and the losses given default, where both parameters can vary widely from one year to another (Fons, 1991). The 1981-2002 average default rate for Canadian obligors rated in CreditPro was 1.70%, with most defaults actually occurring after 1997. Moreover, a global study by Fridson, Garman and Osashima (2000) indicates that the average recovery rate for a defaulted corporate issue was 40.19% for the 1978-1999 period. Yet, it was only 28.66% in 1999. Such variations are mainly stochastic as they can be little explained by common factors such as the industry, economic conditions or volume of defaults being resolved at the time.

Finally, we report beta estimates for the sensitivity of long and short-term Treasury yields to stock returns as measured by the monthly-annualized excess returns on the TSE Index. The –0.077 beta coefficient found for three-month T-bill returns is significant at the 5% level, as indicated by its t-statistic (–3.28). In contrast, the –0.022 beta found for over ten-year Treasuries is not significant as indicated by a low –0.96 t-statistic.

3.3.2. Overview of Canadian corporate bonds' historical performance

3.3.2.1. Historical performance per industry, rating class and maturity bucket

Table 12, panel A presents the summary statistics for annualized series of monthly excess returns on the twelve equal-weighted portfolios of rated corporate bonds corresponding to various industries, rating classes, and maturity buckets for the February 1993 to May 2002 period. Each series of excess returns is characterized by its mean, standard deviation, skewness and excess kurtosis. The Sharpe ratio provides a measure of risk-adjusted performance comparable across bond categories. $VaR_{99\%}$ refers to the value-at-risk or maximum negative excess return on a given portfolio over a one-month horizon expressed in annualized percentage and computed with a 99% confidence level.

The "total" portfolio returns are on average 2.70% over the one-month T-Bill rate, while BB-rated bonds have the maximum mean excess return of 3.05%, and short-term bonds have the minimum mean excess return of 2.38%. Moreover, the "total" portfolio exhibits a 1.26% standard deviation, in between that of long-term bonds (0.96%) and B-rated bonds (1.51%).

In terms of risk-adjusted performance, Sharpe ratios range from 2.29 for BB-rated bonds to 1.81 for short-term issues. "Industry" and "maturity" portfolios and B-rated bonds suggest an inverse relation between the risk-adjusted performance and average credit quality. In contrast, the average Sharpe ratios and rating scores of "rating" portfolios are positively related, which is more consistent with expectations. If ratings are a consistent measure of a bond's risk, they should be able to predict superior returns alone as well as in conjunction with other non-diversifiable risk sources. Interestingly, the risk-adjusted performance of "maturity" portfolios is positively related to the time to maturity as long, medium and short-term portfolios exhibit 2.21, 2.13 and 1.81 Sharpe ratios, respectively. Moreover, the medium-term cohort exhibits excess returns with the highest mean (2.82%) and standard deviation (1.33%).

Table 12 also reports measures of skewness and excess kurtosis that account for the asymmetry and fat-tails of bond excess return distributions. Contrary to the empirical evidence, all bond excess return distributions exhibit positive skewness, in particular those of BB and B-rated bonds. The fact that extreme values are found in the right tail of the distribution is due to the absence of defaulted bonds from our dataset. Consistent with the literature, negative excess kurtosis is reported implying a larger-than-normal dispersion of returns. Only BB and B-rated bonds exhibit "peaked" distributions, as indicated by their 0.65 and 0.59 excess kurtosis. Fat tails call for a measure of downside risk to quantify the 1% worst return on each portfolio.

Again, the exclusion of most defaulted issues underestimates the true downside risk of a corporate bond portfolio, as evidenced by positive VaR figures. The upward bias is larger for the lower-rated classes of bonds. Indeed, the distributions of excess returns concern solely "survivors", hence reflect the premium that compensates for a higher default risk but ignores actual losses from default. The BB-rated class has the highest VaR and risk-adjusted performance measures.

Finally, beta estimates evaluate the sensitivity of bonds' returns to the stock market for the February 1993 to May 2002 period. As expected, the slope coefficients in the regression of bonds' total returns on the difference between the TSE index total returns and the one-month T-bill rate are negative, with values ranging from –0.005 to –0.035. Only the beta of the short-term cohort (-0.035) is significantly different from zero, as indicated by the –1.68 t-statistic.

We assess the relation between bonds' ratings and their performance. The Spearman rank correlation coefficients that are reported in the **panel B** of **table 12** are –0.7 between ratings and expected returns and -0.9 between ratings and standard deviations. These figures are consistent with the hypothesis that on average lower-rated bonds have a higher return and volatility.

3.3.2.2. Correlation in bond returns

Table 13 presents the Pearson correlation coefficients between corporate bond portfolios' excess returns. First, it appears that lower-rated bonds are less correlated with the other portfolios. In particular, B-rated bonds exhibit the smallest correlation coefficients, such as 0.84 with BB-rated bonds. Also, the level of correlation decreases somewhat as the gap in rating classes widens. For instance, AA-rated bonds exhibit correlation coefficients of 0.97 with A-rated bonds and 0.88 with B-rated bonds. Given that bonds migrate from one sample to another over time, a high level of correlation was expected among "maturity" portfolios' excess returns.

The high degree of correlation in bond excess returns implies limited opportunity of diversification across bond categories and suggests that returns may be driven by a number of common factors. This issue is investigated with a regression model in the following section.

3.4. DRIVERS OF CORPORATE BOND RETURNS

This section attempts to uncover the determinants of bond excess returns depending on the bond portfolio's industry, maturity bucket and credit quality. First, return time series are examined for seasonality effects and autocorrelation. A description of candidate determinants for bond returns follows. After corrective procedures are conducted for multicollinearity in the independent variables and serial correlation in the regression residuals, the regression results are presented and analyzed.

3.4.1. Seasonality and autocorrelation in corporate bond return distributions

3.4.1.1. January effect in time-series of excess returns

Our first concern regards the existence of a potential January effect in the time series of bond excess returns. Jordan (1991) tests for seasonal patterns in corporate bond returns using the Dow Jones composite bond average and reports January and turn-of-the-year effects for the 1963-1986 period.

Table 14 presents monthly annualized percentages of mean excess returns in January and for the rest of the year (February to December). Reported excess returns on the "total" portfolio are on average higher by 0.18% in January compared with the rest of the year. This difference is larger for utilities (0.38%), "A"-rated bonds (0.23%) and the mid-term cohort (0.22%). The following OLS regression model is used to test for the significance of higher excess returns in January compared with other months:

$$R_{i,t} = \alpha_0 + \alpha_1 D_{i,t} + \varepsilon_{q,t}$$

where $R_{i,t}$ is the annualized excess return on portfolio (i) in month (t). The eventuality of a January effect is examined by including a dummy variable $D_{i,t}$ that equals one if (t) is January and zero otherwise.

As expected, reported slope coefficients are positive indicating higher excess returns in January for all the portfolios. However, these differences are not significant based on their reported t-statistics. Therefore, we cannot reject the null hypothesis that excess returns in January are not significantly different from the rest of the year. Besides the absence of a January effect, insignificant F-statistics are reported implying that mean returns from January to December are jointly equal.

3.4.1.2.Serial correlation in time-series of excess returns

In order to model the process generating bond excess returns via an equation with fixed coefficients that can be estimated from past data, the underlying process needs to be stationary. The autocorrelation function provides a partial description of this process by quantifying the correlation or interdependency between neighboring data points in each series of excess returns.

The autocorrelation function is defined as:

$$\hat{\rho}_k = \frac{\sum_{t=1}^{T-k}(y_t - \bar{y})(y_{t+k} - \bar{y})}{\sum_{t=1}^{T}(y_t - \bar{y})^2}$$

The corresponding estimates of $\hat{\rho}_k$ are reported in **Table 15** for a number of lags (k) up to 48 months.

Consistent with Duffee (1998), we report positive autocorrelation coefficients, all significant at the 5% level up to a 6-month lag. Coefficients are homogeneous and behave similarly across portfolios for a given number of lags. Returns lagged by three and six months exhibit high autocorrelation coefficients in the vicinity of 0.80 and 0.50, respectively. These estimates decrease more substantially for 12 and 24-month lags to around 0.10 and –0.10, respectively. Because corporate bonds may not trade daily, the latest price is reported as the current price to build the series of daily excess returns. This non-synchronous trading amplifies autocorrelation and could explain its magnitude for small lags.

The plot of sample autocorrelation functions for the twelve series of excess returns that is presented in **Figure 8** shows that values of $\hat{\rho}_k$ fall quickly after six lags and remains small until 24 lags. However, coefficients start to grow again for 36 and 48-month lags, which questions the stationarity of excess returns time-series. Annaert et al. (1999) also observe significant negative first-order serial correlation in the European credit spreads. They suggest that this could be an indication of mean reversion, meaning a tendency for credit spreads to revert to a long-term average. Our results suggest a similar interpretation.

3.4.2. Dependent and independent variables

This section describes the potential determinants of corporate bonds' excess returns. More precisely, the bond portfolios under study are the "total" portfolio, including the 147 rated bonds from our dataset, as well as eleven equally-weighted portfolios, namely the "industry", "rating" and "maturity" sub-samples. Bonds issued in the middle of a month would be included in the relevant portfolio(s) on the first day of the following month. Excess returns are computed daily as the difference between a bond's total return and the corresponding 1-month T-bill rate, and then averaged over each month to get individual bond's monthly annualized excess returns. These series are equal-weighted averages across bonds in a given portfolio at the beginning of a month and used as the dependent variable in the regression model.

The first series of independent variables, described in the next paragraph, include variables related to the bonds' specific features and credit quality evolution. The following two groups of factors refer to common time-varying determinants. First, market risk is characterized by the term structure of interest rates and the returns on the stock market. Secondly, the macroeconomic context is summarized by the inflation rate and the level of economic activity, as suggested by Elton et al. (2001).

The regression model jointly considers market and credit risk factors, which is consistent with current risk management practices (Crouhy et al., 2001). This distinction also allows a comparison of the impact of common and diversifiable risk factors. The term structure of interest rates and stock returns are systematic sources of risk, while ratings are industry and firm-specific. Although ratings evaluate the relative creditworthiness of an obligor in a given industry, their ability to explain excess returns implies that credit risk cannot be fully diversified and requires additional returns. In particular, a number of papers suggest that ratings are influenced by the state of the economy so that co-movements in issuers' credit quality are positively correlated. The cross-sectional regression coefficients on each set of variables reveal the relative sensitivity of corporate bonds to market and credit risks, depending on their maturity, industry and credit quality.

3.4.2.1. Specific factors

Bond variables

Bonds' features should be accounted for to enhance the comparability of their return time-series (Perraudin et al., 1999). Seniority and collateral affect bonds' prices as both provisions increase the recovery rate in case of default. Recall that we selected exclusively senior unsecured non-callable corporate bonds, so that we do not investigate the relative impact of these covenants on the excess returns. However, other specific factors are included to account for the average liquidity, time to maturity and coupon rate in each portfolio. The corresponding information is retrieved from the Bloomberg station.

Liquidity:

Annaert et al. (1999) argue that to the extent that the one-month Treasury is more liquid than the corporate bond, the spread between the two will include a liquidity premium. When liquidity is measured as the issue's size, many authors find a negative relationship between excess returns and size. In particular, Campbell et al. (2003) use the natural logarithm of the issue size to account for cross-sectional differences in bond liquidity and report a significant and negative relation with credit spreads. Hence, larger issues are considered more liquid and require a lower yield. Therefore, the expectation is that issue size is inversely related with excess returns. Furthermore, the strength of this relation should increase as the portfolio's credit quality decreases. Indeed, increased uncertainty in the bond market may create a flight to quality that favors investment-grade bonds and Treasuries at the expense of lower-rated bonds.

For an equal-weighted portfolio, we suggest that a larger size in dollar terms implies the inclusion of either more bonds, hence a higher level of diversification, or larger and thus more liquid issues. In either case, the portfolio should be regarded as less risky implying a smaller premium over the risk-free rate. Excess returns are therefore expected to be negatively related to the portfolio's total size.

Time to maturity

Credit spreads, that is, the difference in return between a corporate bond and a Treasury of identical maturity, are a common measure of credit risk. The term structure of credit spreads reflects the relation between a bond's credit risk and its term to maturity. The literature notes that it is not necessarily upward sloping. Depending on the credit quality of the bond, the term structure of credit spreads can also be humped-shaped. As the time horizon lengthens, highly rated issues are more likely to undergo a downgrade while the probability of an upgrade increases for junk bonds (Kryzanowski et al., 2001; Annaert et al., 1999). Therefore, credit spreads for non-investment grade bonds can be lower for longer maturity bonds.

While we examine bond returns in excess of the one-month T-bill rate and not credit spreads, the summary statistics for "maturity" portfolios presented in Table 12 show a similar pattern. Mid-term bonds had the highest excess returns, on average 2.82%, against a mean 2.15% and 2.38% for long-term and short-term bonds, respectively. Actually, long-term bonds exhibit the lowest level of credit risk, as measured by an average 3.02 rating score for the February 1993 to May 2002 period, explaining the low level of excess returns in spite of a greater risk of future rating downgrades.

Coupon rate

For tax reasons, the coupon rate may impact bond returns. The weighted-average coupon rate on each portfolio is included in the regression model and recomputed annually. In addition to the inclusion of new issues, "maturity" and "rating" portfolios are also affected by the movements of bonds already outstanding by changing portfolios due to the time elapsed and rating migrations.

Credit risk

Because they form homogeneous samples in terms of relative credit risk, "rating" portfolios are not concerned by migration dynamics or changes in their credit quality. In contrast, the "total", "industry" and "maturity" portfolios' credit quality evolution needs to be accounted for. To this end, we include a mean rating score, as well as drift and activity ratios as explanatory variables for these portfolios' excess returns.

Credit ratings

The explanatory power of ratings assesses their relevance as relative metrics of credit risk. A portfolio's rating score is computed as the monthly average of included bonds' beginning-of-month ratings. Looking at US investment-grade bonds, Duffee (1998) found that the credit spread widens at an increasing rate as the credit quality worsens. Similarly, we expect a bond portfolio's excess returns to be positively related to a higher score, i.e. a lower credit quality.

Rating migrations

The monthly average rating drift and activity ratios describe the direction and volatility of rating migrations in a given portfolio. They are computed following Carty et al. (1993) and based on the rating revisions recorded in CreditPro. The expectation is that excess returns are negatively related to the rating drift and positively related to the rating activity.

3.4.2.2. Common factors

Market risk

Term structure of interest rates

As in Christiansen (2000) and Campbell et al. (2003), the term structure of interest rates is represented by its slope and its short and long-term levels. An upward sloping yield curve indicates higher expected interest rates. Hence, a steeper yield curve is associated with lower future bond prices and higher future yields. The empirical evidence suggests that credit spreads are negatively correlated with the level and slope of the term structure of interest rates (Christiansen, 2000; Duffee, 1998). Moreover, the effects of changes in the long-term level and in the slope of the term structure are more visible for longer-maturity bonds (Elton et al., 2001).

A rise in the slope implies that either the short- (long-) term level of interest rates has decreased (increased). A higher long-term level of interest rates signals lower future bond prices, hence it is associated with lower excess returns. Excess returns increase as the result of a decrease in the short-term level of interest rates. The expectation is that excess returns decrease on average when the yield curve becomes steeper or the levels of risk-free rates increase.

Stock returns

The empirical evidence suggests that Treasuries are not sensitive to the influences governing stock returns, in contrast to corporate bonds where expected defaults decrease (increase) as equity prices increase (decrease) (Elton et al., 2001). Elton et al. (2001) note that the excess returns on the stock market (S&P500) represent expectations about the future economic environment. Therefore, the expectation is for a negative and significant relation between corporate bond excess returns and stock returns.

The macroeconomic context

The macroeconomic context is represented by the growth rates in the consumer price index (CPI) and in the real gross domestic product (GDP). Ederington and Lee (1993) report that the government bond market is highly influenced by macroeconomic announcements. As we examine bond returns in excess of the one-month T-bill rate and include the term structure of interest rates as a predictor of excess returns, the regression model may already reflect the macroeconomic context.

Canadian real gross domestic product (GDP)

Bond excess returns are expected to behave cyclically. In recessions, risk-free rates decrease causing bond prices to increase, all else held equal. The growing uncertainty surrounding the debt service results in wider credit spreads to compensate for the higher risk of default. Hence, excess returns and the level of economic activity should be inversely related resulting in a negative regression coefficient for the real GDP growth rate. Also, the strength of this relation is likely to depend on each bond portfolio's average credit quality and term to maturity.

Canadian consumer price index (CPI)

A higher-than-expected or increasing trend in the CPI causes bond prices to fall while yields and interest rates rise. The total return on a bond already outstanding is likely to decrease as the coupon rate is fixed while the bond price decreases. Excess returns are even lower if the T-bill rate increases as a result of higher inflation. Therefore, the coefficient on the change in the CPI is expected to be negative.

3.4.3. Primary results

We examine the determinants of the equal-weighted average of corporate bonds monthly-annualized excess returns for the February 1993 to May 2002 period. Price and yield histories are retrieved from Bloomberg.

The independent variables presented below are monthly data with their expected coefficient sign in parentheses. The information regarding issue-specific features is from the Bloomberg station.

(-) ln_IS_t refers to the natural logarithm of the mean issue size, computed monthly as the equal-weighted average of bonds' face value.

(-) ln_PF_t refers to the natural logarithm of the total dollar face value of bonds included in a portfolio at the beginning of a month.

(?) CPN_t refers to the equal-weighted monthly average coupon rate paid by bonds in a portfolio at the beginning of a given month, in percentage.

(?) MAT_t refers to the equal-weighted monthly average of the years remaining to maturity for bonds in a portfolio at the beginning of a given month.

(+) RS_t refers to the equal-weighted average of beginning-of-month ratings held by bonds included in portfolio (i) in month (t). It is assumed constant for that month. Ratings are updated for potential migrations recorded in CreditPro at the beginning of the following month. The rating score is also adjusted for the addition of new issues. To be consistent with the rest of the paper, the scoring system ignores modifiers so that AAA is 1, AA is 2, A is 3, BBB is 4, BB is 5, B is 6, CCC is 7, CC is 8, C is 9, and D (default) is 10.

(-) RD_t refers to the rating drift in portfolio (i) computed as the difference between the number of upgrades and downgrades, divided by the number of issuers rated at the beginning of a given month.

(-) RA_t refers to the rating activity in portfolio (i) computed by dividing the sum of all upward and downward letter-rating changes by the number of issuers outstanding at the beginning of a given month.

(-) $Slope_t$ refers to the slope of the term structure computed monthly as the difference between the 10-year and the 2-year Treasury rates, following Campbell et al. (2003). The corresponding rates are from the Canadian Financial Markets Research Centre (CFMRC).

(-) ST_IR_t refers to the short-term interest rate level measured by the three-month T-bill rate, as reported monthly by the Canadian Financial Markets Research Centre (CFMRC).

(-) LT_IR_t refers to the long-term interest rate level, measured by the over ten-year Treasury yields reported monthly by the Canadian Financial Markets Research Centre (CFMRC).

(-) TSE_T_t refers to the monthly annualized total return on the TSE index, which includes dividends and is retrieved from the TSE Western database.

(-) TSE_X_t refers to the monthly annualized excess return on the TSE index (i.e., the above total TSE returns), TR_{TSE_i}, less the corresponding one-month T-bill rate, as indicated by the TSE Western database and the Canadian Financial Markets Research Center (CFMRC).

(-) GDP_t refers to the monthly-annualized real GDP growth rate, from Statistics Canada (CANSIM, table 379-0018)

(-) CPI_t refers to inflation measured as the monthly changed in the consumer price index (CPI), retrieved from Statistics Canada (Series 326-0001).

The "full model" is the regression model that includes the variables described above as independent variables. The dependent variable R_{it} refers to bond excess returns for portfolio (i) in month (t).

The full model of a "rating" portfolio consists in 11 predictors and can be written as:

$$R_{it} = \beta_0 + \beta_1 \ln(IS_{it}) + \beta_2 \ln(P\overline{S}_{it}) + \beta_3 CPN_{it} + \beta_4 Mat_{it} + \beta_5 Slope\,(IR)_t + \beta_6 ST\,(IR)_t + \beta_7 LT\,(IR)_t + \beta_8 TSE\,(t)_t + \beta_9 TSE\,(x)_t + \beta_{10} \Delta GDP_t + \beta_{11} \Delta CPI_t + \varepsilon_t$$

The remainder of the models include three additional predictors corresponding to the rating score, rating drift and activity ratios, and are given by:

$$R_{it} = \beta_0 + \beta_1 \ln(IS_{it}) + \beta_2 \ln(P\overline{S}_{it}) + \beta_3 CPN_{it} + \beta_4 Mat_{it} + \beta_5 Slope(IR)_t + \beta_6 ST(IR)_t + \beta_7 LT(IR)_t + \beta_8 TSE(t)_t + \beta_9 TSE(x)_t + \beta_{10} \Delta GDP_t + \beta_{11} \Delta CPI_t + \beta_{12} RS_{it} + \beta_{13} RD_{it} + \beta_{14} RA_{it} + \varepsilon_t$$

The full models have R-squared (R^2) ranging from 0.532 for BB-rated bonds to 0.983 for the industrials portfolio. Based on the F-statistics, all the models are significant at the 5% level. The standard errors of estimates are inversely related to the model's explanatory power with values ranging from 0.16 for industrials to 0.96 for BB-rated bonds. Finally, low Durbin-Watson statistics suggest that positive serial correlation exists in the twelve series of residuals estimates.[5]

3.4.4. Multicollinearity and serial correlation

3.4.4.1. Examination of multicollinearity in the regression models

In this section, we investigate potential relations among independent variables, which could translate into multicollinearity and distort regression results. There is no statistical test to confirm the presence of multicollinearity but several indicators do exist. Pindyck and Rubinfeld (1999) explain that the distributions of the estimated regression parameters are sensitive to the correlation between independent variables as well as to the standard error of the regression. Large standard errors widen confidence intervals resulting in imprecise coefficient estimates, and even sign reversals. Therefore, we could misleadingly conclude that a predictor is non-significant while it is actually strongly

[5] These results appear in Table 17 and are referred to as "full model".

related to bond returns. Because R^2 and F-statistics are largely unaffected by multicollinearity, a powerful model with few significant predictors is an indication of multicollinearity. Indeed, we report a 0.98 R^2 for industrials with nearly half of the independent variables being non-significant. The BB model exhibits a 0.53 R^2 while only three predictors out of eleven are significant. Moreover, the Pearson correlation coefficients matrix presented in panel A of **table 16** exhibits a strong linkage between bond returns and some independent variables. However, these latter variables are found to be statistically insignificant when estimated in the full models (**table 17**). For instance, the "total" excess returns relate to both the issue and portfolio size logarithms with correlation coefficients of 0.48 and 0.47, respectively. Still, only the former appears as a significant predictor of "total" bond returns. In contrast, their modest correlation with changes in the CPI (-0.07) and TSE total returns (-0.06) translate into coefficients significant at the 5% level. Despite an 83.4% correlation coefficient with financials bond returns, the interest rate slope is found non-significant in the regression results. However, both the long and short-term interest rates levels are significant at the 1% level. Such contradictions can be observed in all the portfolios' regression estimates.

The matrix of pairwise Pearson correlation coefficients reported in panel B and C of **table 16** confirms our intuition that some independent variables are strongly interrelated. Most coefficients are superior to 0.1638; i.e., ARE significant at the 5% level. Although no specific threshold exists, Pindyck et al. (1999) suggest that a correlation of 0.50 or larger is signals a multicollinearity problem. Panel A shows low pairwise correlation coefficients for predictors common to all the regression models, except when it comes to the interest rate term structure. Reported correlation with the TSE total returns are non significant, while the TSE excess returns relate somewhat to the interest rate slope and short-term level with 0.21 and 0.27 correlation coefficients. The CPI and real GDP growth rates are inversely related with a –0.24 correlation coefficient. The rest of the coefficients with the GDP growth rate are not significant. Inflation also relates to the slope (-0.20) and long-term level (-0.31) of interest rates. The only concern regards the interest rate term structure. Specifically, the short-term interest rate level exhibits correlation coefficients of 0.50 and –0.55 with the long-term level and the slope of interest rates, respectively.

Relations among independent variables unique to a portfolio are the major source of multicollinearity. The first table in Panel B reports seven correlation coefficients superior to 0.75 between the issue and the portfolio size logarithms and only one non-significant coefficient. The issue size logarithm relates strongly and negatively to most portfolios' average coupon rate and maturity. The next table evidences the high and widespread correlations between a portfolio's size logarithm, its coupon rate and maturity. In addition, the coupon rate is strongly linked to interest rate slope and levels. In contrast, maturity does not correlate to any specific predictor but exhibits high correlation with several predictors in the BBB, BB-rated and short-term regression models. Furthermore, we find that the rating score mainly relates to the issue and portfolio size logarithms as well as to the long-term interest rate level in all but the industrials and medium-term bond models. The rating score also relates to the rating dynamics measures, with correlation coefficients around 0.6. Finally, the link between the rating drift and activity ratios is particularly strong and pervasive among the regression models.

Pearson correlation coefficients straightforwardly identify high correlation between two predictors but give little guidance as to how these latter variables should be sorted out in order to minimize the impact of multicollinearity on regression results. To identify multicollinearity arising from three or more variables being interrelated, we regress each independent variable on all the others and use the multiple correlation coefficient to compute that predictor's volatility inflation factor or VIF as [1/(1-R-square)]. A VIF value superior or equal to five provides evidence of a strong relation between the independent variable and at least one other independent variable in the model.

In order to limit multicollinearity, the predictors that are not highly interrelated are gathered into a reduced form of the full model, which is henceforth denoted as the reduced model. To this end, predictors exhibiting a VIF superior or equal to five are alternatively removed from the full model. The F-statistics for the change in R^2 assesses the significance of that predictor's contribution to the full model's explanatory power. Above all, the variance inflation factors that decrease as a result of a predictor's removal indicate which independent variable(s) the excluded predictor is most related. In the end, a reduced model contains independent variables exhibiting variance inflation factors less than five. Depending on the severity of multicollinearity, between two and five subsets were created for a portfolio so that each predictor is included in at least one reduced model. All of them contain variables with VIF values lower than five; namely the CPI and real GDP growth rates as well as TSE total and excess returns. Our description of created subsets assumes the presence of these predictors. Hence, **table 18** and the next section concentrate on separating intertwined independent variables.

3.4.4.2. Description of subsets of uncorrelated predictors

In the **"total"** portfolio, nine predictors exhibit VIF in excess of five and are alternatively removed from the full model. F-statistics for the changes in R^2 provide evidence that the portfolio size logarithm (VIF=47.7), the rating score (VIF=326.4), the rating drift (VIF=6.9) and activity ratios (VIF=7.7) do not increase the model's explanatory power. In addition, removing the coupon rate (VIF=199.4) removes substantial multicollinearity in the portfolio size logarithm (VIF down to 39.9) and rating score (VIF down to 43.5). Also, the presence of either the interest rate slope (VIF=12.5) or short-term level (VIF=18.0) in the model results in insignificant VIF values. Similarly, removing the rating drift or the rating activity results in a 2.5 VIF value for the other variables. However, it is unclear which predictors significantly relate to the long-term interest rate level (VIF=12.6). Maturity (VIF=2.0) is included in the five reduced models. The first model examines the interest rate slope, rating score and rating drift ratio influences on bond returns. The second model comprises the coupon rate, short-term interest rates level, and rating activity ratio. The third subset includes the portfolio size logarithm, interest rate slope and short-term level, and rating activity ratio. The fourth model encompasses the interest rate slope and long-term level, and the rating drift ratio. Finally, the fifth model includes the issue size logarithm, interest rate slope and rating drift ratio.

The **AA** regression model owes its multicollinearity to five predictors. With the exception of the coupon rate, all of these predictors contribute to the model's explanatory power as evidenced by F-statistics for change in R^2, which is significant at the 5% level. Our primary analysis uncovers a strong relation between the portfolio size logarithm

(VIF=10.7) and coupon rate (VIF=24.0). Both predictors also relate somewhat to the term structure of interest rates. Interest rate slope (VIF=13.1) and short-term level (VIF=15.9) are highly correlated. When one is removed from the equation, the other's VIF drops to 1.5. Finally, omitting the long-term interest rate level (VIF=10.1) causes the largest drop in R^2 (-3.8%) but provides no evidence of a specific linkage to another predictor. Maturity (VIF=3.2) can be included in the two reduced models. The first subset excludes the coupon rate and the short-term interest rate level. The portfolio size logarithm, the slope and long-term level of interest rates are removed from the second subset of predictors.

The **A** regression model's explanatory power is not increased by two of the five collinear predictors, namely the coupon rate (VIF=35.4) and interest rate slope (VIF=15.3). The latter variable correlates strongly to the short-term interest rate level (VIF=16.5) as shown by VIF values of only 2.0 and 1.9, respectively, when the other variable is dropped from the model. Both variables relate significantly to the coupon rate and somewhat to the issue size logarithm (VIF=15.9). In contrast, the long-term interest rate level (VIF=7.8) is not linked with any specific factor. Model 1 includes the portfolio size logarithm, coupon rate, maturity, and the interest rate slope. Model 2 comprises the issue size logarithm, the coupon rate, and the short and long-term levels of interest rates.

The **BBB** regression model exhibits large multicollinearity in seven predictors. Maturity (VIF=99.0) is the only variable that does not contribute to the model R^2. Its removal decreases the VIF of the issue size logarithm (14.1) and of the coupon rate (434.1) to 7.6 and 352, respectively. Moreover, the portfolio size logarithm (VIF=256.1) is strongly linked to the coupon rate. To a lesser extent, both predictors also relate to the slope (VIF=15.2) and the short-term level (VIF=14.5) of interest rates. These latter predictors are highly interrelated as shown by an insignificant VIF when either one is removed. Given the magnitude and extent of multicollinearity, four reduced models are necessary to observe all the predictors. The first reduced model includes the portfolio size logarithm, and the short and long-term interest rate levels. Model 2 includes the issue size logarithm, and the interest rate slope and long-term level. Model 3 encompasses the maturity, the slope and long-term level of interest rates. Model 4 includes the coupon rate, the short and long-term levels of interest rates.

The **BB** regression model exhibits multicollinearity among seven predictors. Two of them, the interest rate slope and the coupon rate, contribute to the R^2 of the full model as evidenced by F-statistics for the change in R^2, which are significant at the 5% level. The coupon rate (VIF=17.8) relates mainly to the issue size logarithm (VIF=38.5). The latter is also significantly correlated with the portfolio size logarithm (VIF=38.5) and the long-term interest rate level (VIF=13.2). Deleting the slope (VIF=10.4) or the short-term interest rate level (VIF=10.7) removes collinearity in the remaining predictor. Both predictors also relate to the portfolio size logarithm. Again, four reduced models are estimated. The first one includes the issue size logarithm and the short-term interest rate level. The second model includes the portfolio size logarithm and the slope of interest rates. The third subset encompasses maturity, the slope and long-term level of interest rates. The coupon rate and the short-term level of interest rates are included in the fourth subset.

The **B** full model excludes either the issue size or the portfolio size logarithm because of quasi-perfect correlation between the two variables. Hence, each version of the "full" model includes 13 predictors. In either version, significant VIF values regard maturity (6.3), the slope (7.6), and short (8.4) and long-term levels (7.4) of interest rates. The F-statistics for the changes in R^2 indicate that all but interest rate slope significantly contribute to the explanatory power of the model. The two reduced models include the coupon rate (VIF=2.0).

Ten predictors exhibit high multicollinearity in the **financials** full model. Among them, only the short-term interest rate level is meaningful to the model explanatory power (F=35.7). A primary analysis indicates a strong link between the coupon rate (VIF=172.6), rating score (196.6) and maturity (58.8). Removing the coupon rate or the rating score also decreases the VIF values for the portfolio size logarithm, interest rate slope, rating drift and activity ratios. Furthermore, we find evidence of a strong linkage between interest rate slope and short-term level on the one hand, and between rating drift and activity ratios on the other hand. Among the five reduced models, all but model 2 include the issue size logarithm. Model 2 instead encompasses the portfolio size logarithm. Model 1 also comprises the coupon, and short-term interest rate level and rating drift ratio. Model 2 examines the short and long-term levels of interest rates and the rating activity ratio. The third subset contains the slope and short-term interest rate level, and the rating activity ratio. Model 4 incorporates maturity, interest rate slope and the rating drift ratio. The fifth reduced model includes the short-term interest rate level and the rating score.

The **industrials** regression model exhibits multicollinearity in seven predictors. Our primary result indicates strong relations exist between the rating drift and activity ratios (VIF=5.7 and 6.1, respectively), between the coupon rate and maturity (VIF=38.2 and 15.1, respectively), and between the short-term level and the slope of interest rates (VIF=22.9 and 17.8, respectively). Furthermore, the issue size logarithm is linked to both the term structure of interest rates and the rating dynamics measures. The short and long-term levels of interest rates do not contribute to the explanatory power of the model, as evidenced by low F-statistics for the changes in R^2. Removing the coupon rate causes a change in R^2 close to zero although it is significant at the 10% level. The remainder of the collinear predictors contributes to the model R^2 at the 5% level. All the reduced models include the portfolio size logarithm (VIF=3.4). Model 1 includes the issue size logarithm, maturity, and short-term interest rate level. The second reduced model includes the coupon rate and the interest rate slope. Finally, model 3 includes maturity and the slope and long-term level of interest rates.

Utilities exhibit high VIF measures in nine predictors, among which the rating drift and activity ratios are the only non-significant contributors to the model R^2. Excluding the rating score (VIF=26.7) lowers the VIF of the portfolio size logarithm and maturity from 19.6 and 17.9 to 5.2 and 3.4, respectively. The slope and short-term level of interest rates are strongly interrelated and linked slightly to the issue size logarithm (VIF=21.3). Finally, the long-term interest rate level (VIF=8.9) is related somewhat to the slope of the term structure. All the reduced models include the coupon rate (VIF=2.0). Model 1 includes the maturity, slope and long-term level of interest rates, the rating score and rating activity ratio. Model 2 comprises the coupon rate, interest rates slope and long-term level, the rating score and activity ratio.

The rating drift and rating activity ratios of long-term bonds are perfectly correlated, forcing the exclusion of either one of them when estimating the **long-term** full model. In both versions of the full model, they exhibit a 2.2 VIF and coefficients with equal value but opposite sign. Furthermore, the rating score (VIF=21.0), the portfolio size (36.2), maturity (23.4) and coupon rate (15.7) are strongly interrelated. Removing the short-term interest rate level lowers the VIF of the slope (VIF=17.0) and long-term level of interest rates (VIF=15.4) below the critical threshold value of five. All three variables also relate to a lower extent to portfolio size, coupon rate and maturity. All the reduced models include the issue size logarithm (VIF=3.1). The first reduced model includes the maturity, slope and long-term level of interest rates, the rating score and rating activity ratio. The second model includes the portfolio size logarithm, the slope and short-term level of interest rates, and rating activity. The coupon, interest rate slope, rating drift and activity ratios comprise the third subset of predictors.

Similar to the long-term model, the **medium-term** full model includes either the rating drift or the rating activity ratio. However, it exhibits much higher multicollinearity. The F-statistics for the change in R^2 show that maturity, the rating score and the short-term interest rate level contribute to the explanatory power of the model at the 5% confidence level. Also, the issue (VIF=122.5), portfolio size logarithms (VIF=78.5), coupon rate (VIF=206.1), maturity (VIF=62.8), and rating score (VIF=37.9) are strongly interrelated. Removing any of these variables from the full model substantially decreases the value of remaining predictors' VIF. To illustrate, excluding the coupon rate reduces the VIF of maturity, rating score, issue and portfolio size to 10.0, 6.9, 10.1 and 6.4, respectively. To a lesser extent, these predictors also relate to the long-term interest rate level. Moreover, interest rate slope (VIF=17.0) and short-term level (15.8) are highly correlated and somewhat linked to the long-term interest rate level. The first reduced model includes the portfolio size logarithm, maturity, the short and long-term levels of interest rates, and the rating activity ratio. The second subset encompasses the issue size logarithm, the interest rate slope and long-term level, the rating score and activity ratio. The coupon rate, the short- and long-term levels of interest rates, the rating score and drift ratio are included in the third reduced model.

Finally, the **short-term** regression model exhibits extreme correlation between the issue and portfolio size logarithms, forcing the exclusion of either one of these variables to estimate the full model. Even separated, both predictors have excessive VIF caused by their strong linkage to the rating score (VIF=105.5). The coupon rate and the rating activity ratio are the two collinear predictors that cannot contribute to the model's explanatory power, as evidenced by non-significant F-statistics for the change in R^2. Moreover, the link between maturity (VIF=286.6) and coupon rate (VIF=237.3) is shown by their VIF decreasing to 65 when either one of them is removed from the equation. Both predictors relate to a lesser extent to rating drift and activity ratios. The exclusion of the interest rate slope (VIF=37.9) causes the VIF of the short- and long-term interest rate levels to fall below five. However, interest rates short- (VIF=25.7) and long-term (VIF=7.2) levels are not interrelated. Included simultaneously, then separately, the rating drift and activity ratios exhibit VIF close to 60 and 9, respectively. Two versions of the full model exist including either the issue or the portfolio size logarithm. The first reduced model includes the portfolio size logarithm, the short- and long-term interest rate levels, and the rating drift ratio. The second model includes the issue size logarithm, the slope and long-term level of interest rates, and the rating activity ratio. The third subset encompasses the issue size logarithm, maturity, the slope and long-term level of interest rates. The fourth and final reduced model includes the coupon rate, the short- and long-term levels of interest rates, and the rating score.

3.4.4.3.Summary statistics for reduced models and corrections for serial correlation

Table 18 describes the full and reduced models for each portfolio under study. Measures of model appropriateness include the R-square, adjusted R-square and the F-statistics. The reduced forms of the models are somewhat less powerful than the original version but always significant at the 5% level. Moreover, the amount of explanatory power lost (ΔR^2) by the deletion of predictors is almost always significant at the 5% level as evidenced by F-statistics for ΔR^2. The maximum and minimum changes in R^2 are –16.3% and –0.1% for "total" and "A-rates bonds" second reduced model, respectively. The next columns describe the extent of multicollinearity in a given full model with counts of independent variables exhibiting VIF values in excess of 5 or 10. Finally, the Akaike information criterion (AIC) and Schwarz criterion (SW) are based on the sum of squares of residuals with a penalty on extra coefficients. They help discriminate between alternative versions of the reduced model and should be minimized. The lower explanatory power of most reduced models translates into higher AIC and SW values compared with the full version of the model. Finally, Durbin-Watson statistics (DW), which are reported in the last column, provide evidence of widespread positive serial correlation in the residuals of all full and reduced regression models with values between 0.41 and 1.74. Indeed, the full model with 14 (11) explanatory variables has its DW statistic compared to lower and upper critical values d_l=1.39 (1.45) and d_u=1.96 (1.90). The null hypothesis that no serial correlation exists in the regression residuals is rejected with a 95% confidence level given that all the full and reduced models have DW statistics between zero and the corresponding lower critical value.

The issue with serial correlation is that it exaggerates the estimates of goodness of fit while underestimating the uncertainty of the coefficients. The remedial measure for autocorrelation is to model disturbances as p-order autocorrelation process. The disturbance process implicit in the AR(1) procedure is: $\hat{\varepsilon}_t = \rho\hat{\varepsilon}_{t-1} + \upsilon_t$ where ρ is the coefficient of serial correlation and υ_t a stochastic component. All but the "total" portfolio's full and reduced equations are modeled as AR(2) to eliminate serial correlation in the residual series, as evidenced by Durbin-Watson statistics are all in the vicinity of 2.0. The AR(p) values and DW statistics are reported at the bottom of a model table of estimation results.

3.4.5. Final results

Table 19 reports the coefficients, t-statistics and VIF of the explanatory variables includes in a given reduced model. Measures of the model appropriateness are reported at the bottom of each table. In particular, Akaike information criterion and Schwarz criterion allow comparing the reduced models with one another as well as with the original full model. Standard errors are also reported to control for the improved accuracy of coefficient estimates.

3.4.5.1. Bond variables

Liquidity

The issue size logarithm is a significant predictor of bond returns in three regression models. Consistent with Campbell et al (2003), we report a –8.80 coefficient that is significant at the 1% level for the returns of A-rated bonds. This suggests that smaller issues demand a higher return to compensate for lower liquidity. However, the issue size logarithm is positively related to short-term and industrial bond returns in two and one reduced models, respectively. The coefficient estimates for short-term (industrials) are 0.81 and 1.01 (1.91), which are significant at the 5% level.

Regarding the natural logarithm of the total portfolio size, we argued earlier in this paper that a larger portfolio, in dollar terms, is either more liquid or better diversified. In either case, the relation with excess returns is expected to be negative. Our results, however, are mixed. The portfolio size logarithm has alternatively an estimated coefficient of –1.67 and 0.57 when regressed against industrials and B-rated bond returns. These estimates are significant at the 5% and 10% levels, respectively.

Time to maturity

For high-quality bonds, we expect excess returns to increase with the average remaining time to maturity to compensate for greater risk of interest rate changes and downgrades. In contrast, our findings indicate that excess returns on A-rated and utilities bonds are negatively related to the average time to maturity as indicated by coefficients of -0.24 and -0.23, respectively, which are significant at the 10% and 1% levels.

Coupon rate

The coupon rate has small yet significant coefficients in two utilities reduced models (0.06 and 0.05, both significant at the 5% level). In the "total" portfolio's regression results, we report a –1.27 coefficient significant at the 10% level. The coupon rate is fixed according to the bond's features and interest rates levels, which are already included in the model. To be meaningful, the coupon rate should convey information that is not otherwise available. Previously discussed F-statistics for the change in the R^2 value indicate that omitting the coupon rate does diminish most models' explanatory power.

3.4.5.2. Credit risk

Ratings

The annual rating score is a relative metric of credit risk and is expected to be positively related to excess returns. However, it is never found to be significant in any reduced model. In contrast, rating migration dynamics yield significant results.

Rating migration dynamics

As expected, the "total" portfolio returns exhibit a negative (positive) relation to the rating drift (activity) ratio with a 10% confidence level. More precisely, three reduced models yield –7.38, -8.76 and –7.76 coefficients for the rating drift ratio, and a 7.45 coefficient for the rating activity ratio. A –5.69 coefficient for the rating drift ratio is also reported in the regression results of short-term bond returns. This is consistent with the hypothesis that excess returns increase in times of deteriorating credit quality. The positive coefficient for rating activity signals that increased uncertainty in the bond market calls for higher returns.

3.4.5.3.Market risk factors

Overall, our results suggest that market risk factors can best explain bond excess returns. In particular, the term structure of interest rates is highly significant in almost all the reduced models.

The term structure of interest rates

The slope of the yield curve exhibits positive coefficients in all the regression results with a 1% significance level. This finding is consistent with Collin-Dufresne et al. (2001), but contradicts Christiansen (2000). While the former view the slope of the term structure as a measure of economic uncertainty, the latter argues that an upward sloping yield curve indicates higher future interest rates. Positive coefficients on the slope of interest rates conform with the notion that longer-term bonds are more exposed to market risk, hence require higher returns in excess of the risk-free rate.

The slope of the yield curve explains "total", financials, industrials and utilities regression results with 1.2, 0.75, 0.68 and 0.96 coefficients, respectively. Among "rating" portfolios, non-investment grades, i.e. BB or B-rated bonds, have their returns unaffected by the slope of the yield curve, similarly to the medium-term cohort. In contrast, investment-grades exhibit 0.88, 0.72 and 0.74 regression coefficients. It relates to long, and short-term bond returns with 0.61 and 1.49 coefficients. This is consistent with Guedes and Opler (1994) who argue that non-investment grade obligors issue mid-term, while high quality obligors issue at both ends of the maturity spectrum.

Levels of the yield curve:

Reported coefficients on the short-term interest rates level are negative and almost always significant at the 1% level. Reported coefficients are –0.41, -0.11 and -0.33 in the financials, industrials and utilities reduced models. They are –0.41, -0.68, -0.33 and –0.27 in the AA, A, BBB and B-rated bond regression results. Finally, the long, medium, and short-term bond coefficients estimates for the short-term level of the yield curve are -0.39, -0.25 and -0.85, respectively.

The long-term interest rates level is a significant predictor of both long and short-term bond returns, as evidenced by 0.28 and 0.31 coefficients significant at the 5% level. It can also explain A and B-rated bond returns with 0.54 and 0.57 coefficients significant at the 1% level.

Equity returns

Total returns on the TSE are found to be a significant predictor of "total" bond excess returns, as evidenced by a –1.10 regression coefficient significant at the 10% level. The negative relation between stock and bond returns is consistent with the common view that returns on these investment classes are negatively correlated.

In contrast, stock and bond excess returns appear to be positively related, in the A and BB-rated reduced models with 0.01 and 1.29 coefficients reported for **TSE excess returns** with a 10% confidence level.

3.4.5.4. The macroeconomic context

As mentioned earlier, the economic context is characterized by the growth rates in the CPI and in the real GDP to measure inflation and the economic activity, respectively.

Inflation

Coefficients associated with inflation are non-significant in the "total", industrials, BBB and BB regression models. In the other eight models, our findings are unanimous as to the negative relation between excess return and changes in the consumer price index. Reported coefficients on inflation are –0.20 and –0.40 with industrials and utilities returns, -0.31 and –0.29 with AA-rated bond returns, -0.24 and –0.30 with A-rated bond returns, -0.21 and –0.22 with midterm returns, and -0.16 with short-term returns, all significant at the 5% level. These findings imply that inflation harms bonds' excess returns. It seems that the market expected an even lower inflation rate than that recorded in Canada from 1993 through 2002 (only 1.8%), resulting in lower real returns.

GDP growth rate

The level of economic activity, as measured by the real GDP growth rate, is not as powerful as inflation in explaining bond excess returns. It relates negatively to excess returns on financials (–0.15) and utilities (–0.04) at the 10% and 5% significance levels, respectively. Excess returns increase during economic downturns, when obligors are most likely to undergo financial distress. However, positive coefficients of 0.06 and 0.09, which are significant at the 10% level, also are obtained for short-term for two reduced models.

3.5. Components of corporate bond return volatilities

3.5.1. Volatility decomposition

This section investigates the volatility pattern of Canadian corporate bond returns over the period from February 1993 to May 2002. We follow Campbell et al. (2001) to construct time-series for the market, industry and firm-specific volatility components (henceforth referred to as MKT, IND and FIRM, respectively) that sum to the total volatility of a bond's returns.

While Campbell et al. (2001) use the CRSP value-weighted index of stocks traded on the NYSE, AMEX and Nasdaq, we build our own "bond index" to overcome a lack of data regarding the Canadian bond market. More precisely, we use the 192 corporate issues presented earlier in this thesis to represent the "market". Since it represents bonds that survived the whole period, its use introduces a survivorship bias into the results presented below. This "market" is denoted m. Individual bonds are denoted j and belong to one of the three industries i, namely financials, industrials and utilities. They are defined as in the previous section (i.e., based on S&P's GISC classification). Subscripts s and t indicate that the data is either daily or monthly, respectively.

We compute daily total returns as the sum of price return and accrued interests. The difference with the corresponding 1-month T-bill rate provides daily series of individual bond excess returns that we average monthly. R_{jit} refers to the excess return on bond j in industry i in month t. Also, the weight of bond j in industry i, w_{jit}, is the average bond traded market value in month t.

Hence, the excess return on industry i in month t is computed as:

$$(1) \qquad R_{it} = \sum_{j \in i} w_{jit} R_{jit}$$

Furthermore, w_{it} is the weight of industry i in the market m measured as the market value of industry i in month t. Hence, the monthly excess return on the market is:

$$(2) \qquad R_{mt} = \sum_{i} w_{it} R_{it}$$

To obtain the industry residual, we use equation (3)

$$(3) \qquad R_{it} = R_{mt} + \varepsilon_{it}$$

Where ε_{it} is the difference between the industry return, R_{it}, and the market return, R_{mt}.

Similarly, the residual for individual bond returns or firm-specific residual is computed as:

$$(4) \qquad R_{jit} = R_{it} + \eta_{jit}$$

Where η_{jit} is the difference between the firm-specific return, R_{ijt}, and the industry return, R_{it}.

Subsequently, we estimate the market-wide (MKT), the industry (IND), and the firm-specific (FIRM) volatility components. Their historical movements are plotted to evaluate the variations in the portion of risk that can be diversified away.

3.5.2. Estimation

We follow the procedure presented by Campbell et al (2001) as we compute returns daily and construct monthly volatility estimates.

Market volatility (MKT_t)

The sample volatility of the market return, MKT_t, in month t is computed for each month:

$$MKT_t = \hat{\sigma}^2_{mt} = \sum_{s \in t} (R_{ms} - \mu_m)^2$$

where μ_m is the monthly mean market excess return and R_{ms} is the daily market excess return, where both variables are constructed as a value-weighted average of all bonds in the sample on a given day. Weights refer to the aggregate market value of all bonds outstanding in the dataset on a given day.

Industry volatility (IND_t)

For volatility in industry i, we sum the squares of the industry-specific residuals in equation (3) within month t:

$$\hat{\sigma}^2_{\varepsilon_{it}} = \sum_{s \in t} \varepsilon^2_{is}$$

Next, we average over industries to get the monthly average industry volatility IND_t:

$$IND_t = \sum_i w_{it} \hat{\sigma}^2_{\varepsilon_{it}}$$

Firm-specific volatility ($FIRM_t$)

Estimating the firm-specific volatility is done in a similar way. First, we sum the squares of firm-specific residuals in equation (4) for each bond in the sample in period t:

$$\hat{\sigma}^2_{\eta jit} = \sum_{s \in t} \eta^2_{jis}$$

The weighted average of firm-specific volatilities within each industry is based on the mean bond market value and computed as:

$$\sigma^2_{\eta_{it}} = \sum_{j \in i} w_{jit} \hat{\sigma}^2_{\eta_{jit}}$$

Finally, we average over industries to obtain a measure of average firm-level volatility $FIRM_t$ in period t:

$$FIRM_t = \sum_i w_{it} \hat{\sigma}^2_{\eta_{it}}$$

3.5.3. Primary results and graphical analysis

Figure 9 presents the monthly standard deviation of the value-weighted "total" bond portfolio's returns from February 1993 to May 2002. This graph shows that the return volatility of Canadian corporate bonds has slightly decreased over time. Also, peaks in standard deviations do not exhibit persistance effects and correspond to the beginning of the studied period, namely 1993 and 1995. The return standard deviation averaged 12.35% for the value-weighted bond portfolio. In the first half of the period, between February 1993 and December 1997, it was somewhat higher around 15.2% and decreased thereafter to 10.26%.

Figure 10 shows plots of individual volatility components estimated monthly using daily returns. In order to uncover potential trends in the volatility components, we eliminate the cyclical and irregular components of each time-series with 12-month moving averages.

Each plot presents the monthly time-series for individual volatility components and a lagged moving average of order 12.

The market volatility MKT presented in panel A has fluctuated much over time. Comparing the monthly series with the smoothed average suggests that there is a slow-moving component along with high-frequency noise. MKT was particularly high in March 1993 and February 1995. Smaller peaks correspond to January 1998 and September 2001. MKT decreases over the 1995-1996 and 1998-2000 periods, and the smoothed series exhibit a modest downward trend.

The behavior of industry-level volatility, denoted IND, is depicted in panel B. Compared with MKT, IND is much higher in magnitude with a smoothed average of 3.62% against 0.73% for MKT. On average, IND represents 44.50% of the total return volatility. IND was particularly high at the end of the sample period, reaching 21%. After a sharp increase in 1993, IND decreases slowly between 1993 and 1995. In 1997, IND reaches its February 1993 level with a volatility of 8.0%. Thereafter, it decreased substantially to 3.3% until the end of 2000. IND appears to increase in times of economic downturn and remains at low levels in times of economic expansion.

The plot of firm-specific volatility, denoted "FIRM", is presented in panel C. It exhibits an upward slope particularly perceivable at the end of the studied period. FIRM is the other major volatility component since it represents 45% of the total return volatility. Figure 10 reveals that the three volatility components are especially low between 1998 and the end of 2000. After 2001, all the components increased, especially FIRM, IND to a lesser extent and MKT very slightly. This suggests that peaks in the volatility on the bond market are primarily due to increases in idiosyncratic and industry-specific volatility components, rather than to an increase in the market volatility.

Panel A of **figure 11** plots the 12-month moving averages of individual volatility components. Based on the graph, MKT remains very low over the studied period, compared with IND and FIRM. Also, no particular trend can be detected for MKT, while IND exhibits a u-shaped pattern. FIRM increases slowly between 1993 and mid-1997, and increases from mid-2000.

To better analyze the evolution in the composition of a corporate bond return volatility, we examine the levels of MKT, IND and FIRM relative to the total return variability over the February 1993 to May 2002 period. **Figure 11,** panel B presents the 12-month moving averages of the percentage of each volatility component. It clearly shows an upward trend in FIRM and a downward trend in IND. Regarding MKT, it reaches 20% of the total volatility between 1995 and 1998 but not in a persistent manner. The relative level of MKT volatility varies over time but exhibits no particular trend. It always remains the smallest volatility component. Until 1997, IND is the main volatility component, representing on average 62% of the total volatility. From mid-1996, IND decreases sharply while FIRM continuously increases. This result shows that the composition of the total volatility on the bond market has changed dramatically over time although total volatility has not increased.

Table 20 reports the mean and standard deviations of individual volatility components. The upper panel reports figures for the 1993-2002 sample period, and for the 1993-1997 and 1998-2002 sub-periods. Over the studied period, the total volatility of a bond return averaged 9.6%. Also, the level of MKT was very modest compared with IND or FIRM with means of 0.85%, 4.13% and 4.62%, respectively. In other words, FIRM accounted for 45% of the total volatility, IND for 44.5% and MKT for only 10.5%. This finding suggests that a well-diversified portfolio requires the inclusion of a large number of bonds given the modest contribution of non-diversifiable risk to the total volatility of bond returns.

The next four columns in **table 20** compare the mean and standard deviation of each volatility component in the first (February 1993 to December 1997) and second halves (January 1998 to May 2002) of the studied period. Both MKT and IND decreased sharply, the latter from 5.80% to 2.90%, and the former from 1.37% to 0.48%. In contrast, FIRM has tripled from 2.10% to 6.44%. In aggregate, the total bond volatility remains fairly stable around 9.50%.

Then, the sample period from February 1993 to May 2002 is split into five sub-periods of two-year lengths. The corresponding means and standard deviations are reported in the bottom panel of table 21. This refinement aims at uncovering potential trends in the volatility components. The period from January 1998 to December 2000 is characterized by a sharp decrease in volatility, perceptible in all volatility components and more particularly in MKT and IND. The overall volatility increases markedly in the following period with a peak in FIRM, while MKT increases only slightly. In contrast, IND increases to a level twice that of 1996-1998. In terms of relative volatility, MKT and IND decrease over the periods from 15% and 65% in 1993-1995 to 2% and 22% in 2000-2002, respectively. FIRM on the other hand increases from 20% to 75%.

We cannot keep the duration or term-to-maturity of each portfolio constant over time. Therefore, we wish to examine if volatility has systematically changed due to a systematic change in this variable. To this end, the volatility series are regressed against the weighted-average term-to-maturity of the samples and regression results reported in panel B of table 20. Time to maturity can explain between 3.6% and 20.8% of the variability in the series of volatility components. Also, regressions R-squared are markedly higher for twelve-month moving average series, ranging from 20.6% to 45.5% for the industry and market volatility series, respectively. The explanatory power of time to maturity is lower when it comes to the total volatility monthly series (0.5%) and twelve-month moving average series (4.9%). Still, reported coefficients are significant for all the monthly series and moving averages at the 1% level. Interestingly, time to maturity exhibits positive coefficients in the monthly time series of market and industry-specific volatility components, with 0.29 and 0.02 coefficients, respectively. In contrast, it relates negatively to the monthly series of total and idiosyncratic volatility, as evidenced by -1.17 and -1.80 coefficient estimates, respectively. As expected, 12-month moving averages exhibit similar results. We report 0.22 and 0.66 coefficients for the market and industry volatility moving averages, respectively. The regression results are –1.11 and –0.23 for the firm-specific and total volatility moving averages, respectively. These findings indicate that the evolution of volatility components over time matches that of the samples' time to maturity. In particular, the market and industry volatility series' downward trends reflect studied portfolios' decrease in average time maturity. Similarly, the market and firm-specific volatility series soaring at the end of the studied period correspond to the lowering of time to maturity In order to confirm our intuition that no systematic trend exists in the volatility components, the next section uses unit root tests.

3.5.4. Stochastic vs. Deterministic Trend

Following Campbell et al. (2001), we compute autocorrelation coefficients for monthly volatility components estimated from daily returns data with 1, 2, 3, 6 and 12-month lags. **Table 21** presents autocorrelations for the time–series of each value-weighted variance component: MKT, IND, and FIRM. The null hypothesis states that each correlation coefficient is zero. The null hypothesis holds at the 5% level of confidence for MKT at all lags. The absence of autocorrelation in the time-series of the market-wide volatility component is evidenced by coefficients very close to zero from the one-month lag, and inferior to the critical Pearson value of 0.1638. Autocorrelation coefficients are significantly positive for IND up to a 6-month lag and for FIRM up to a 12-month lag. Reported coefficients are high at the 6-month lag, 0.3088 for IND and 0.4181 for FIRM. High coefficients may reveal the presence of unit-roots at least in the FIRM time-series.

The issue is whether the series of volatility components are consistent with a random walk process with stochastic trend, or with a deterministic process with a time trend. The following equation describes the evolution of any of the volatility components as:

$$(5) \qquad Y_t = \alpha + \beta t + \rho Y_{t-1} + \varepsilon_t$$

Our previous results suggest that FIRM has increased over time. More generally, we hypothesize that Y_t has grown because of a positive trend (β>0), but is stationary after detrending (i.e. φ<1), and then Y_t could be used in the regression. However, in case Y_t

follows a random walk with a positive drift (i.e. α>0, β=0, and φ=1), detrending the series would not make it stationary and ΔY_t should be included in place of Y_t in the regression model to avoid spurious results. Also, equation (5) assumes no serial correlation in the error terms, although we wish to allow for serial correlation in the ε_t and still test for unit root.

To this end, Dickey-Fuller tests are augmented by including lagged changes in Y_t on the right-hand side of equation (5), which becomes:

$$(6) \qquad Y_t = \alpha + \beta t + \rho Y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta y_{t-j} + \varepsilon_t$$

with α is the constant, β is the coefficient on the trend (t), $\varepsilon \sim N(0, \sigma^2)$ and $\Delta Y_t = Y_t - Y_{t-1}$

Following Campbell et al. (2001), we consider two versions of the regression model described in equation (6) used to test the null hypothesis of a unit root against the alternative hypothesis of stationarity.

The first version of the model includes a constant and can be written as:

$$(7a) \qquad \Delta Y_t = \alpha + \rho Y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j} + \varepsilon_t$$

It is tested for the null hypothesis (α, φ) = (0, 1) with a t-statistic.

Alternatively, the model includes both a constant and a trend and can be written as:

$$(7b) \qquad \Delta Y_t = \mu + \beta t + \rho Y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j} + \varepsilon_t$$

It is tested for two null hypotheses: (α,β,φ) = (0,0,1) and (α,β,φ) = (α,0,1). The studied models and tests performed are reported with their results in panel A of table 22.

The estimation of equations *(7a)* and *(7b)* involves first the estimation of the unrestricted version of both models:

$$(8a) \qquad \Delta Y_t = \alpha + (\rho - 1)Y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j}$$

$$(8b) \qquad \Delta Y_t = \alpha + \beta t + (\rho - 1)Y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j}$$

Then, the restricted version of equations *(7a)* and *(7b)* is estimated as:

$$(9a) \qquad \Delta Y_t = \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j}$$

$$(9b) \qquad \Delta Y_t = \alpha + \sum_{j=1}^{p} \lambda_j \Delta Y_{t-j}$$

Also, we need to decide on the number of lags *(p)* to include in the regression model for each volatility component. To this end, we follow Perron (1989) and start with twelve lags. If the last lag is not significant at the 10% level, we include one less lag and test again if the last lag is significant. The procedure repeats until we find the last lag to be significant as indicated by its t-statistics. The first form of the model includes four lags for MKT, two lags for IND and two lags for FIRM. In the alternative version of the regression model that has both a constant and a trend, the numbers of lags are zero for MKT (the model becomes a standard Dickey-Fuller test), two for IND and two for FIRM. The reported Durbin-Watson statistics in the first lines of **table 23** belong to the one of the value intervals leading to accept the null hypothesis ($d_u < DW < 2$ or $2 < DW < 4 - d_u$). In turn, this confirms the absence of serial correlation in the error terms.

Following Dickey and Fuller (1981), we use the "t-statistic" for the estimated α in model *(a)* in order to test the null hypothesis that $(\alpha, \varphi) = (0, 1)$.

The t-statistic is computed as:

$$\tau_{\alpha} = \frac{\hat{\alpha}}{S_{\alpha}} .$$

Reported values for the t-statistic are –0.30 for MKT, -0.10 for IND and 0.36 for FIRM. All values are inferior to the critical-τ of 2.54 reported in Dickey et al. (1981) for a sample size of 100 and a 95% confidence level. We conclude that the process underlying each volatility component of corporate bond excess returns is a unit root.

In model *(b),* the t-statistic is used to estimate α and β in order to test the null hypothesis (α,β,φ) = (0,0,1). The t-statistics computed are:

$$\tau_{\alpha} = \frac{\hat{\alpha}}{S_{\alpha}} \quad \text{and} \quad \tau_{\beta} = \frac{\hat{\beta}}{S_{\beta}}$$

Computed τ-statistics for the estimated α indicate that the null hypothesis should be accepted with a 95% confidence level for IND and FIRM, as indicated by their respective statistics of 1.88 and –0.71. The reported τ-statistic for MKT, on the contrary, rejects the null hypothesis of unit root at the 5% level. The reported τ_{α} of 4.23 is superior to the critical -τ of 3.11. The conclusion that MKT is stationary is not further supported by the computed τ-statistics for the estimated β. Indeed, τ-statistics for the estimated β indicate that the null hypothesis should be accepted with a 95% confidence level for all the time-series of volatility components. Their values, as reported in the last line of **table 22**, are –2.68 for MKT, -0.72 for IND and 1.73 for FIRM. All of these values are inferior to the critical-τ of 2.79.

Moreover, Dickey-Fuller (1981) presents F-statistics to test the null hypothesis that the true model is a random walk with zero drift. They note that F-statistics are more powerful tests and prevail in case of disagreement with the τ-tests.

Generally, the F-statistic is computed as:

$$F = (N\text{-}k)\,(ESS_R\text{-}ESS_{UR}) \,/\, q(ESS_{UR})$$

Where ESS_R and ESS_{UR} are the sum of squared residuals in the restricted and unrestricted regressions, respectively. N is the number of observations, k is the number of estimated parameters in the unrestricted regression, and q is the number of parameters restrictions. In model (*a*), the null hypothesis $(\alpha,\varphi) = (0,1)$ is tested with a F-statistic denoted ϕ_1. The reported ϕ_1-values are 0.05 for MKT, 0.01 for IND and 0.07 for FIRM. These very low statistics are insignificant at the 5% level as indicated by a critical-ϕ_1^* of 4.71. These findings are unanimous as to accepting the null hypothesis of a unit root in each time-series of the volatility components.

In model (*b*), the null hypothesis $(\alpha,\beta,\varphi) = (0,0,1)$ is tested with a F-statistic denoted ϕ_2. The reported ϕ_2-values are –2.90 for MKT, 3.49 for IND and 2.44 for MKT. These results reject the presence of a deterministic process with time trend in any of the volatility component. Finally, we compute ϕ_3-statistics to test the null hypothesis $(\alpha,\beta,\varphi) = (\alpha,0,1)$. Again, the reported values for MKT, IND and FIRM, which are respectively –4.39, 5.23 and 3.58, are all inferior to the critical-ϕ_3* of 6.49. In turn, this implies that the null hypothesis can be accepted with a 95% level of confidence.

Overall, we accept the null hypothesis that a unit root exists in the second-order autoregressive process for IND and FIRM whether a trend is included or not. One t-test is found significant for MKT indicating a deterministic trend. However, the remaining tests, in particular the F-statistics, reject the presence of stationarity in the market-wide volatility component.

SUMMARY

This thesis analyzes the one-year rating migration behavior of long-term Canadian corporate debt issuers between January 1981 and December 2001. Our findings show that the average credit quality of Canadian obligors has deteriorated over the studied period. Consistent with previous papers, issuers are most likely to retain their initial ratings over a one-year horizon. Also, rating migrations are of small magnitude. Only 2.58% span more than two rating classes and concern non-investment-grade issuers, which in this thesis are BB and B-rated issuers. However, the one-year unconditional rating transition matrix shows a weak relation between rating stability and credit quality.

Our main contribution regards the computation of one-year rating transition matrices and rating drift and activity ratios conditional on the level of economic activity as well as on the obligor industry. We find that economic downturns (expansions) correspond to a deteriorated (improved) credit quality as well as higher (lower) rating activity ratios. Statistical tests evidence that these differences with unconditional estimates are significant. As expected, economy-conditioned rating transition matrices exhibit lower (higher) diagonal probabilities for a recession (expansion) year. However, these differences are not found to be significant when compared with the unconditional rating transition matrix. Furthermore, we find that the industrials and utilities have undergone the worst and best credit quality evolution, respectively, over the studied period. Differences in rating migration dynamics were found significant when compared with unconditional estimates. However, we find no evidence that they become significantly more correlated in times of economic downturns. Also, chi-square statistics assert that the unconditional rating transition matrix differs significantly from those of financials and utilities issuers over the studied period.

In the second part of this thesis, risk-adjusted performance measures assert that Canadian corporate bonds have outperformed alternative investment classes, namely Treasuries and stocks, over the 1993-2002 period. We attribute much of this finding to the survival bias caused by the impossibility of including defaulted issues in the studied bond cohort. Moreover, we document no seasonal effect in the monthly times-series of bond excess returns, although peaks in the autocorrelation functions could indicate some mean reversion process. These series are corrected for serial correlation and regressed against credit and market risk factors, as well as macroeconomic indicators. We find that the term structure of interest rates is a major determinant of corporate bond returns, regardless of the industry, maturity bucket or rating class, in contrast with stock returns.

Based on the methodology of Campbell et al. (2001), we show that the total volatility of Canadian corporate bonds has slightly decreased over the 1993 to 2002 period. Regarding the volatility components of bond returns, we find that the relative and absolute levels of market volatility remain fairly low and steady over the sample period. We also document a sharp increase in the relative level of firm-specific volatility and a simultaneous decrease in the level of the industry volatility. Finally, augmented Dickey-Fuller tests provide no evidence of deterministic trends in the volatility components.

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5. TABLES

TABLE 1 - Descriptive statistics: Canadian corporate bond dataset and studied portfolios (February 1993 - May 2002)

This table presents the average composition of the bond dataset, denoted "Total" portfolio, and of the "industry", "maturity" and "rating" sub-samples under study for the February 1993 to May 2002 period.

Corporate bond portfolios	Number of issues	Weight, %	Rated issues	Weight, %	Coupon rate, %	Years to maturity (average)	Issue size (average, $)	Rating score (average)
Total	192	100.00	147	100.00	7.45	16.22	153,476,732	3.29
"Industry"								
Financials	70	36.46	51	34.69	7.36	14.48	187,961,970	2.89
Industrials	46	23.96	34	23.13	7.57	10.03	138,455,556	3.94
Utilities	76	39.58	62	42.18	7.41	21.56	130,805,778	3.27
"Maturity"								
Long-term	42	21.88	38	25.85	7.60	26.80	177,088,950	3.02
Mid-term	79	41.15	64	43.54	7.34	10.15	152,049,456	3.32
Short-term	71	36.98	45	30.61	7.49	5.33	133,673,754	3.72
"Rating"								
AA	25	17.01	25	17.01	7.17	13.26	242,359,425	2.00
A	42	28.57	42	28.57	7.30	15.04	139,940,642	3.00
BBB	35	23.81	35	23.81	7.56	11.11	127,487,137	4.00
BB	21	14.29	21	14.29	7.55	7.42	119,245,987	5.00
B	24	16.33	24	16.33	7.78	6.89	69,750,000	6.00

TABLE 2 - Annual evolution of corporate bond portfolios' characteristics (February 1993 to May 2002)

Table 2 presents the evolution of equal-weighted bond portfolios in terms of credit risk (rating drift, activity and score if applicable), remaining time to maturity (average number of years), coupon rate, and liquidity (average issue size and total portfolio size in dollars).

Panel A - Total portfolio

Annual features of the "total" portfolio built as an equal-weighted portfolio of all the bonds in our dataset.

	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (Total, $)	Rating score (average)	Rating activity %	Rating drift %
1993	15.93	8.37	139,706,019	2,970,000,000	2.99	0.00	0.00
1994	16.17	8.64	138,919,525	4,763,000,000	2.95	0.00	0.00
1995	15.46	8.62	145,833,476	6,503,000,000	2.96	0.00	0.00
1996	14.97	8.26	142,320,803	5,900,500,000	3.04	0.00	0.00
1997	13.33	7.85	152,962,145	13,320,500,000	3.17	1.26	-5.03
1998	12.96	7.58	155,483,638	16,398,760,000	3.25	6.80	-2.91
1999	12.12	7.41	156,993,751	18,924,960,000	3.30	0.00	0.00
2000	11.25	7.43	157,427,386	20,777,690,000	3.32	7.16	-7.16
2001	10.97	7.36	159,699,518	22,662,910,000	3.33	7.97	-7.97
2002	9.69	7.33	161,154,358	24,078,060,000	3.37	0.00	0.00

Note: The rating drift measures the direction of the credit quality evolution and is computed as the difference between upward and downward letter rating changes divided by the number of issuers rated at the beginning of a given year. The rating activity measures the volatility of rating migrations and is computed by dividing the sum of all upward and downward letter-rating changes by the number of issuers outstanding at the beginning of a given year.

TABLE 2 *(continued)* **- Annual evolution of corporate bond portfolios' characteristics (February 1993 to May 2002)**

Panel B - Industry portfolios

Annual features of "industry" equal-weighted portfolios of bonds belonging to the "financials", "utilities" and "industrials" sectors.

Financials	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (Total, $)	Weight in "total" portfolio (%)	Rating (average, score)	Rating activity (%)	Rating drift (%)
1993	15.85	8.41	207,000,000	1,035,000,000	19.44	2.20	0.00	0.00
1994	15.67	8.40	219,285,714	1,535,000,000	15.82	2.14	0.00	0.00
1995	14.89	8.51	221,363,636	2,435,000,000	18.53	2.14	0.00	0.00
1996	13.86	7.85	187,000,000	935,000,000	24.40	2.33	0.00	0.00
1997	11.62	7.46	197,500,000	6,320,000,000	26.62	2.69	0.00	0.00
1998	10.82	7.26	182,804,878	7,495,000,000	31.66	2.92	9.21	-9.21
1999	10.40	7.18	188,255,814	8,095,000,000	32.41	2.95	0.00	0.00
2000	9.71	7.23	199,888,889	8,995,000,000	32.60	2.90	12.20	-21.95
2001	10.78	7.20	208,229,167	9,995,000,000	32.25	2.93	0.00	0.00
2002	9.14	7.15	216,078,431	11,020,000,000	32.06	2.89	0.00	0.00

Industrials	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (Total, $)	Weight in total portfolio (%)	Rating score (average)	Rating activity, %	Rating drift, %
1993	15.11	8.85	132,500,000	795,000,000	41.20	3.67	0.00	0.00
1994	12.72	8.63	145,000,000	1,595,000,000	42.64	3.64	0.00	0.00
1995	13.06	8.59	157,307,692	2,045,000,000	39.90	3.62	0.00	0.00
1996	11.45	8.34	152,656,250	2,442,500,000	36.23	3.68	0.00	0.00
1997	10.21	7.90	155,595,238	3,267,500,000	34.17	3.73	3.68	-14.72
1998	9.82	7.62	153,557,692	3,992,500,000	33.12	3.71	0.00	0.00
1999	8.67	7.46	151,500,000	4,545,000,000	31.49	3.76	0.00	0.00
2000	7.75	7.49	148,484,848	4,900,000,000	30.22	3.85	0.00	0.00
2001	6.82	7.47	149,594,595	5,535,000,000	28.14	3.81	10.30	-10.30
2002	5.57	7.47	149,594,595	5,535,000,000	27.66	3.94	0.00	0.00

TABLE 2 *(continued)* **- Annual evolution of corporate bond portfolios' characteristics (February 1993 to May 2002)**

Panel B (continued) - ***Industry portfolios***

Utilities	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (Total, $)	Weight in "total" portfolio (%)	Rating (average, score)	Rating activity (%)	Rating drift (%)
1993	16.83	8.48	114,000,000	1,140,000,000	39.35	3.10	0.00	0.00
1994	20.13	8.75	102,062,500	1,633,000,000	41.54	3.06	0.00	0.00
1995	18.44	8.70	101,150,000	2,023,000,000	41.57	3.12	0.00	0.00
1996	19.59	8.45	105,125,000	2,523,000,000	39.37	3.11	0.00	0.00
1997	18.16	8.27	120,419,355	3,733,000,000	39.20	3.10	0.00	0.00
1998	18.26	7.84	132,736,757	4,911,260,000	35.22	3.13	0,00	0.00
1999	17.28	7.57	133,722,553	6,284,960,000	36.11	3.19	0.00	0.00
2000	16.29	7.55	127,457,222	6,882,690,000	37.18	3.20	8.56	0.00
2001	15.31	7.44	127,373,393	7,132,910,000	39.61	3.25	12.80	-12.80
2002	14.37	7.37	125,384,333	7,523,060,000	40.28	3.27	0.00	0.00

TABLE 2 ***(continued)*** **- Annual evolution of corporate bond portfolios' characteristics (February 1993 to May 2002)**

Panel C - "Maturity" portfolios

Annual characteristics of the "maturity" portfolios in terms of size (liquidity), years to maturity and credit quality (rating score, drift and activity). Short-term (ST) bonds have 2-7 years to maturity, medium-term (MT) bonds 7-15 years to maturity, long-term (LT) bonds over 15 years to maturity.

LT	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (Total, $)	Rating score (average)	Rating activity (%)	Rating drift (%)
1993	27.36	8.43	187,473,333	1,687,260,000	3.22	0.00	0.00
1994	28.23	8.59	187,473,333	1,687,260,000	3.15	0.00	0.00
1995	28.41	8.29	171,578,750	2,745,260,000	3.06	0.00	0.00
1996	27.56	8.14	160,697,895	3,053,260,000	3.06	0.00	0.00
1997	26.85	8.08	155,163,000	3,103,260,000	3.05	0.00	0.00
1998	25.76	8.00	192,437,857	5,388,260,000	2.96	0.00	0.00
1999	27.10	7.76	170,921,538	4,443,960,000	2.92	8.20	-8.20
2000	26.76	7.52	185,998,462	4,835,960,000	2.89	0.00	0.00
2001	25.25	7.46	187,865,333	5,635,960,000	2.93	0.00	0.00
2002	24.76	7.21	171,280,000	5,480,960,000	2.94	6.40	-6.40

TABLE 2 *(continued)* **- Annual evolution of corporate bond portfolios' characteristics (February 1993 to May 2002)**

Panel C (continued) - "Maturity" portfolios

MT	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (Total, $)	Rating score (average)	Rating activity (%)	Rating drift (%)
1993	12.41	7.31	126,400,000	2,528,000,000	3.40	0.00	0.00
1994	11.36	7.68	129,346,154	3,363,000,000	3.80	0.00	0.00
1995	10.67	7.79	144,219,512	5,913,000,000	3.68	0.00	0.00
1996	10.02	7.77	144,613,636	6,363,000,000	3.33	0.00	0.00
1997	9.98	7.47	144,086,957	6,628,000,000	3.43	0.00	0.00
1998	9.98	7.51	156,844,444	7,058,000,000	3,44	0.00	0.00
1999	9.79	7.01	169,540,541	6,273,000,000	3.45	0.00	0.00
2000	9.33	6.88	156,187,500	4,998,000,000	3.36	0.00	0.00
2001	9.06	6.83	170,296,296	4,598,000,000	3.16	3.35	-3.36
2002	8.87	6.77	178,959,524	3,758,150,000	2.95	0.00	0.00

ST	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (Total, $)	Rating score (average)	Rating activity (%)	Rating drift (%)
1993	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1994	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1995	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1996	6.98	8.07	72,500,000	72,500,000	3.33	0.00	0.00
1997	6.51	7.81	139,500,000	2,092,500,000	3.43	0.00	0.00
1998	5.86	7.74	139,583,333	4,187,500,000	3.45	0.00	0.00
1999	5.37	7.71	137,333,333	6,180,000,000	3.51	2.22	-2.22
2000	4.76	7.47	147,864,821	8,280,430,000	3.48	0.00	0.00
2001	4.27	7.25	150,985,417	10,870,950,000	3.58	8.33	-5.56
2002	3.58	7.17	147,949,375	11,835,950,000	3.66	10.00	-10.00

TABLE 2 *(continued)* - **Annual evolution of corporate bond portfolios' characteristics (February 1993 to May 2002)**

Panel D - "Rating" portfolios

This table presents the annual characteristics of "rating" portfolios in terms of performance (annualized return over the corresponding one-month T-bill rate), time to maturity, coupon rate, and liquidity.

AA	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (total, $)	Excess return (average, %)
1993	17.63	8.24	227,500,000	910,000,000	3.426
1994	16.33	8.55	235,000,000	1,410,000,000	4.080
1995	15.31	8.59	228,888,889	2,060,000,000	1.916
1996	14.32	8.18	243,571,429	3,410,000,000	3.155
1997	12.95	7.54	242,142,857	5,085,000,000	3.736
1998	12.53	7.38	240,652,174	5,535,000,000	1.315
1999	11.18	7.14	242,142,857	5,085,000,000	1.358
2000	10.48	7.04	260,217,391	5,985,000,000	0.951
2001	10.89	6.52	243,270,321	5,335,000,000	2.205
2002	10.99	6.05	260,208,333	6,245,000,000	3.976

A	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (total, $)	Excess return (average, %)
1993	14.36	8.16	130,416,667	1,565,000,000	3.809
1994	17.87	8.59	125,400,000	2,508,000,000	4.148
1995	15.92	8.06	127,625,000	3,063,000,000	2.270
1996	16.38	7.89	132,100,000	3,963,000,000	3.492
1997	15.16	7.59	132,444,444	4,768,000,000	4.109
1998	17.87	7.70	143,201,463	5,871,260,000	1.383
1999	14.68	7.31	150,376,604	7,969,960,000	1.404
2000	14.10	7.20	144,270,517	8,367,690,000	1.215
2001	12.23	7.13	156,983,731	10,517,910,000	2.235
2002	11.87	7.15	156,587,996	20,225,970,000	4.131

BBB	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (total, $)	Excess return (average, %)
1993	15.50	8.02	134,000,000	2,010,000,000	3.669
1994	14.80	8.01	129,705,882	2,205,000,000	4.365
1995	13.13	7.80	131,600,000	3,290,000,000	2.297
1996	12.31	7.71	131,785,714	3,690,000,000	3.768
1997	10.83	7.52	125,972,222	4,535,000,000	4.343
1998	10.30	7.39	126,428,571	5,310,000,000	1.530
1999	9.81	7.28	126,304,348	5,810,000,000	1.584
2000	8.97	7.18	124,166,667	5,960,000,000	1.437
2001	7.89	7.16	122,653,061	6,010,000,000	2.624
2002	7.56	7.04	122,254,902	6,235,000,000	4.630

TABLE 2 *(continued)* - **Annual evolution of corporate bond portfolios' characteristics (February 1993 to May 2002)**

Panel D (continued) - "Rating" portfolios

BB	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (total, $)	Excess return (average, %)
1993	11.45	8.04	111,250,000	222,500,000	4.251
1994	11.03	8.04	111,250,000	222,500,000	4.088
1995	10.03	8.04	111,250,000	222,500,000	2.320
1996	9.03	8.04	111,250,000	222,500,000	4.284
1997	7.91	7.30	118,125,000	472,500,000	3.670
1998	6.74	7.15	128,214,286	897,500,000	1.557
1999	5.72	7.15	127,812,500	1,022,500,000	2.089
2000	4.78	7.26	121,944,444	1,097,500,000	1.937
2001	4.26	7.25	125,681,818	1,382,500,000	3.227
2002	3.28	7.25	125,681,818	1,382,500,000	4.506

B	Years to maturity (average)	Coupon rate (average, %)	Issue size (average, $)	Portfolio size (total, $)	Excess return (average, %)
1993	10.87	8.12	55,000,000	11,000,000	4.138
1994	10.27	8.12	55,000,000	11,000,000	1.964
1995	9.27	8.12	55,000,000	11,000,000	3.294
1996	8.27	8.12	55,000,000	110,000,000	3.565
1997	7.27	8.12	55,000,000	110,000,000	1.273
1998	6.27	8.12	55,000,000	110,000,000	1.643
1999	5.27	8.12	55,000,000	110,000,000	1.443
2000	4.27	8.12	55,000,000	110,000,000	3.424
2001	4.09	7.50	128,750,000	515,000,000	4.918
2002	3.09	7.50	128,750,000	515,000,000	4.138

TABLE 3 - Unconditional rating transition matrix for a one-year tracking horizon (1981-2001)

This table presents the average rating transition probabilities (in percent) for Canadian long-term debt issuers over a one-year tracking horizon.
Computations are based on Standard and Poor's ratings recorded in their CreditPro database from January 1, 1981 to December 31, 2001.

From	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR
AAA	**80.85**	17.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.13
AA	1.19	**90.08**	6.35	0.00	0.79	0.00	0.00	0.00	0.00	1.59
A	0.00	0.49	**90.20**	5.39	0.00	0.00	0.00	0.00	0.00	3.92
BBB	0.00	0.00	1.50	**91.23**	3.51	0.00	0.00	0.00	1.00	2.76
BB	0.00	0.00	0.00	3.91	**84.36**	5.54	0.00	0.00	0.98	5.21
B	0.00	0.00	0.00	0.00	3.37	**77.53**	1.69	0.56	9.55	7.30
CCC	0.00	0.00	0.00	0.00	0.00	0.00	**25.00**	25.00	50.00	0.00
CC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**33.33**	66.67	0.00

NR or « not rated » is regarded as non-informative to quantify rating migrations. Therefore, like "default", it is a terminal state. Issuers which re-emerge from these states are considered as new entities.

Spearman rank correlation - Migration probabilities and rating categories

Portfolio	Rank	Migration probability (%)	Rank	D	D^2
AAA	1	80.85	5	-4	16
AA	2	90.08	3	-1	1
A	3	90.20	2	1	1
BBB	4	91.23	1	3	9
BB	5	84.36	4	1	1
B	6	77.53	6	0	0
CCC	7	25.00	8	-1	1
CC	8	33.00	7	1	1
SUM					13
Spearman ρ	0.35				

<u>TABLE 4</u> - Unconditional annual rating migration dynamics (1981-2001)

Panel A – Annual rating drift and rating activity ratios

Columns 1 and 2 contain the annual percentages of letter-rating downgrades and upgrades used to compute the annual average letter-rating drift and activity (%) in columns 3 and 5 for Canadian corporate issuers rated by Standard & Poor's between January 1, 1981 and December 30, 2001.

The rest of the data covers the January 1 to May 31, 2002. For this period, 1.29% of obligors were upgraded, and 9.91% were downgraded. The rating drift and activity ratios are -8.62% and 16.38%, respectively.

YEAR	Upgrades (%)	Downgrades (%)	Rating Drift (%)	Rating Activity (%)
1981	0.00	9.09	-9.09	9.09
1982	0.00	21.43	-21.43	21.43
1983	0.00	23.53	-23.53	23.53
1984	5.56	0.00	5.56	5.56
1985	5.88	0.00	5.88	5.88
1986	0.00	18.57	-18.57	18.57
1987	10.53	5.26	5.26	15.79
1988	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00
1990	0.00	18.18	-18.18	36.36
1991	0.00	18.18	-18.18	18.18
1992	0.00	19.23	-19.23	19.23
1993	0.00	8.33	-8.33	8.33
1994	3.51	5.26	-1.75	8.77
1995	1.45	2.90	-1.45	4.35
1996	3.66	3.66	0.00	10.98
1997	1.00	0.00	1.00	1.00
1998	3.39	3.39	0.00	12.71
1999	1.38	6.90	-5.52	13.79
2000	1.96	5.23	-3.27	14.38
2001	2.81	12.36	-9.55	24.72
Mean			**-6.68**	**12.98**
Standard deviation			*9.58*	*9.20*

Panel B - Unconditional rating drift and rating activity ratios for various sub-periods

Periods		Rating Drift (%)	Rating Activity(%)
1981-2001	Mean	-6.68	12.98
(whole period)	*Standard deviation*	*9.58*	*9.20*
1981-1989	Mean	-6.23	11.11
("Eighties")	*Standard deviation*	*12.20*	*9.01*
1983-1989	Mean	-3.65	9.93
(80s recession removed)	*Standard deviation*	*12.28*	*9.40*
1990-1999	Mean	-7.16	13.37
("Nineties")	*Standard deviation*	*8.56*	*9.85*
1993-1999	Mean	-2.29	8.56
(90s recession removed)	*Standard deviation*	*3.40*	*4.57*
2000-2001	Mean	-6.41	19.55
(Latest trends)	*Standard deviation*	*4.44*	*7.31*

TABLE 5 – **Conditional annual rating drift and rating activity: Impact of the obligor's industry (1981-2001)**

Panel A – Annual percentage rating drift and activity ratios for the three industry samples: financials, industrials and utilities.

YEAR	Unconditional		Financials		Industrials		Utilities	
	Rating drift %	**Rating activity%**	**Rating drift %**	**Rating activity%**	**Rating drift %**	**Rating activity%**	**Rating drift %**	**Rating activity%**
1981	-9.09	9.09	0.00	0.00	-12.50	12.50	0.00	0.00
1982	-21.43	21.43	0.00	0.00	-27.27	45.45	0.00	0.00
1983	-23.53	23.53	0.00	0.00	-33.33	50.00	0.00	0.00
1984	5.56	5.56	0.00	0.00	7.69	7.69	0.00	0.00
1985	5.88	5.88	0.00	0.00	0.00	0.00	33.33	33.33
1986	-18.57	18.57	0.00	0.00	-18.18	18.18	0.00	0.00
1987	5.26	15.79	0.00	0.00	0.00	33.33	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	-18.18	36.36	-14.29	42.86	-20.00	20.00	-33.33	33.33
1991	-18.18	18.18	-25.00	25.00	-20.00	20.00	0.00	0.00
1992	-19.23	19.23	-28.57	28.57	-20.00	20.00	0.00	0.00
1993	-8.33	8.33	-18.18	18.18	-10.00	10.00	0.00	0.00
1994	-1.75	8.77	-23.08	23.08	2.94	2.94	10.00	10.00
1995	-1.45	4.35	-11.76	11.76	2.63	2.63	7.14	7.14
1996	0.00	10.98	-12.50	12.50	0.00	8.00	6.25	6.25
1997	1.00	1.00	0.00	0.00	1.54	1.54	0.00	0.00
1998	0.00	12.71	0.00	0.00	0.00	18.99	0.00	0.00
1999	-5.52	13.79	4.76	4.76	-6.86	16.67	-4.55	13.64
2000	-3.27	14.38	0.00	0.00	-2.00	14.00	-9.68	22.58
2001	-9.55	24.72	-8.00	8.00	-8.04	26.79	-14.63	29.27
Mean (%)	**-6.68**	**12.98**	**-6.51**	**8.32***	**-7.78**	**15.65**	**-0.26***	**7.41***
t-statistic	*N/A*	*N/A*	*0,02*	*-1,46*	*-0,32*	*0,71*	*1,91*	*-1,41*
Stdev (%)	**9.58**	**9.20**	**0.10**	**0.12***	**0.11**	**0.14***	**0.12***	**0.13***
F-test	*N/A*		*1,10*	*1,80*	*1,39*	*2,35*	*1,54*	*1,96*
ρ(GDP;RD)/ ρ(GDP;RA) in%	70.71	-51.49	46.06	-46.73	68.38	-44.74	27.73	-10.77

Differences with unconditional estimates for the means and variances are assessed with t-tests and F-tests, respectively: * 10% level of significance. Correlation coefficients between the real GDP growth rate and the rating dynamics assess the influence of the economic context. The data for the 01/2002-05/2002 yields -11.36, -7.69 and -1.34 percent rating drift ratios, and 11.36, 15.38 and 31.03 percent rating activity ratios for financials, industrials and utilities, respectively.

<u>TABLE 5</u> ***(continued)*** **- Conditional Rating Drift and Activity: obligors' industry (1981-2001)**

Panel B – Significance of the obligor's industry on rating migration dynamics: statistical tests for various sub-periods

Periods		Financials		Industrials		Utilities	
		Rating Drift, %	Rating Activity, %	Rating Drift, %	Rating Activity , %	Rating Drift, %	Rating Activity, %
1981-1989	**Mean**	**0.00****	**0.00*****	**-9.29**	**18.57**	**3.70*****	**3.70****
	T-statistics	*1.53*	*-3.70*	*-0.49*	*1.03*	*1.81*	*-1.55*
	Standard deviation	0.00	0.00	0.14	0.20***	0.11	0.11
	F-statistics	*0.00*	*0.00*	*1.364*	*4.800*	*0.830*	*1.52*
1983-1989	**Mean**	**0.00**	**0.00*****	**-6.26**	**15.60**	**4.76****	**4.76**
	T-statistics	*0.79*	*-2.80*	*-0.37*	*0.69*	*1.27*	*-0.87*
	Standard deviation	0.00	0.00	0.14	0.20***	0.13	0.13
	F-statistics	*0.00*	*0.00*	*1.355*	*4.34*	*1.05*	*1.80*
1990-1999	**Mean**	**-12.86***	**16.67**	**-6.98**	**12.08**	**-1.45***	**7.04****
	T-statistics	*-1.28*	*0.620*	*0.046*	*-0.24*	*1.236*	*-1.39*
	Standard deviation	0.11	0.14	0.10	0.08	0.12*	0.10
	F-statistics	*1.88*	*1.922*	*1.409*	*0.64*	*2.086*	*1.14*
1993-1999	**Mean**	**-8.68*****	**10.04**	**-1.39**	**8.68**	**2.69****	**5.29**
	T-statistics	*-1.54*	*0.391*	*0.373*	*0.04*	*2.134*	*-1.21*
	Standard deviation	0.01***	0.09**	0.05	0.07	0.05	0.05
	F-statistics	*9.43*	*3.784*	*2.187*	*2.33*	*2.311*	*1.44*
1993-2001	**Mean**	**-7.64****	**8.70**	**-2.20**	**11.28**	**-0.61**	**9.88**
	T-statistics	*-1.37*	*-0.787*	*0.501*	*0.05*	*0.755*	*0.10*
	Standard deviation	9.48***	8.39	4.87	8.57	8.03***	10.40***
	F-statistics	*5.16*	*1.45*	*1.53*	*1.54*	*4.24*	*3.23*

*(***, **, and * denote significance at the 5, 10 and 15 percent levels respectively).*

TABLE 6 - Industry-conditioned rating transition matrices (1981-2001)

Each panel presents the rating migration probabilities for a sample of obligors sorted by industry, namely "industrials", "financials" and "utilities", in percent, each based on 21 annual matrices of migration counts corresponding to the 1981-2001 period.

***Panel A – Industrials*[6]**

From	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR
AAA	**80.95**	19.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	1.61	**91.94**	3.23	0.00	3.23	0.00	0.00	0.00	0.00	0.00
A	0.00	0.00	**91.58**	8.42	0.00	0.00	0.00	0.00	0.00	0.00
BBB	0.00	0.00	1.97	**90.82**	3.93	0.00	0.00	0.00	2.62	0.66
BB	0.00	0.00	0.00	4.35	**84.58**	5.14	0.00	0.00	5.14	0.79
B	0.00	0.00	0.00	0.00	2.84	**75.89**	2.13	0.71	9.93	8.51
CCC	0.00	0.00	0.00	0.00	0.00	0.00	**50.00**	0.00	0.00	50.00
CC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	100.00

***Panel B – Financials*[7]**

From	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR
AAA	**78.26**	17.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.35
AA	0.00	**92.55**	6.83	0.00	0.00	0.00	0.00	0.00	0.00	0.62
A	0.00	0.00	**82.76**	1.72	0.00	0.00	0.00	0.00	0.00	15.52
BBB	0.00	0.00	0.00	**81.58**	10.53	0.00	0.00	0.00	0.00	7.89
BB	0.00	0.00	0.00	10.00	**80.00**	0.00	0.00	0.00	0.00	10.00
B	0.00	0.00	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	0.00
CCC	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00
CC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00

[6] "Industrials" include Aerospace & automotive, capital goods, metal, Consumer & service sector, Energy & natural resources, Forest & building products, Leisure time & media, Health care & chemicals, High technology & computers sectors.
[7] "Financials" include Financial Institutions, Insurance, and Real Estate sectors.

<u>TABLE 6</u> *(continued)*- Industry-conditioned rating transition matrices (1981-2001)

***Panel C – Utilities*[8]**

From	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR
AAA	**100.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	4.35	**84.78**	6.52	0.00	0.00	0.00	0.00	0.00	4.35	0.00
A	0.00	1.52	**92.42**	4.55	0.00	0.00	0.00	0.00	1.52	0.00
BBB	0.00	0.00	1.54	**95.38**	0.00	0.00	0.00	0.00	0.00	3.08
BB	0.00	0.00	0.00	2.38	**83.33**	9.52	0.00	0.00	4.76	0.00
B	0.00	0.00	0.00	0.00	5.26	**81.58**	0.00	0.00	0.00	13.16
CCC	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	50.00	0.00	50.00
CC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**50.00**	0.00	50.00

[8] « Utilities » include the Transportation, Telecommunication, and Utilities sectors.

TABLE 7 - **Conditional rating drift and activity: Impact of the business cycle (1981-2001)**

This table reports the annual percentage letter-rating drift and activity for years of economic expansion, recession and negative GDP growth.
The t-statistics test the null hypothesis that the difference in means between unconditional and economy-conditioned rating drift and activity is zero. The F-statistics test the null hypothesis that the difference in the variance of the rating drift and activity is zero between unconditional and economy-conditioned estimates. Levels of significance are 10% (*) and 5% (**).

Year	Expansion	
	Rating Drift	Rating
1981	-9.09	9.09
1984	5.56	5.56
1985	5.88	5.88
1987	5.26	15.79
1988	0.00	0.00
1994	-1.75	8.77
1997	1.00	1.00
1998	0.00	12.71
1999	-5.52	13.79
2000	-3.27	14.38
Mean	**-0.19****	**8.70***
t-test	*2,27*	*-1,45*
Stdev	**4.95**	**5.55****
F-stat	*0.31*	*0,41*

Year	Recession	
	Rating Drift	Rating
1982	-21.43	21.43
1983	-23.53	23.53
1986	-18.75	18.75
1989	0.00	0.00
1990	-18.18	36.36
1991	-18.18	18.18
1992	-19.23	19.23
1993	-8.33	8.33
1995	-1.45	4.35
1996	0.00	10.98
2001	-9.55	24.72
Mean	**-12.60***	**16.90**
t-test	*-1.73*	*1.02*
Stdev	**9.00****	**10.33****
F-stat	*0.92*	*0.93*

Negative real GDP growth years		
Year	Rating Drift	Rating
1982	-21.43	21.43
1990	-18.18	36.36
1991	-18.18	18.18
1992	-19.23	19.23
Mean	**-19.26****	**23.80****
t-test	*-5.83*	2.29
Stdev	**1.53**	**8.48****
F-stat	*0.03*	*0.89*

Years of economic expansion exhibit an annual real GDP growth rate superior to the 1981-2001 average, namely 1.67%.

Years of economic recession exhibit an annual real GDP growth rate inferior to the 1981-2001 average, namely 1.67%.

Years of negative real GDP growth rate are selected to examine the extent to which rating migration dynamics differ from the rest of the business cycle.

TABLE 8 - Economy-conditioned rating transition matrices (1981-2001)

Panel A - Recession years: average annual rating migration probabilities (%)

	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR
AAA	**72.00**	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
AA	0.96	**88.46**	7.69	0.00	1.92	0.00	0.00	0.00	0.00	0.96
A	0.00	0.00	**87.34**	8.86	0.00	0.00	0.00	0.00	0.00	3.80
BBB	0.00	0.00	4.10	**87.70**	4.92	0.00	0.00	0.00	0.82	2.46
BB	0.00	0.00	0.00	4.26	**85.11**	4.26	0.00	0.00	1.06	5.32
B	0.00	0.00	0.00	0.00	3.92	**72.55**	3.92	0.00	15.69	3.92
CCC	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	100.00	0.00
CC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	100.00	0.00

Years: 1982,1983,1986,1989,1990,1991,1992,1993,1995,1996,2001

Panel B - Expansion years: average annual rating migration probabilities (%)

	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR
AAA	**90.91**	9.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	1.35	**91.22**	5.41	0.00	0.00	0.00	0.00	0.00	0.00	2.03
A	0.00	0.80	**92.00**	3.20	0.00	0.00	0.00	0.00	0.00	4.00
BBB	0.00	0.00	0.36	**92.78**	2.89	0.00	0.00	0.00	1.08	2.89
BB	0.00	0.00	0.00	3.76	**84.04**	6.10	0.00	0.00	0.94	5.16
B	0.00	0.00	0.00	0.00	3.15	**79.53**	0.79	0.79	7.09	8.66
CCC	0.00	0.00	0.00	0.00	0.00	0.00	**33.33**	33.33	33.33	0.00
CC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**50.00**	50.00	0.00

Years: 1981,1984,1985,1987, 1988, 1994, 1997,1998, 1999, and 2000.

Note: Recession (expansion) years correspond to years of below (above) the 1981-2001 annual average real GDP growth rate of 1.67%.

TABLE 9 - Chi-square tests of homogeneity: Significance of the business cycle on rating transition matrices (1981-2001)

Each entry cell is the squared difference between the unconditional and the conditional migration probability divided by the unconditional estimate. Grey lines indicate rating categories excluded from the computed chi-tests (the corresponding transition probabilities were computed for few issuers).

Panel A – Recession years

	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR	One-rating χ^2-statistics
AAA	0.9689586	17.021277								2.1276596	**20.118****
AA	0.0440265	0.0290562	0.2841176		1.6072603					0.2466951	**2.211**
A		0.4901961	0.0903261	2.2312415						0.0039272	**2.816**
BBB			4.4767505	0.1360612	0.5660146				0.0333447	0.0321848	**5.244**
BB				0.0307202	0.0065183	0.296866			0.0076801	0.0022142	**0.344**
B					0.0899971	0.3197698	2.9669516	0.5617978	3.9418593	1.5659325	**9.446**
CCC							25	25	50		100.000
CC								33.333333	16.666667		50.000
WR			1.5235507	8.6992754						0.3339921	**10.557**
									Matrix χ^2-statistics		**40.179**

Panel B – Expansion years

	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR	One-rating χ^2-statistics
AAA	1.2512378	3.6948303								2.1276596	**7.074**
AA	0.0217399	0.0143477	0.1402947		0.7936508					0.1218158	**1.092**
A		0.1957961	0.0360784	0.8912114						0.0015686	**1.125**
BBB			0.8684064	0.0263933	0.1097963				0.0064683	0.0062433	**1.017**
BB				0.005983	0.0012695	0.0578172			0.0014958	0.0004312	**0.067**
B					0.0145131	0.0515668	0.4784575	0.0905968	0.6356734	0.2525259	**1.523**
CCC							2.7777778	2.7777778	5.5555556		11.111
CC								8.3333333	4.1666667		12.500
WR			0.2538194	1.4492754						0.0556422	**1.759**
									Matrix χ^2-statistics		**11.898**

Critical-$\chi^2_{0.05;45}$ = 61.66   ***Critical-$\chi^2_{0.05;9}$ =16.92***   ***Critical-$\chi^2_{0.01;9}$ =21.671***   ** and *** denotes significance at the 5% and 1% levels.

TABLE 10 - Chi- square tests of homogeneity: Significance of the obligor's industry on rating transition matrices (1981-2001)

Panel A – Industrials

	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR	One-rating χ^2-statistics
AAA	0.000127	0.2412312								2.1276596	**2.369**
AA	0.1459649	0.038246	1.5365112		7.4533802					1.5873016	**10.761**
A		0.4901961	0.0212019	1.7013989						3.9215686	**6.134**
BBB			0.1428349	0.0018283	0.0516368				0.1199478	0.0065074	**0.323**
BB				0.0493115	0.0005745	0.028767			0.0356644	0.0010334	**0.115**
B					0.0845668	0.0347582	0.1160557	0.0386852	0.1132332	0.943994	**1.331**
CCC							25	25	0		50.000
CC								33.333333	16.666667		50.000
										Matrix χ^2-statistics	**21.034**

Critical- $\chi^2_{0.05;45}$ ***= 61.66***

Panel B – Financials

	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR	One-rating χ^2-statistics
AAA	0.0829811	0.0080441								2.3166955	**2.408**
AA	1.1952191	0.0675756	0.036757		0.7936508					0.5881117	**2.681**
A		0.4901961	0.6132836	2.4951728						34.287205	**37.886*****
BBB			1.5037594	1.0205803	14.035088				1.0025063	9.575074	**27.137*****
BB				9.4921281	0.2258247	5.5374593			0.9771987	4.3992264	**20.632****
B					3.3707865	6.5135971	1.6853933	0.5617978	9.5505618	7.3033708	28.986
CCC							25	25	50		100.000
CC								33.333333	66.666667		100.000
										Matrix χ^2-statistics	**90.744*****

Critical- $\chi^2_{0.01,36}$ ***= 58.62*** ****** denotes significance at the 1% level; ** denotes significance at the 5% level.***

Note: grey lines indicate rating categories excluded from the computed chi-tests: transition probabilities are computed for a very small number of issuers.

TABLE 10 *(continued)* **- Chi-square tests of homogeneity: Significance of the obligor's industry on rating transition matrices (1981-2001)**

Panel C – Utilities

	AAA	AA	A	BBB	BB	B	CCC	CC	D	NR	One-rating χ^2-statistics
AAA	4.5352744	17.021277								2.1276596	23.684
AA	8.315572	0.3114546	0.0046884		0.7936508					4.8009122	**14.226**
A		2.1430886	0.0550436	0.1329533						1.476665	**3.808**
BBB			0.0008008	0.1893811	3.5087719				4.2924471	2.7568922	**10.748**
BB				0.5971924	0.0126115	2.8697255			0.9771987	0.0388239	**4.496**
B					1.0623839	0.2116581	1.6853933	0.5617978	1.362522	7.3033708	**12.187**
CCC							25	25	0		50.000
CC								8.3333333	4.1666667		12.500
										Matrix χ^2-statistics	**45.465**

Critical- $\chi^2_{0.01,36} = \mathbf{58.62}$

Critical- $\chi^2_{0.05,36} = \mathbf{51.00}$

Note: grey lines indicate rating categories excluded from the computed chi-tests: transition probabilities are computed for a very small number of issuers.

TABLE 11 - Relative performance of alternative investment classes (February 1993 –May 2002)

This table presents statistics characterizing the annualized total return distributions of two alternative domestic investment classes: fixed-income and equities.

The first line, "total corporate bonds", refers to our dataset of corporate bonds composed of 192 issues. Total returns are computed based on Bloomberg price and yield histories.

The Sharpe ratio is computed as the difference between the asset's return and the one-month T-bill rate, divided by the standard deviation of the asset's return.

Value-at-risk ($VaR_{99\%}$) indicates the 1% lowest monthly excess return in annualized percentage.

Betas estimate the sensitivity of long and short-term Treasuries to variations in the stock market, proxied by the TSE_{300} index.

** denotes significance at the 5% level.

Investments	Mean	Standard deviation	Sharpe ratio	Beta	Skewness	Excess Kurtosis	$VaR_{99\%}$
Total corporate bonds	7.22	1.19	2.13	-0.019 *(-0.815)*	-0.90	0.61	5.62
Short-term Treasuries (3-month)	4.70	1.34	0.55	-0.077** *(-3.277)*	0.22	0.37	1.95
Long-term Treasuries (over 10-year)	6.75	1.24	1.80	-0.022 *(-0.958)*	0.60	-0.93	5.08
TSE total returns	1.03	4.84	-2.08		-0.93	2.71	-20.11

Source: TSE Western (TSE total returns) and the Canadian Financial Markets Research Centre (Treasuries returns).

TABLE 12 - Relative performance of the studied corporate bond portfolios (February 1993 –May 2002)

Panel A – Performance measures

Means and standard deviations of monthly annualized excess returns are presented for the equal-weighted "total", "industry", "maturity" and "rating" portfolios of corporate bonds. The Sharpe ratio provides a risk-adjusted measure of performance, comparable across portfolios.

Skewness and excess kurtosis characterize the shape of the excess return distribution (Excel provides us with measures of kurtosis in excess of the normal kurtosis value, 3). The value-at-risk (VaR, in percentage) is computed at the 99% level of confidence. Reported figures indicate the lowest excess return exceeded in 99% of the months. VaR figures are positive because defaulted bonds are excluded from the studied sample.

Beta estimates are the slope coefficients in the regression of portfolios' monthly total returns on the TSE300 monthly returns adjusted for dividends less the corresponding one-month T-bill rate for the 02/1993 to 05/2002 period. The t-statistics indicate that only the beta of the short-term cohort is significantly negative at the 5% level (*).

Corporate bond portfolios	Mean	Standard deviation	Sharpe ratio	Skewness	Excess Kurtosis	VaR99%	Beta	t-statistic for betas
Total	2.70	1.26	2.13	0.04	-1.55	0.867	-0.019	-0.815
FIN	2.55	1.28	2.00	0.09	-1.48	0.676	-0.027	-1.125
IND	2.64	1.18	2.24	0.02	-1.55	0.917	-0.017	-0.769
UTI	2.90	1.41	2.06	0.29	-1.02	0.785	-0.011	-0.486
AA	2.52	1.29	1.95	0.07	-1.48	0.535	-0.021	-0.904
A	2.73	1.35	2.01	0.05	-1.55	0.735	-0.020	-0.801
BBB	2.92	1.34	2.17	0.10	-1.49	0.963	-0.011	-0.464
BB	3.05	1.33	2.29	0.78	0.65	1.226	-0.005	-0.225
B	2.87	1.51	1.90	0.83	0.59	0.776	-0.026	-1.117
LT	2.15	0.97	2.21	0.20	-1.26	0.724	-0.014	-0.624
MT	2.82	1.33	2.13	0.08	-1.48	0.884	-0.014	-0.609
ST	2.38	1.31	1.81	0.52	-1.21	0.728	-0.035*	-1.676

TABLE 12 ***(continued)*** **- Relative performance of alternative investment classes (February 1993 –May 2002)**

Panel B –Spearman rank correlations

Spearman rank correlation - Returns and ratings

"Rating" portfolios	Rank	Excess returns	Rank	D	D^2
AA	1	**2.52**	5	-4	16
A	2	**2.73**	4	-2	4
BBB	3	**2.92**	2	1	1
BB	4	**3.05**	1	3	9
B	5	**2.87**	3	2	4
Sum					34
Spearman ρ	**-0.70**				

Spearman rank correlation - Standard deviations and ratings

"Rating" portfolios	Rank	Standard deviation	Rank	D	D^2
AA	1	**1.29**	5	-4	16
A	2	**1.35**	4	-2	4
BBB	3	**1.34**	2	1	1
BB	4	**1.33**	3	1	1
B	5	**1.51**	1	4	16
Sum					38
Spearman ρ	**-0.90**				

<u>TABLE 13</u> – Correlation coefficients between the time series of corporate bond portfolios' monthly excess returns (February 1993 – May 2002)

This table reports the correlation coefficients across studied portfolios' monthly excess returns times series. IND, FIN and UTI refer to the equal-weighted industry portfolios, namely industrials, financials and utilities. The next portfolios comprise corporate bonds with a similar rating, and are rebalanced annually. LT, MT and ST refer to the long-term, mid-term and short-term cohorts defined following Duffee (1998).

Corporate bond portfolio	TOTAL	IND	FIN	UTI	AA	A	BBB	BB	B	LT	MT	ST
TOTAL	1											
FIN	0.952	0.978	1									
IND	0.961	1										
UTI	0.965	0.951	0.919	1								
AA	0.970	0.977	0.985	0.955	1							
A	0.957	0.988	0.968	0.962	0.968	1						
BBB	0.977	0.988	0.974	0.973	0.984	0.979	1					
BB	0.889	0.900	0.845	0.935	0.901	0.880	0.913	1				
B	0.884	0.838	0.850	0.900	0.877	0.828	0.876	0.836	1			
LT	0.953	0.975	0.958	0.971	0.972	0.979	0.977	0.905	0.866	1		
MT	0.975	0.988	0.972	0.973	0.984	0.985	0.996	0.914	0.855	0.977	1	
ST	0.981	0.982	0.969	0.976	0.988	0.977	0.991	0.915	0.884	0.977	0.989	1

<u>TABLE 14</u> - Seasonality in the time series of corporate bond portfolios' monthly excess returns (February 1993 –May 2002)

The top line is the annual mean excess return for the February 1993 – May 2002 period. Following lines show the annualized excess returns per month (%). The positive difference in mean returns between January and the monthly average for the rest of the year is tested with the regression model $R_{i,t} = \alpha_0 + \alpha_1 D_{i,t} + \varepsilon_{i,t}$ where the existence of a January effect is tested with the dummy variable $D_{i,t}$ that equals 1 if t is January, 0 otherwise.

Reported t-statistics are not significant at conventional confidence levels. We accept the null hypothesis that excess returns in January are not significantly higher than over the rest of the year.

The F-statistics test the null hypothesis that mean returns from January to December are jointly equal. Results bring no evidence that the null hypothesis can be rejected. Hence, time-series of excess returns can best be described as a random walk.

Corporate bond portfolios	Total	FIN	IND	UTI	AA	A	BBB	BB	B	LT	MT	ST
All months	**2.70**	**2.55**	**2.64**	**2.9**	**2.52**	**2.73**	**2.92**	**3.05**	**2.87**	**2.15**	**2.82**	**2.38**
January	**2.86**	**2.6**	**2.74**	**3.25**	**2.6**	**2.94**	**3.12**	**3.22**	**2.98**	**2.28**	**3.02**	**2.72**
February	2.58	2.48	2.53	2.73	2.43	2.40	2.82	2.98	2.95	2.05	2.66	2.53
March	2.59	2.50	2.51	2.76	2.43	2.63	2.80	2.79	2.92	2.05	2.69	2.50
April	2.51	2.47	2.47	2.61	2.39	2.52	2.70	2.69	2.85	1.97	2.59	2.47
May	2.61	2.50	2.56	2.78	2.40	2.64	2.81	2.78	3.01	2.05	2.68	2.55
June	2.55	2.47	2.51	2.68	2.38	2.62	2.74	2.70	2.61	2.10	2.65	2.45
July	2.60	2.50	2.58	2.72	2.42	2.66	2.81	2.90	2.66	2.16	2.71	2.53
August	2.65	2.39	2.69	2.87	2.39	2.79	2.91	3.02	2.65	2.08	2.83	2.57
September	2.75	2.67	2.72	2.87	2.61	2.78	2.96	3.14	2.92	2.18	2.87	2.63
October	2.86	2.70	2.78	3.10	2.67	2.93	3.11	3.21	2.95	2.27	3.00	2.74
November	2.96	2.76	2.84	3.27	2.82	2.98	3.20	3.61	3.00	2.31	3.10	2.90
December	2.90	2.66	2.80	3.24	2.74	2.94	3.12	3.52	2.91	2.32	3.08	2.83
February to December	**2.68**	**2.55**	**2.63**	**2.87**	**2.51**	**2.71**	**2.9**	**3.03**	**2.86**	**2.14**	**2.8**	**2.6**
January minus (February to December)	**0.18**	**0.05**	**0.11**	**0.38**	**0.09**	**0.23**	**0.22**	**0.19**	**0.12**	**0.15**	**0.22**	**0.11**
t-statistics	0.407	0.116	0.274	0.763	0.207	0.495	0.478	0.398	0.232	0.426	0.481	0.251
F-statistics	0.813	0.969	0.873	0.666	0.862	0.825	0.774	0.927	1.024	0.845	0.8	0.831

TABLE 15 – **Autocorrelation coefficients for time-series of corporate bond portfolios' excess returns (February 1993 –May 2002)**

This table presents the sample autocorrelation functions of the twelve equal-weighted portfolios' time-series of monthly excess returns.

Reported coefficients show significant autocorrelation in all the series up to 6-month lags. Non-synchronous bond trading could account for the significance of coefficients for a small number of lags (Chang and Huang, 1993).

Between 12 and 36-month lag, autocorrelation coefficients decrease rapidly and remain low. However, a peak in autocorrelation is observed for a 48-month lag, suggesting some kind of mean reversion in the time-series of excess returns.

Corporate bond portfolios	ρ_1	ρ_2	ρ_3	ρ_6	ρ_{12}	ρ_{24}	ρ_{36}	ρ_{48}
Total	0.9667*	0.9091*	0.8342*	0.5794*	0.1173	-0.1024	0.0337	-0.2053*
FIN	0.9542*	0.9007*	0.8319*	0.6027*	0.1442	-0.0552	0.1018	-0.2292*
IND	0.9690*	0.9127*	0.8396*	0.5902*	0.1435	-0.0701	0.1280	-0.1575
UTI	0.9472*	0.8751*	0.7791*	0.5127*	0.0708	-0.1601	-0.1031	-0.1980*
AA	0.9525*	0.8872*	0.8089*	0.5558*	0.0961	-0.06	0.0653	-0.2235*
A	0.9489*	0.8914*	0.8148*	0.5780*	0.1852*	-0.0392	0.0765	-0.1863*
BBB	0.9683*	0.9092*	0.8297*	0.5649*	0.0860	-0.0952	0.0031	-0.2666*
BB	0.9240*	0.8027*	0.6845*	0.4086*	-0.0111	-0.0706	0.0025	-0.4269*
B	0.9517*	0.8974*	0.8301*	0.5420*	-0.0916	-0.1643*	-0.2034*	-0.4254*
ST	0.9733*	0.9210*	0.8607*	0.5984*	-0.0488	-0.2437*	-0.2660*	0.3437*
MT	0.9631*	0.8996*	0.8196*	0.5644*	0.1110	-0.0937	0.0023	-0.2462*
LT	0.9421*	0.8729*	0.7978*	0.5782*	0.1588	-0.1139	-0.0023	-0.0697

** denotes significance at the 5% level.*

TABLE 16– Correlation structure of the dependent and independent variables (February 1993 –May 2002)

Panel A - Correlation coefficients between portfolios' bond excess returns and independent variables

		TOTAL	AA	A	BBB	BB	B	IND	FIN	UTI	LT	MT	ST
ln_IS	**Pearson**	**-.482(**)**	**-.259(**)**	**-.493(**)**	**.262(**)**	**-.446(**)**	**.449(**)**	**.985(**)**	**.321(**)**	**-.412(**)**	**-.272(**)**	**-.482(**)**	**-.279(*)**
	Sig.	*.000*	.006	.000	.005	.000	.000	.000	.001	*.000*	*.004*	.000	.015
ln_PF	**Pearson**	**-.467(**)**	**-.444(**)**	**-.436(**)**	**-.491(**)**	**-.378(**)**	**.449(**)**	**-.332(**)**	**-.510(**)**	**-.390(**)**	**-.571(**)**	**-.361(**)**	**-.358(**)**
	Sig.	*.000*	.000	.000	.000	.000	.000	.000	.000	*.000*	*.000*	.000	.002
CPN	**Pearson**	**.391(**)**	**.430(**)**	**.481(**)**	**.491(**)**	**.415(**)**	**-.358(**)**	**.522(**)**	**.440(**)**	**-.158**	**.472(**)**	**.507(**)**	**.274(*)**
	Sig.	*.000*	.000	.000	.000	.000	.000	.000	.000	*.097*	*.000*	.000	.016
MAT	**Pearson**	**.091**	**.188(*)**	**.071**	**.393(**)**	**.300(**)**	**.108**	**.411(**)**	**.505(**)**	**.098**	**.164**	**.341(**)**	**.230(*)**
	Sig.	*.341*	.048	.459	.000	.002	.260	.000	.000	*.309*	*.087*	.000	.045
CPI	**Pearson**	**-.068**	**-.467(**)**	**-.403(**)**	**-.405(**)**	**.085**	**-.220(*)**	**-.381(**)**	**-.438(**)**	**-.369(**)**	**-.281(**)**	**-.416(**)**	**-.245(*)**
	Sig.	*.481*	.000	.000	.000	.385	.021	.000	.000	*.000*	*.003*	.000	.033
GDP	**Pearson**	**-.141**	**.113**	**.083**	**.106**	**-.172**	**.088**	**.094**	**.099**	**.090**	**.045**	**.101**	**.103**
	Sig.	*.139*	.237	.387	.266	.076	.359	.328	.302	*.349*	*.641*	.291	.375
Slope	**Pearson**	**.712(**)**	**.841(**)**	**.842(**)**	**.871(**)**	**.609(**)**	**.791(**)**	**.863(**)**	**.834(**)**	**.853(**)**	**.874(**)**	**.866(**)**	**.929(**)**
	Sig.	*.000*	.000	.000	.000	.000	.000	.000	.000	*.000*	*.000*	.000	.000
ST_IR	**Pearson**	**-.292(**)**	**-.449(**)**	**-.412(**)**	**-.483(**)**	**-.196(*)**	**-.581(**)**	**-.452(**)**	**-.418(**)**	**-.516(**)**	**-.478(**)**	**-.469(**)**	**-.901(**)**
	Sig.	*.002*	.000	.000	.000	.044	.000	.000	.000	*.000*	*.000*	.000	.000
LT_IR	**Pearson**	**.441(**)**	**.479(**)**	**.502(**)**	**.453(**)**	**.366(**)**	**.271(**)**	**.489(**)**	**.508(**)**	**.375(**)**	**.467(**)**	**.457(**)**	**.438(**)**
	Sig.	*.000*	.000	.000	.000	.000	.004	.000	.000	*.000*	*.000*	.000	.000
TSE_T	**Pearson**	**-.055**	**.080**	**.092**	**.107**	**-.018**	**.028**	**.120**	**.066**	**.088**	**.104**	**.100**	**.155**
	Sig.	*.564*	.405	.336	.263	.852	.772	.209	.492	*.356*	*.281*	.295	.182
TSE_XS	**Pearson**	**.020**	**.236(*)**	**.215(*)**	**.229(*)**	**.037**	**.163**	**.243(*)**	**.221(*)**	**.224(*)**	**.216(*)**	**.231(*)**	**.309(**)**
	Sig.	.837	.013	.024	.016	.704	.089	0.10	.020	*.018*	*.024*	.015	.007
RS	**Pearson**	N/A	N/A	N/A	N/A	N/A	N/A	**-.278(**)**	**-.524(**)**	**-.250(**)**	**.660(**)**	**-.152**	**.264(*)**
	Sig.	N/A	N/A	N/A	N/A	N/A	N/A	.003	.000	*.008*	*.000*	.111	.021
RD	**Pearson**	N/A	N/A	N/A	N/A	N/A	N/A	**-.007**	**-.562(**)**	**-.196(*)**	**.215(*)**	**.082**	**.187**
	Sig.	N/A	N/A	N/A	N/A	N/A	N/A	.943	.000	*.039*	*.024*	.393	.105
RA	**Pearson**	N/A	N/A	N/A	N/A	N/A	N/A	**-.229(*)**	**.532(**)**	**-.015**	**-.215(*)**	**-.082**	**-.231(*)**
	Sig.	N/A	N/A	N/A	N/A	N/A	N/A	.016	.000	*.877*	*.024*	.393	.045

TABLE 16 *(continued)* – **Correlation structure of the dependent and independent variables (February 1993 –May 2002)**

Panel B - Summary statistics and correlation coefficients of independent variables common to all the regression models

"CPI" refers to the monthly change in the Canadian consumer price index and reflects inflation. Source: Statistics Canada.
"GDP" refers to the Canadian real GDP growth rate, seasonally adjusted and presented as a monthly percentage change. Source: Statistics Canada.
The term structure of interest rates is represented by its "Slope" (10-year minus 2-year Canadian Treasury rates), its "Short-term level (3-month T-Bill rate) and "Long-term level" (over 10year Treasury rate). Source: Canadian Financial Markets Research Centre (CFMRC).
"TSE total returns" refers to the S&P/TSX Composite Index including dividends. "TSE excess returns" refer to the "TSE total returns" minus the corresponding 1-month t-bill rate. Figures are monthly percentages from TSE Western database.

Means and Standard deviations (%)

	CPI	GDP	Slope of interest rates	Short-term interest rates level	Long-term interest rates level	TSE total returns	TSE excess returns
Mean (%)	1.70	0.28	1.01	4.52	6.77	1.03	-3.46
Standard deviation (%)	0.89	0.34	0.70	1.28	1.24	4.84	5.06

Pearson correlation coefficients *(* and ** indicate significance at the 5% and 1% level)*

		CPI	GDP	Slope	ST IR	LT IR	TSE T	TSE X
CPI	**Pearson**	**1**	**-.237(*)**	**-.198(*)**	**0.052**	**-.307(**)**	**0.049**	**-0.049**
	Sig	.	*0.012*	*0.037*	*0.589*	*0.001*	*0.61*	*0.612*
GDP	**Pearson**	**-.237(*)**	**1**	**-0.021**	**-0.168**	**-0.087**	**0.151**	**0.185**
	Sig	*0.012*	.	*0.829*	*0.078*	*0.364*	*0.114*	*0.052*
Slope	**Pearson**	**-.198(*)**	**-0.021**	**1**	**-.553(**)**	**.346(**)**	**0.089**	**.205(*)**
	Sig	*0.037*	*0.829*	.	*0*	*0*	*0.352*	*0.031*
ST IR	**Pearson**	**0.052**	**-0.168**	**-.553(**)**	**1**	**.497(**)**	**-0.069**	**-.263(**)**
	Sig	*0.589*	*0.078*	*0*	.	*0*	*0.473*	*0.005*
LT IR	**Pearson**	**-.307(**)**	**-0.087**	**.346(**)**	**.497(**)**	**1**	**0.042**	**-0.096**
	Sig	*0.001*	*0.364*	*0*	*0*	.	*0.662*	*0.315*
TSE T	**Pearson**	**0.049**	**0.151**	**0.089**	**-0.069**	**0.042**	**1**	**0.111**
	Sig	*0.61*	*0.114*	*0.352*	*0.473*	*0.662*	.	*0.246*
TSE X	**Pearson**	**-0.049**	**0.185**	**.205(*)**	**-.263(**)**	**-0.096**	**0.111**	**1**
	Sig	*0.612*	*0.052*	*0.031*	*0.005*	*0.315*	*0.246*	.

TABLE 16 *(continued)* – **Correlation structure of the dependent and independent variables (February 1993 –May 2002)**

Panel C - Factors specific to a bond portfolio

The following tables show the correlation coefficients between all the independent variables and predictors taking values unique to a portfolio. Ln_IS then ln_PF refer to the natural logarithms of the average issue and portfolio size (in dollars) for a given portfolio. CPN and MAT refer to the average coupon rate and years to maturity. Except for "rating" portfolios, the last three tables report correlation coefficients with the rating score (RS), the rating activity ratio (RA) and the rating drift ratio (RD).

ln_IS		*ln_PF*	*CPN*	*MAT*	*CPI*	*GDP*	*Slope*	*ST_IR*	*LT_IR*	*TSE_T*	*TSE_X*	*RS*	*RA*	*RD*
Total	Pearson	.981(**)	-.940(**)	-.321(**)	.396(**)	0.055	-.433(**)	-.338(**)	-.867(**)	-0.08	-0.001	0.959(**)	0.643(**)	-0.646(**)
	Sig	*0*	*0*	*0.001*	*0*	*0.564*	*0*	*0*	*0*	*0.404*	*0.995*	*0*	*0*	*0.002*
AA	Pearson	.778(**)	-.746(**)	-.655(**)	.257(**)	0.108	-.242(*)	-.359(**)	-.596(**)	-0.051	0.026	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.006*	*0.257*	*0.01*	*0*	*0*	*0.593*	*0.79*	*N/A*	*N/A*	*N/A*
A	Pearson	.896(**)	-.936(**)	-.663(**)	.359(**)	0.015	-.340(**)	-.408(**)	-.802(**)	-0.073	-0.001	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.874*	*0*	*0*	*0*	*0.443*	*0.994*	*N/A*	*N/A*	*N/A*
BBB	Pearson	-.854(**)	.880(**)	.921(**)	-.246(**)	-0.093	.305(**)	.409(**)	.736(**)	0.133	0.056	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.009*	*0.333*	*0.001*	*0*	*0*	*0.165*	*0.56*	*N/A*	*N/A*	*N/A*
BB	Pearson	.947(**)	-.954(**)	-.862(**)	0.161	0.081	-.479(**)	-.406(**)	-.922(**)	-0.098	-0.018	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.098*	*0.407*	*0*	*0*	*0*	*0.314*	*0.851*	*N/A*	*N/A*	*N/A*
B	Pearson	1.0(**)	-.369(**)	-.566(**)	.314(**)	-0.132	0.154	-.395(**)	-.332(**)	-0.136	-0.064	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.001*	*0.169*	*0.108*	*0*	*0*	*0.157*	*0.506*	*N/A*	*N/A*	*N/A*
IND	Pearson	-.30(**)	.540(**)	.420(**)	-.362(**)	0.078	.857(**)	-.418(**)	.515(**)	0.141	.259(**)	-0.296(**)	0.004	-.220(*)
	Sig.	*0.001*	*0*	*0*	*0*	*0.417*	*0*	*0*	*0*	*0.139*	*0.006*	*0.002*	*0.969*	*0.021*
FIN	Pearson	-.205(*)	.585(**)	.464(**)	0.028	-0.156	.235(*)	.300(**)	.565(**)	-0.08	-0.138	-.531(**)	-.361(**)	.244(**)
	Sig.	*0.031*	*0*	*0*	*0.773*	*0.103*	*0.013*	*0.001*	*0*	*0.402*	*0.148*	*0*	*0*	*0.01*
UTI	Pearson	.816(**)	.403(**)	-.653(**)	.246(**)	0.151	-.500(**)	-.390(**)	-.894(**)	-0.032	0.057	.660(**)	.378(**)	-.257(**)
	Sig	*0*	*0*	*0*	*0.009*	*0.114*	*0*	*0*	*0*	*0.742*	*0.549*	*0*	*0*	*0.007*
LT	Pearson	0.108	-.336(**)	-.260(**)	-0.028	-0.069	-.456(**)	.244(*)	-0.107	-0.093	-0.172	-0.118	.193(*)	-.193(*)
	Sig.	*0.263*	*0*	*0.006*	*0.772*	*0.473*	*0*	*0.01*	*0.266*	*0.336*	*0.072*	*0.219*	*0.043*	*0.043*
MT	Pearson	.467(**)	-.899(**)	-.892(**)	.348(**)	0.015	-.357(**)	-.303(**)	-.765(**)	-0.065	-0.008	-.414(**)	-.427(**)	.427(**)
	Sig.	*0*	*0*	*0*	*0*	*0.876*	*0*	*0.001*	*0*	*0.5*	*0.93*	*0*	*0*	*0*
ST	Pearson	.968(**)	-.766(**)	-.685(**)	0.223	0.094	-.466(**)	0.012	-.791(**)	-0.093	-0.107	-.964(**)	.349(**)	-.333(**)
	Sig.	*0*	*0*	*0*	*0.053*	*0.419*	*0*	*0.917*	*0*	*0.426*	*0.356*	*0*	*0.002*	*0.003*

TABLE 16 *(continued)* **– Correlation structure of the dependent and independent variables (February 1993 –May 2002)**

Panel C (continued)- Factors specific to a bond portfolio

ln_PF		ln_IS	CPN	MAT	CPI	GDP	Slope	ST_IR	LT_IR	TSE_T	TSE_X	RS	RA	RD
Total	**Pearson**	.981(**)	-.925(**)	-.363(**)	.322(**)	0.08	-.438(**)	-.323(**)	-.832(**)	-0.092	-0.025	0.949(**)	0.646(**)	-0.651(**)
	Sig	*0*	*0*	*0*	*0.001*	*0.407*	*0*	*0.001*	*0*	*0.339*	*0.793*	*0*	*0*	*0*
AA	**Pearson**	.778(**)	-.915(**)	-.601(**)	.279(**)	0.089	-.326(**)	-.380(**)	-.813(**)	-0.06	0.019	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.003*	*0.351*	*0*	*0*	*0*	*0.529*	*0.847*	*N/A*	*N/A*	*N/A*
A	**Pearson**	.896(**)	-.836(**)	-.566(**)	.308(**)	0.057	-.284(**)	-.399(**)	-.754(**)	-0.091	-0.013	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.001*	*0.554*	*0.002*	*0*	*0*	*0.344*	*0.889*	*N/A*	*N/A*	*N/A*
BBB	**Pearson**	-.854(**)	-.995(**)	-.974(**)	.386(**)	0.043	-.408(**)	-.320(**)	-.846(**)	-0.06	0.008	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.651*	*0*	*0.001*	*0*	*0.534*	*0.933*	*N/A*	*N/A*	*N/A*
BB	**Pearson**	.947(**)	-.936(**)	-.960(**)	.343(**)	0.05	-.506(**)	-.375(**)	-.904(**)	-0.083	-0.007	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.607*	*0*	*0*	*0*	*0.393*	*0.944*	*N/A*	*N/A*	*N/A*
B	**Pearson**	1.000(**)	-.369(**)	-.566(**)	.314(**)	-0.132	0.154	-.395(**)	-.332(**)	-0.136	-0.064	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.001*	*0.169*	*0.108*	*0*	*0*	*0.157*	*0.506*	*N/A*	*N/A*	*N/A*
IND	**Pearson**	-.300(**)	-.228(*)	-.380(**)	0.064	-0.004	-0.132	0.056	-.245(**)	-0.04	-0.05	0.029	0.096	-.254(**)
	Sig.	*0.001*	*0.016*	*0*	*0.506*	*0.964*	*0.167*	*0.556*	*0.01*	*0.678*	*0.604*	*0.761*	*0.314*	*0.007*
FIN	**Pearson**	-.205(*)	-.853(**)	-.916(**)	.304(**)	0.098	-.484(**)	-.270(**)	-.807(**)	-0.099	-0.033	.910(**)	.419(**)	-.398(**)
	Sig.	*0.031*	*0*	*0*	*0.001*	*0.308*	*0*	*0.004*	*0*	*0.299*	*0.732*	*0*	*0*	*0*
UTI	**Pearson**	.816(**)	.504(**)	-.620(**)	.343(**)	0.07	-.431(**)	-.340(**)	-.836(**)	-0.079	-0.015	.832(**)	.553(**)	-.383(**)
	Sig	*0*	*0*	*0*	*0*	*0.467*	*0*	*0*	*0*	*0.408*	*0.877*	*0*	*0*	*0*
LT	**Pearson**	0.108	-.818(**)	-.797(**)	.372(**)	0.006	-.450(**)	-.258(**)	-.835(**)	-0.07	-0.035	-.901(**)	-.292(**)	.292(**)
	Sig.	*0.263*	*0*	*0*	*0*	*0.951*	*0*	*0.007*	*0*	*0.468*	*0.715*	*0*	*0.002*	*0.002*
MT	**Pearson**	.467(**)	-.202(*)	-.584(**)	0.098	0.038	-.252(**)	-0.005	-.421(**)	0.017	0.022	.225(*)	0.104	-0.104
	Sig.	*0*	*0.034*	*0*	*0.308*	*0.692*	*0.008*	*0.958*	*0*	*0.857*	*0.82*	*0.017*	*0.279*	*0.279*
ST	**Pearson**	.968(**)	-.882(**)	-.824(**)	.279(*)	0.055	-.518(**)	0.065	-.803(**)	-0.095	-0.124	-.880(**)	.475(**)	-.465(**)
	Sig.	*0*	*0*	*0*	*0.015*	*0.635*	*0*	*0.576*	*0*	*0.414*	*0.287*	*0*	*0*	*0*

Coupon		ln_IS	ln_PF	MAT	CPI	GDP	Slope	ST_IR	LT_IR	TSE_T	TSE_X	RS	RA	RD
Total	**Pearson**	-.940(**)	-.925(**)	.318(**)	-.348(**)	-0.11	.401(**)	.460(**)	.904(**)	0.053	-0.036	-0.994(**)	-0.641(**)	0.623(**)
	Sig	*0*	*0*	*0.001*	*0*	*0.25*	*0*	*0*	*0*	*0.581*	*0.709*	*0*	*0*	*0*
AA	**Pearson**	-.746(**)	-.915(**)	.635(**)	-.287(**)	-0.131	.388(**)	.458(**)	.885(**)	0.067	-0.024	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.002*	*0.171*	*0*	*0*	*0*	*0.487*	*0.8*	*N/A*	*N/A*	*N/A*
A	**Pearson**	-.936(**)	-.836(**)	.645(**)	-.398(**)	-0.079	.389(**)	.463(**)	.890(**)	0.043	111	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.412*	*0*	*0*	*0*	*0.652*	***-0.054***	*N/A*	*N/A*	*N/A*
BBB	**Pearson**	.880(**)	-.995(**)	.980(**)	-.383(**)	-0.057	.424(**)	.343(**)	.865(**)	0.062	-0.009	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.549*	*0*	*0*	*0*	*0.519*	*0.925*	*N/A*	*N/A*	*N/A*
BB	**Pearson**	-.954(**)	-.936(**)	.863(**)	-.223(*)	-0.131	.372(**)	.500(**)	.908(**)	0.028	-0.07	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0.021*	*0.178*	*0*	*0*	*0*	*0.773*	*0.474*	*N/A*	*N/A*	*N/A*
B	**Pearson**	-.369(**)	-.369(**)	-.230(*)	0.044	0.183	-.238(*)	-0.144	-.409(**)	-0.03	0.068	N/A	N/A	N/A
	Sig.	*0*	*0*	*0.016*	*0.645*	*0.056*	*0.012*	*0.133*	*0*	*0.753*	*0.478*	*N/A*	*N/A*	*N/A*
IND	**Pearson**	.540(**)	-.228(*)	.905(**)	-.336(**)	-0.108	.448(**)	.420(**)	.907(**)	0.056	-0.031	-.569(**)	-.367(**)	.258(**)
	Sig.	*0*	*0.016*	*0*	*0*	*0.258*	*0*	*0*	*0*	*0.56*	*0.745*	*0*	*0*	*0.006*
FIN	**Pearson**	.585(**)	-.853(**)	.968(**)	-.259(**)	-0.135	.346(**)	.504(**)	.894(**)	0.054	-0.045	-.982(**)	-.418(**)	.388(**)
	Sig.	*0*	*0*	*0*	*0.006*	*0.158*	*0*	*0*	*0*	*0.576*	*0.641*	*0*	*0*	*0*
UTI	**Pearson**	.403(**)	.504(**)	-.448(**)	.378(**)	-0.005	-.274(**)	-0.079	-.319(**)	-0.003	0.027	.567(**)	.536(**)	-.359(**)
	Sig	*0*	*0*	*0*	*0*	*0.959*	*0.004*	*0.41*	*0.001*	*0.977*	*0.776*	*0*	*0*	*0*
LT	**Pearson**	-.336(**)	-.818(**)	.768(**)	-.528(**)	0.004	.492(**)	.258(**)	.788(**)	0.035	0.005	.817(**)	.332(**)	-.332(**)
	Sig.	*0*	*0*	*0*	*0*	*0.969*	*0*	*0.007*	*0*	*0.719*	*0.963*	*0*	*0*	*0*
MT	**Pearson**	-.899(**)	-.202(*)	.787(**)	-.382(**)	-0.048	.462(**)	.334(**)	.817(**)	0.069	0.01	.280(**)	.465(**)	-.465(**)
	Sig.	*0*	*0.034*	*0*	*0*	*0.619*	*0*	*0*	*0*	*0.474*	*0.92*	*0.003*	*0*	*0*
ST	**Pearson**	-.766(**)	-.882(**)	.988(**)	-.383(**)	0.085	.350(**)	0.009	.644(**)	0.13	0.15	.569(**)	-.737(**)	.718(**)
	Sig.	*0*	*0*	*0*	*0.001*	*0.465*	*0.002*	*0.941*	*0*	*0.262*	*0.196*	*0*	*0*	*0*

TABLE 16 ***(continued)*** **– Correlation structure of the dependent and independent variables (February 1993 –May 2002)**

Panel B (continued) - Factors specific to a bond portfolio

Maturity		ln_IS	ln_PF	CPN	CPI	GDP	Slope	ST_IR	LT_IR	TSE_T	TSE_X	RS	RA	RD
Tot	Pearson	-.321(**)	-.363(**)	.318(**)	0.063	-0.033	0.153	0.036	0.074	0.08	0.137	-0.348(**)	-0.176(**)	0.176(**)
	Sig	*0.001*	*0*	*0.001*	*0.514*	*0.729*	*0.11*	*0.706*	*0.438*	*0.403*	*0.151*	*0*	*0*	*0*
AA	Pearson	-.663(**)	-.566(**)	.645(**)	-.612(**)	0.099	-0.052	.389(**)	.428(**)	0.024	111	N/A	N/A	N/A
	Sig.	0	0	0	0	0.304	0.587	0	0	0.806	-0.059	*N/A*	*N/A*	*N/A*
A	Pearson	-.655(**)	-.601(**)	.635(**)	-.469(**)	0.039	0.126	.271(**)	.417(**)	0.008	-0.022	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.685*	*0.189*	*0.004*	*0*	*0.937*	*0.818*	*N/A*	*N/A*	*N/A*
BB	Pearson	.921(**)	-.974(**)	.980(**)	-.402(**)	-0.02	.319(**)	.396(**)	.823(**)	0.089	0.01	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.835*	*0.001*	*0*	*0*	*0.351*	*0.913*	*N/A*	*N/A*	*N/A*
BB	Pearson	-.862(**)	-.960(**)	.863(**)	-.408(**)	0.004	.465(**)	.325(**)	.841(**)	0.086	0.013	N/A	N/A	N/A
	Sig.	*0*	*0*	*0*	*0*	*0.971*	*0*	*0.001*	*0*	*0.38*	*0.894*	*N/A*	*N/A*	*N/A*
B	Pearson	-.566(**)	-.566(**)	-.230(*)	-.403(**)	-0.057	.388(**)	.363(**)	.824(**)	0.065	0.006	N/A	N/A	N/A
	Sig.	*0*	*0*	*0.016*	*0*	*0.552*	*0*	*0*	*0*	*0.498*	*0.954*	*N/A*	*N/A*	*N/A*
IND	Pearson	.420(**)	-.380(**)	.905(**)	-.307(**)	-0.063	.289(**)	.419(**)	.758(**)	0.102	0.028	-.538(**)	-.455(**)	.292(**)
	Sig.	*0*	*0*	*0*	*0.001*	*0.514*	*0.002*	*0*	*0*	*0.286*	*0.774*	*0*	*0*	*0.002*
FIN	Pearson	.464(**)	-.916(**)	.968(**)	-.324(**)	-0.121	.430(**)	.396(**)	.882(**)	0.057	-0.033	-.970(**)	-.494(**)	.484(**)
	Sig.	*0*	*0*	*0*	*0.001*	*0.206*	*0*	*0*	*0*	*0.549*	*0.734*	*0*	*0*	*0*
UTI	Pearson	-.653(**)	-.620(**)	-.448(**)	-.560(**)	0.073	.190(*)	.345(**)	.618(**)	0.055	-0.036	-.881(**)	-.631(**)	.514(**)
	Sig	*0*	*0*	*0*	*0*	*0.444*	*0.046*	*0*	*0*	*0.568*	*0.71*	*0*	*0*	*0*
LT	Pearson	-.260(**)	-.797(**)	.768(**)	-.245(**)	-0.007	0.114	.585(**)	.779(**)	0.106	-0.019	.567(**)	0.148	-0.148
	Sig.	*0.006*	*0*	*0*	*0.01*	*0.945*	*0.234*	*0*	*0*	*0.271*	*0.846*	*0*	*0.123*	*0.123*
MT	Pearson	-.892(**)	-.584(**)	.787(**)	-.349(**)	-0.001	.237(*)	.334(**)	.696(**)	0.087	0.029	.412(**)	.404(**)	-.404(**)
	Sig.	0	0	0	0	0.989	0.012	0	0	0.362	0.766	0	0	0
ST	Pearson	-.685(**)	-.824(**)	.988(**)	-.41(**)	0.088	.298(**)	0.031	.562(**)	0.117	0.133	.472(**)	-.771(**)	.767(**)
	Sig.	*0*	*0*	*0*	*0*	*0.451*	*0.009*	*0.792*	*0*	*0.315*	*0.253*	*0*	*0*	*0*

RS		ln_IS	ln_PF	CPN	MAT	CPI	GDP	Slope	ST_IR	LT_IR	TSE_T	TSE_X	RA	RD
Tot	Pearson	0.959(**)	0.949(**)	-0.994(**)	-0.348(**)	0.342(**)	0.084	-0.410(**)	-0.441(**)	-0.893(**)	-0.074(**)	0.020	0.660(**)	-0.638(**)
	Sig.	0	0	0	0.001	0.001	0.387	0	0	0	0.411	0.885	0	0
IND	Pearson	-.296(**)	0.029	-.569(**)	-.538(**)	.295(**)	-0.09	-.216(*)	-.224(*)	-.482(**)	0.004	0.005	.286(**)	-.197(*)
	Sig.	0.002	0.761	0	0	0.002	0.348	0.023	0.018	0	0.969	0.955	0.002	0.038
FIN	Pearson	-.531(**)	.910(**)	-.982(**)	-.970(**)	.281(**)	0.125	-.452(**)	-.423(**)	-.914(**)	-0.06	0.027	.467(**)	-.425(**)
	Sig.	0	0	0	0	0.003	0.19	0	0	0	0.53	0.777	0	0
UTI	Pearson	.660(**)	.832(**)	.567(**)	-.881(**)	.523(**)	-0.08	-.284(**)	-.294(**)	-.671(**)	-0.075	-0.018	.689(**)	-.581(**)
	Sig	*0*	*0*	*0*	*0*	*0*	*0.402*	*0.003*	*0.002*	*0*	*0.436*	*0.849*	*0*	*0*
LT	Pearson	-0.118	-.901(**)	.817(**)	.567(**)	-.411(**)	-0.049	.597(**)	0.085	.745(**)	0.036	0.051	.323(**)	-.323(**)
	Sig.	*0.219*	*0*	*0*	*0*	*0*	*0.611*	*0*	*0.379*	*0*	*0.712*	*0.595*	*0.001*	*0.001*
MT	Pearson	-.414(**)	.225(*)	.280(**)	.412(**)	-.260(**)	.204(*)	-.303(**)	.218(*)	0.039	0.112	0.067	.528(**)	-.528(**)
	Sig.	0	0.017	0.003	0	0.006	0.032	0.001	0.022	0.686	0.244	0.483	0	0
ST	Pearson	-.964(**)	-.880(**)	.569(**)	.472(**)	-0.111	-0.166	.476(**)	-0.036	.759(**)	0.06	0.073	-0.134	0.129
	Sig.	*0*	*0*	*0*	*0*	*0.339*	*0.152*	*0*	*0.76*	*0*	*0.606*	*0.533*	*0.249*	*0.266*

<u>TABLE 16</u> *(continued)* – Correlation structure of the dependent and independent variables (February 1993 –May 2002)

Panel B (continued) - Factors specific to a bond portfolio

RD		ln_IS	ln_PF	MAT	CPN	CPI	GDP	Slope	ST_IR	LT_IR	TSE_T	TSE_X	RS	RA
Total	**Pearson**	**-0.646(**)**	**-0.651(**)**	**0.623(**)**	**0.177**	**-0.450(**)**	**0.101**	**0.230(*)**	**0.247(**)**	**0.568(**)**	**0.128**	**0.083**	**-0.638(**)**	**-0.853(**)**
	Sig.	*0*	*0*	*0*	*0.106*	*0*	*0.232*	*0.042*	*0.032*	*0*	*0.178*	*0.466*	*0*	*0*
IND	**Pearson**	**-.220(*)**	**-.254(**)**	**.258(**)**	**.292(**)**	**-0.177**	**-0.025**	**-.314(**)**	**.485(**)**	**.272(**)**	**0.066**	**-0.022**	**-.197(*)**	**-.772(**)**
	Sig	*0.021*	*0.007*	*0.006*	*0.002*	*0.064*	*0.797*	*0.001*	*0*	*0.004*	*0.489*	*0.816*	*0.038*	*0*
FIN	**Pearson**	**.244(**)**	**-.398(**)**	**.388(**)**	**.484(**)**	**-.278(**)**	**0.011**	**.611(**)**	**-.195(*)**	**.399(**)**	**0.035**	**0.049**	**-.425(**)**	**-.962(**)**
	Sig.	*0.01*	*0*	*0*	*0*	*0.003*	*0.912*	*0*	*0.04*	*0*	*0.716*	*0.61*	*0*	*0*
UTI	**Pearson**	**-.257(**)**	**-.383(**)**	**-.359(**)**	**.514(**)**	**-.333(**)**	**.228(*)**	**-0.08**	**.245(**)**	**.271(**)**	**0.137**	**0.131**	**-.581(**)**	**-.811(**)**
	Sig	*0.007*	*0*	*0*	*0*	*0*	*0.016*	*0.401*	*0.01*	*0.004*	*0.15*	*0.17*	*0*	*0*
LT	**Pearson**	**-.193(*)**	**.292(**)**	**-.332(**)**	**-0.148**	**-0.07**	**.277(**)**	**-.212(*)**	**-.202(*)**	**-.354(**)**	**0.039**	**0.122**	**-.323(**)**	**-1.0(**)**
	Sig.	*0.043*	*0.002*	*0*	*0.123*	*0.468*	*0.003*	*0.026*	*0.035*	*0*	*0.688*	*0.203*	*0.001*	*0*
MT	**Pearson**	**.427(**)**	**-0.104**	**-.465(**)**	**-.404(**)**	**.333(**)**	**-.228(*)**	**0.08**	**-.245(**)**	**-.271(**)**	**-0.137**	**-0.131**	**-.528(**)**	**-1.0(**)**
	Sig.	*0*	*0.279*	*0*	*0*	*0*	*0.016*	*0.404*	*0.01*	*0.004*	*0.15*	*0.17*	*0*	*0*
ST	**Pearson**	**-.333(**)**	**-.465(**)**	**.718(**)**	**.767(**)**	**-0.144**	**0.058**	**-.232(*)**	**.484(**)**	**.235(*)**	**0.097**	**0.046**	**0.129**	**-.971(**)**
	Sig.	*0.003*	*0*	*0*	*0*	*0.215*	*0.617*	*0.044*	*0*	*0.041*	*0.404*	*0.695*	*0.266*	*0*

RA		ln_IS	ln_PF	MAT	CPN	CPI	GDP	Slope	ST_IR	LT_IR	TSE_T	TSE_X	RS	RD
Total	**Pearson**	**0.643(**)**	**0.646(**)**	**-0.641(**)**	**-0.176(**)**	**0.328(**)**	**-0.140(**)**	**-0.445(**)**	**-0.094(**)**	**-0.621(**)**	**-0.148(**)**	**-0.131(**)**	**0.660(**)**	**-0.853(**)**
	Sig.	*0*	*0*	*0*	*0.108*	*0.002*	*0.17*	*0*	*0.410*	*0*	*0.188*	*0.118*	*0*	*0*
IND	**Pearson**	**0.004**	**0.096**	**-.367(**)**	**-.455(**)**	**.316(**)**	**-0.158**	**0.185**	**-.375(**)**	**-.308(**)**	**-0.128**	**-0.087**	**.286(**)**	**-.772(**)**
	Sig.	0.969	0.314	0	0	0.001	0.098	0.051	0	0.001	0.181	0.362	0.002	0
FIN	**Pearson**	**-.361(**)**	**.419(**)**	**-.418(**)**	**-.494(**)**	**0.164**	**0.006**	**-.636(**)**	**0.174**	**-.458(**)**	**-0.047**	**-0.053**	**.467(**)**	**-.962(**)**
	Sig.	0	0	0	0	0.086	0.954	0	0.067	0	0.621	0.579	0	0
UTI	**Pearson**	**.378(**)**	**.553(**)**	**.536(**)**	**-.631(**)**	**.534(**)**	**-.220(*)**	**-.218(*)**	**-0.099**	**-.390(**)**	**-0.128**	**-0.137**	**.689(**)**	**-.811(**)**
	Sig	*0*	*0*	*0*	*0*	*0*	*0.02*	*0.022*	*0.302*	*0*	*0.18*	*0.153*	*0*	*0*
LT	**Pearson**	**.193(*)**	**-.292(**)**	**.332(**)**	**0.148**	**0.07**	**-.277(**)**	**.212(*)**	**.202(*)**	**.354(**)**	**-0.039**	**-0.122**	**.323(**)**	**-1.0(**)**
	Sig.	*0.043*	*0.002*	*0*	*0.123*	*0.468*	*0.003*	*0.026*	*0.035*	*0*	*0.688*	*0.203*	*0.001*	*0*
MT	**Pearson**	**-.427(**)**	**0.104**	**.465(**)**	**.404(**)**	**-.333(**)**	**.228(*)**	**-0.08**	**.245(**)**	**.271(**)**	**0.137**	**0.131**	**.528(**)**	**-1.0(**)**
	Sig.	*0*	*0.279*	*0*	*0*	*0*	*0.016*	*0.404*	*0.01*	*0.004*	*0.15*	*0.17*	*0*	*0*
ST	**Pearson**	**.349(**)**	**.475(**)**	**-.737(**)**	**-.771(**)**	**.226(*)**	**-0.13**	**.228(*)**	**-.449(**)**	**-.240(*)**	**-0.12**	**-0.086**	**-0.134**	**-.971(**)**
	Sig.	*0.002*	*0*	*0*	*0*	*0.05*	*0.263*	*0.047*	*0*	*0.037*	*0.302*	*0.461*	*0.249*	*0*

TABLE 17 - Full models – OLS regressions (February 1993 – May 2002)

The tables below present the regression estimates of all the full models. VIF (and its reciprocal tolerance) is the variance inflation factor for each predictor and measures multicollinearity. The R-square and F-statistics assess the model appropriateness. The Durbin-Watson statistics assert the presence of positive serial correlation in the residuals.

TOTAL	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-21.30302	8.842846	-2.409068	0.0179	0.021	48.354
ln_PF	0.89198	0.656569	1.358547	0.1774	0.021	47.669
CPN	-3.748621	1.880616	-1.993295	0.049	0.005	199.374
MAT	-0.000625	0.024672	-0.025317	0.9799	0.489	2.044
CPI	0.272182	0.123676	2.200776	0.0301	0.378	2.643
GDP	-0.295981	0.222725	-1.328904	0.187	0.775	1.29
Slope	0.659503	0.339208	1.944241	0.0548	0.08	12.454
ST_IR	-0.378128	0.213402	-1.771905	0.0796	0.055	18.026
LT_IR	0.676909	0.194314	3.483574	0.0007	0.08	12.462
TSE_T	-3.297155	1.469063	-2.244392	0.0271	0.909	1.1
TSE_X	-0.00998	0.014731	-0.677444	0.4997	0.846	1.182
RS	-9.87159	7.849783	-1.257562	0.2116	0.003	326.478
RA	7.798954	5.584049	1.396649	0.1657	0.13	7.722
RD	-3.957646	5.654994	-0.69985	0.4857	0.145	6.908
R-squared	0.722988	Mean dependent var		2.698122		
Adjusted R-squared	0.683007	S.D. dependent var		1.263792		
S.E. of regression	0.711541	Akaike info criterion		2.281302		
Sum squared resid	49.11022	Schwarz criterion		2.645387		
Log likelihood	-112.7529	F-statistic		18.08327		
Durbin-Watson stat	0.874188	Prob(F-statistic)		0		

FINANCIALS	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-1.416509	1.677591	-0.844371	0.4005	0.13	7.685
ln_PF	0.883461	0.249513	3.540739	0.0006	0.029	33.967
CPN	-1.152649	0.956291	-1.205333	0.231	0.006	172.589
MAT	0.127308	0.130923	0.972395	0.3333	0.017	58.938
CPI	-0.16322	0.066689	-2.447492	0.0162	0.449	2.227
GDP	-0.005501	0.129224	-0.042567	0.9661	0.796	1.256
Slope	-0.160868	0.227803	-0.706172	0.4818	0.062	16.203
ST_IR	-0.928741	0.112688	-8.241731	0	0.069	14.445
LT_IR	0.760542	0.107193	7.095099	0	0.091	10.959
TSE_T	-0.676871	0.875014	-0.773555	0.4411	0.89	1.124
TSE_X	0.021591	0.008872	2.43364	0.0168	0.81	1.235
RS	-4.413956	1.599211	-2.760083	0.0069	0.005	196.648
RA	-1.631918	5.528118	-0.295203	0.7685	0.026	38.409
RD	-2.588164	3.484286	-0.74281	0.4594	0.026	38.291
R-squared	0.905653	Mean dependent var		2.554837		
Adjusted R-squared	0.892036	S.D. dependent var		1.275608		
S.E. of regression	0.419138	Akaike info criterion		1.222837		
Sum squared resid	17.04066	Schwarz criterion		1.586922		
Log likelihood	-53.4789	F-statistic		66.50845		
Durbin-Watson stat	1.213767	Prob(F-statistic)		0		

TABLE 17 *(continued)* - Full models – OLS regressions

INDUSTRIALS	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	1.712077	0.108426	15.79023	0	0.087	11.503
ln_PF	-3.183286	0.61561	-5.170941	0	0.298	3.356
CPN	0.343551	0.20795	1.652086	0.1018	0.026	38.208
MAT	-0.064506	0.023169	-2.784205	0.0065	0.066	15.074
CPI	-0.064022	0.024725	-2.589401	0.0111	0.552	1.811
GDP	-0.029381	0.052186	-0.563004	0.5747	0.746	1.341
Slope	0.17188	0.094409	1.820585	0.0718	0.056	17.756
ST_IR	-0.078563	0.056741	-1.384588	0.1694	0.044	22.861
LT_IR	0.046148	0.050237	0.918587	0.3606	0.066	15.144
TSE_T	-0.116967	0.352089	-0.332208	0.7404	0.855	1.169
TSE_X	-0.000116	0.003668	-0.031543	0.9749	0.745	1.342
RS	-0.014241	0.01638	-0.869426	0.3868	0.582	1.717
RD	-4.871711	1.756206	-2.773997	0.0066	0.176	5.685
RA	-3.447139	0.855383	-4.029936	0.0001	0.163	6.129
R-squared	0.982571	Mean dependent var		2.639303		
Adjusted R-squared	0.980056	S.D. dependent var		1.176075		
S.E. of regression	0.16609	Akaike info criterion		-0.6285		
Sum squared resid	2.675843	Schwarz criterion		-0.264415		
Log likelihood	50.196	F-statistic		390.6067		
Durbin-Watson stat	0.517275	Prob(F-statistic)		0		

UTILITIES	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-6.756736	1.825785	-3.700729	0.0004	0.047	21.317
ln_PF	1.406808	0.29351	4.793052	0	0.051	19.593
CPN	0.077125	0.020227	3.81294	0.0002	0.501	1.997
MAT	-0.865911	0.111602	-7.758912	0	0.056	17.893
CPI	-0.58155	0.07083	-8.210511	0	0.45	2.223
GDP	-0.022946	0.138712	-0.165422	0.869	0.782	1.278
Slope	0.786463	0.258175	3.046237	0.003	0.054	18.536
ST_IR	-0.410842	0.122479	-3.354383	0.0011	0.066	15.242
LT_IR	0.510623	0.102548	4.979352	0	0.112	8.925
TSE_T	1.100439	0.921071	1.194738	0.2351	0.903	1.107
TSE_X	0.011456	0.009298	1.232018	0.2209	0.83	1.205
RS	-20.27057	3.705774	-5.469997	0	0.034	29.66
RA	-0.526475	2.614719	-0.20135	0.8408	0.128	7.799
RD	0.091157	2.649674	0.034403	0.9726	0.161	6.23
R-squared	0.913221	Mean dependent var		2.900187		
Adjusted R-squared	0.900696	S.D. dependent var		1.411191		
S.E. of regression	0.444702	Akaike info criterion		1.341245		
Sum squared resid	19.18272	Schwarz criterion		1.70533		
Log likelihood	-60.10975	F-statistic		72.91277		
Durbin-Watson stat	1.205701	Prob(F-statistic)		0		

TABLE 17 *(continued)* - **Full models – OLS regressions**

AA	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	1.549918	1.927056	0.804293	0.4231	0.295	3.393
ln_PF	-0.458418	0.211772	-2.164674	0.0328	0.093	10.726
CPN	-0.336915	0.322852	-1.043556	0.2992	0.042	24.042
MAT	-0.023197	0.024874	-0.932561	0.3533	0.316	3.168
CPI	-0.308029	0.062721	-4.911098	0	0.552	1.812
GDP	0.047823	0.134244	0.35624	0.7224	0.813	1.23
Slope	0.531363	0.214093	2.481926	0.0147	0.076	13.086
ST_IR	-0.514421	0.123461	-4.166682	0.0001	0.063	15.876
LT_IR	0.632091	0.10782	5.862468	0	0.099	10.111
TSE_T	-0.236174	0.900092	-0.262388	0.7936	0.918	1.089
TSE_XS	0.020681	0.008946	2.311807	0.0228	0.87	1.15
R-squared	0.89622	Mean dependent var		2.519108		
Adjusted R-squared	0.884804	S.D. dependent var		1.291415		
S.E. of regression	0.438313	Akaike info criterion		1.289191		
Sum squared resid	19.21185	Schwarz criterion		1.580459		
Log likelihood	-60.19471	F-statistic		78.50675		
Durbin-Watson stat	0.823975	Prob(F-statistic)		0		

A	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-10.22082	2.42448	-4.215677	0.0001	0.063	15.855
ln_PF	0.232562	0.168013	1.384189	0.1694	0.186	5.382
CPN	-0.145105	0.708049	-0.204937	0.838	0.028	35.423
MAT	-0.231834	0.055188	-4.200773	0.0001	0.213	4.692
CPI	-0.370821	0.085708	-4.32657	0	0.383	2.608
GDP	-0.12908	0.152708	-0.845269	0.4	0.803	1.245
Slope	0.116938	0.261018	0.448006	0.6551	0.065	15.29
ST_IR	-0.683575	0.141646	-4.825957	0	0.061	16.464
LT_IR	0.564516	0.107044	5.273683	0	0.128	7.79
TSE_T	-0.092557	1.016729	-0.091034	0.9276	0.924	1.082
TSE_XS	0.011593	0.010137	1.14364	0.2555	0.87	1.149
R-squared	0.878963	Mean dependent var		2.728966		
Adjusted R-2	0.865649	S.D. dependent var		1.354656		
Regression S.E.	0.496535	Akaike info criterion		1.538631		
Sum squared resid	24.65469	Schwarz criterion		1.829899		
Log likelihood	-74.16333	F-statistic		66.01755		
Durbin-Watson stat	0.979639	Prob(F-statistic)		0		

TABLE 17 ***(continued)*** **- Full models – OLS regressions**

BBB	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-22.02162	5.005018	-4.399909	0	0.071	14.063
ln_PF	3.447285	1.559242	2.210872	0.0293	0.004	256.178
CPN	5.892264	2.640973	2.231096	0.0279	0.002	434.119
MAT	0.086016	0.154042	0.558395	0.5778	0.01	99.017
CPI	-0.114082	0.058124	-1.962752	0.0525	0.561	1.781
GDP	0.030517	0.126184	0.241843	0.8094	0.794	1.26
Slope	0.437484	0.214852	2.036209	0.0444	0.066	15.169
ST_IR	-0.620891	0.110089	-5.639873	0	0.069	14.549
LT_IR	0.636211	0.095653	6.651249	0	0.109	9.193
TSE_T	1.025702	0.850008	1.206697	0.2304	0.893	1.12
TSE_XS	0.025355	0.008455	2.998731	0.0034	0.844	1.184
R-squared	0.916893	Mean dependent var		2.918518		
Adjusted R-squared	0.907751	S.D. dependent var		1.343223		
S.E. of regression	0.40797	Akaike info criterion		1.14571		
Sum squared resid	16.64394	Schwarz criterion		1.436978		
Log likelihood	-52.15977	F-statistic		100.2972		
Durbin-Watson stat	0.809223	Prob(F-statistic)		0		

BB	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.078898	9.781393	0.008066	0.9936	0.026	38.525
ln_PF	0.965333	1.067901	0.903954	0.3683	0.013	74.234
CPN	2.886993	0.963759	2.995554	0.0035	0.056	17.788
MAT	-0.059163	0.170282	-0.347442	0.729	0.046	21.594
CPI	0.277964	0.164483	1.689926	0.0943	0.389	2.574
GDP	-0.072405	0.311771	-0.232239	0.8169	0.779	1.284
Slope	0.96885	0.435286	2.225779	0.0284	0.096	10.417
ST_IR	-0.221427	0.242441	-0.913325	0.3634	0.093	10.749
LT_IR	0.143541	0.269928	0.531776	0.5961	0.076	13.179
TSE_T	-1.75937	2.004374	-0.877765	0.3823	0.896	1.116
TSE_XS	-0.004235	0.020399	-0.207608	0.836	0.818	1.222
R-squared	0.532935	Mean dependent var		3.047743		
Adjusted R-squared	0.478853	S.D. dependent var		1.333283		
S.E. of regression	0.962504	Akaike info criterion		2.866789		
Sum squared resid	88.00925	Schwarz criterion		3.166546		
Log likelihood	-141.3732	F-statistic		9.854328		
Durbin-Watson stat	0.469379	Prob(F-statistic)		0		

TABLE 17 *(continued)* - Full models – OLS regressions

B full model 1	Coefficien t	Std. Error	t-Statistic	Prob.	Toleranc e	VIF
ln_IS	1.661301	0.30943 3	5.368854	0	0.276	3.622
CPN	-0.009732	0.01895 4	-0.513449	0.6088	0.49	2.039
MAT	-0.130588	0.05100 6	-2.560226	0.012	0.158	6.325
CPI	-0.12708	0.06986 7	-1.818887	0.0719	0.642	1.556
GDP	0.234679	0.16305 6	1.439255	0.1532	0.796	1.256
Slope	0.202075	0.19591 3	1.03145	0.3048	0.132	7.597
ST_IR	-0.815977	0.10943 5	-7.456238	0	0.119	8.431
LT_IR	1.054775	0.11106 2	9.497204	0	0.135	7.393
TSE_T	-0.527769	1.10007	-0.479759	0.6324	0.887	1.127
TSE_XS	0.015183	0.01078 9	1.407265	0.1624	0.863	1.158
R-squared	0.889756	Mean dependent var		2.868186		
Adjusted R-squared	0.878732	S.D. dependent var		1.511877		
S.E. of regression	0.52649	Akaike info criterion		1.648668		
Sum squared resid	27.71912	Schwarz criterion		1.91718		
Log likelihood	-80.50105	F-statistic		80.70806		
Durbin-Watson stat	1.011401	Prob(F-statistic)		0		

B full model 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	0.915342	0.170491	5.368854	0	0.276	3.622
CPN	-0.009732	0.018954	-0.513449	0.6088	0.49	2.039
MAT	-0.130588	0.051006	-2.560226	0.012	0.158	6.325
CPI	-0.12708	0.069867	-1.818887	0.0719	0.642	1.556
GDP	0.234679	0.163056	1.439255	0.1532	0.796	1.256
Slope	0.202075	0.195913	1.03145	0.3048	0.132	7.597
ST_IR	-0.815977	0.109435	-7.456238	0	0.119	8.431
LT_IR	1.054775	0.111062	9.497204	0	0.135	7.393
TSE_T	-0.527769	1.10007	-0.479759	0.6324	0.887	1.127
TSE_XS	0.015183	0.010789	1.407265	0.1624	0.863	1.158
R-squared	0.889756	Mean dependent var		2.868186		
Adjusted R-squared	0.878732	S.D. dependent var		1.511877		
S.E. of regression	0.52649	Akaike info criterion		1.648668		
Sum squared resid	27.71912	Schwarz criterion		1.91718		
Log likelihood	-80.50105	F-statistic		80.70806		
Durbin-Watson stat	1.011401	Prob(F-statistic)		0		

<u>TABLE 17</u> ***(continued)*** **- Full models – OLS regressions**

LT full model 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.097478	0.717697	0.13582	0.8922	0.326	3.063
ln_PF	-0.426319	0.41337	-1.031326	0.305	0.028	36.201
CPN	-0.619537	0.36393	-1.70235	0.0919	0.064	15.672
MAT	-0.039044	0.133422	-0.292632	0.7704	0.043	23.435
CPI	-0.023255	0.057284	-0.405964	0.6857	0.343	2.915
GDP	-0.013471	0.098205	-0.137174	0.8912	0.773	1.294
Slope	0.295572	0.138297	2.137221	0.0351	0.094	10.645
ST_IR	-0.495074	0.087207	-5.676974	0	0.065	15.384
LT_IR	0.547187	0.07607	7.193179	0	0.102	9.828
TSE_T	0.014385	0.651859	0.022068	0.9824	0.89	1.124
TSE_X	0.011491	0.006447	1.782337	0.0778	0.855	1.17
RS	0.524552	1.222626	0.429037	0.6688	0.048	21.032
RA	-2.409321	1.642077	-1.46724	0.1455	0.452	2.212

R-squared	0.908923	Mean dependent var	2.148963
Adjusted R-squared	0.896717	S.D. dependent var	0.97382
S.E. of regression	0.312963	Akaike info criterion	0.631973
Sum squared resid	9.500776	Schwarz criterion	0.973715
Log likelihood	-21.07448	F-statistic	74.46398
Durbin-Watson stat	1.251904	Prob(F-statistic)	0

LT full model 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.09748	0.717698	0.135823	0.8922	0.326	3.063
ln_PF	-0.426328	0.413369	-1.031349	0.3049	0.028	36.201
CPN	-0.619531	0.36393	-1.702336	0.0919	0.064	15.672
MAT	-0.039047	0.133422	-0.292661	0.7704	0.043	23.435
CPI	-0.023255	0.057284	-0.405958	0.6857	0.343	2.915
GDP	-0.013471	0.098205	-0.137174	0.8912	0.773	1.294
Slope	0.295574	0.138297	2.137244	0.0351	0.094	10.645
ST_IR	-0.495073	0.087207	-5.676966	0	0.065	15.384
LT_IR	0.547187	0.07607	7.193174	0	0.102	9.828
TSE_T	0.014388	0.651859	0.022073	0.9824	0.89	1.124
TSE_X	0.011491	0.006447	1.782337	0.0778	0.855	1.17
RS	0.524525	1.222622	0.429016	0.6689	0.048	21.032
RD	2.408955	1.641851	1.467219	0.1456	0.452	2.212

R-squared	0.908923	Mean dependent var	2.148963
Adjusted R-squared	0.896717	S.D. dependent var	0.97382
S.E. of regression	0.312964	Akaike info criterion	0.631973
Sum squared resid	9.500782	Schwarz criterion	0.973716
Log likelihood	-21.07451	F-statistic	74.46392
Durbin-Watson stat	1.251903	Prob(F-statistic)	0

TABLE 17*(continued)* - Full models – OLS regressions

MT Full 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-0.400969	4.525131	-0.088609	0.9296	0.008	122.462
ln_PF	-1.37743	1.186372	-1.161044	0.2484	0.013	78.521
CPN	1.600079	1.579335	1.013134	0.3135	0.005	206.14
MAT	-0.708799	0.343219	-2.06515	0.0415	0.016	62.81
CPI	-0.201202	0.064759	-3.106947	0.0025	0.542	1.844
GDP	0.011897	0.140148	0.084892	0.9325	0.77	1.299
Slope	0.35918	0.249236	1.441125	0.1527	0.059	17.047
ST_IR	-0.576373	0.125795	-4.581839	0	0.063	15.818
LT_IR	0.492947	0.123369	3.995698	0.0001	0.078	12.764
TSE_T	0.61364	0.931344	0.658876	0.5115	0.892	1.122
TSE_X	0.021221	0.009347	2.270274	0.0254	0.828	1.207
RS	1.159187	2.114628	0.548175	0.5848	0.026	37.92
RA	-0.018882	0.062948	-0.299969	0.7648	0.419	2.388
R-squared	0.899741	Mean dependent var		2.818116		
Adjusted R-squared	0.886441	S.D. dependent var		1.325326		
S.E. of regression	0.446615	Akaike info criterion		1.34223		
Sum squared resid	19.54759	Schwarz criterion		1.682043		
Log likelihood	-61.16489	F-statistic		67.65118		
Durbin-Watson stat	0.833178	Prob(F-statistic)		0		

MT Full 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-0.400969	4.525131	-0.088609	0.9296	0.008	122.462
ln_PF	-1.37743	1.186372	-1.161044	0.2484	0.013	78.521
CPN	1.600079	1.579335	1.013134	0.3135	0.005	206.14
MAT	-0.708799	0.343219	-2.06515	0.0415	0.016	62.81
CPI	-0.201202	0.064759	-3.106947	0.0025	0.542	1.844
GDP	0.011897	0.140148	0.084892	0.9325	0.77	1.299
Slope	0.35918	0.249236	1.441125	0.1527	0.059	17.047
ST_IR	-0.576373	0.125795	-4.581839	0	0.063	15.818
LT_IR	0.492947	0.123369	3.995698	0.0001	0.078	12.764
TSE_T	0.61364	0.931344	0.658876	0.5115	0.892	1.122
TSE_X	0.021221	0.009347	2.270274	0.0254	0.828	1.207
RS	1.159187	2.114628	0.548175	0.5848	0.026	37.92
RD	0.018826	0.062761	0.299969	0.7648	0.419	2.388
R-squared	0.899741	Mean dependent var		2.818116		
Adjusted R-squared	0.886441	S.D. dependent var		1.325326		
S.E. of regression	0.446615	Akaike info criterion		1.34223		
Sum squared resid	19.54759	Schwarz criterion		1.682043		
Log likelihood	-61.16489	F-statistic		67.65118		
Durbin-Watson stat	0.833178	Prob(F-statistic)		0		

<u>TABLE 17</u>*(continued)* - Full models – OLS regressions

ST Full 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	-0.738245	0.264806	-2.787874	0.007	0.003	291.651
CPN	1.948793	1.81594	1.07316	0.2873	0.004	237.256
MAT	-1.303279	0.416112	-3.132036	0.0026	0.003	286.579
CPI	-0.116438	0.051112	-2.278081	0.0261	0.384	2.601
GDP	0.056331	0.078037	0.721849	0.4731	0.776	1.289
Slope	0.198311	0.197982	1.001665	0.3203	0.026	37.941
ST_IR	-1.054178	0.12251	-8.604812	0	0.039	25.719
LT_IR	0.60845	0.094915	6.410446	0	0.14	7.157
TSE_T	0.096226	0.518095	0.185731	0.8533	0.827	1.21
TSE_X	0.005725	0.005122	1.117855	0.2679	0.802	1.246
RS	-1.558564	0.482189	-3.23227	0.002	0.009	105.514
RA	-2.489163	5.433635	-0.458103	0.6485	0.017	59.1
RD	11.41616	6.747031	1.692028	0.0956	0.016	61.222
R-squared	0.976403	Mean dependent var		2.378933		
Adjusted R-squared	0.971534	S.D. dependent var		1.312871		
S.E. of regression	0.221505	Akaike info criterion		-0.013775		
Sum squared resid	3.091069	Schwarz criterion		0.412372		
Log likelihood	14.53034	F-statistic		200.5281		
Durbin-Watson stat	1.739691	Prob(F-statistic)		0		

ST Full 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	17.35792	6.226222	2.787874	0.007	0	3538.3
CPN	7.533502	2.738745	2.750713	0.0078	0.002	540.374
MAT	-0.56668	0.367729	-1.541027	0.1283	0.004	224.007
CPI	-0.116438	0.051112	-2.278081	0.0261	0.384	2.601
GDP	0.056331	0.078037	0.721849	0.4731	0.776	1.289
Slope	0.198311	0.197982	1.001665	0.3203	0.026	37.941
ST_IR	-1.054178	0.12251	-8.604812	0	0.039	25.719
LT_IR	0.60845	0.094915	6.410446	0	0.14	7.157
TSE_T	0.096226	0.518095	0.185731	0.8533	0.827	1.21
TSE_X	0.005725	0.005122	1.117855	0.2679	0.802	1.246
RS	5.971417	2.238686	2.667376	0.0097	0	2274.279
RA	-19.06456	6.106424	-3.12205	0.0027	0.013	74.802
RD	-8.655964	8.259259	-1.048031	0.2986	0.011	92.24
R-squared	0.976403	Mean dependent var		2.378933		
Adjusted R-squared	0.971534	S.D. dependent var		1.312871		
S.E. of regression	0.221505	Akaike info criterion		-0.013775		
Sum squared resid	3.091069	Schwarz criterion		0.412372		
Log likelihood	14.53034	F-statistic		200.5281		
Durbin-Watson stat	1.739691	Prob(F-statistic)		0		

TABLE 18 – Summaries of Full and Reduced Models

The following tables describe the estimated reduced models for each portfolio. ΔR^2 denotes the change in R-square from dropping one or several predictors from the full model. $F(\Delta R^2)$ assesses the statistical significance of the change in R^2. SE is the standard error of the model. AIC is the Akaike information criterion and SW is the Schwarz criterion. DW is the Durbin-Watson statistics.

Total	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.725	0.685	18.12			0.7102	2	7	2.281	2.645	0.874
Model 1	0.598	0.566	18.93	-0.128	7.54	0.8363	0	0	2.549	2.767	0.567
Model 2	0.561	0.526	16.27	-0.163	9.61	0.8739	0	0	2.636	2.854	0.647
Model 3	0.63	0.597	19.01	-0.096	6.7	0.8063	0	0	2.494	2.737	0.657
Model 4	0.627	0.598	21.42	-0.099	5.75	0.8053	0	0	2.473	2.692	0.571
Model 5	0.653	0.626	24.02	-0.072	4.21	0.7763	0	0	2.405	2.624	0.666

All Total reduced models include the maturity, changes in the CPI and real GDP, as well as TSE total and excess returns.
Model 1 includes the slope of interest rates, the rating score and rating drift ratio. Model 2 includes the coupon rate, the short-term interest rate level and the rating activity ratio. Model 3 includes the portfolio size logarithm, the slope and short-term level of interest rates, and the rating activity ratio. Model 4 includes slope and long-term level of interest rates, and the rating drift ratio Model 5 includes the issue size logarithm, the interest rate slope and the rating drift ratio.

AA	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.896	0.885	77.75			0.4403	0	5	1.289	1.580	0.824
Model 1	0.856	0.843	66.56	-0.041	19.34	0.5282	0	0	1.583	1.825	0.640
Model 2	0.811	0.797	54.88	-0.085	26.97	0.5116	0	0	1.833	2.052	0.518

Both AA reduced models include the maturity, changes in the CPI and real GDP, as well as TSE total and excess returns. Model 1 excludes the coupon rate and the short-term interest rate level. Model 2 excludes the portfolio size logarithm, the slope and long-term level of interest rates

TABLE 18 *(continued)*– **Summaries of Full and Reduced Models**

A	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.899	0.888	810.50			.4520	2	4	1.539	1.830	0.980
Model 1	0.823	0.809	59.37	-0.076	25.02	.5905	0	0	1.989	2.207	0.554
Model 2	0.898	0.890	112.27	-0.001	0.468	.4485	0	0	1.507	1.726	0.966

All A reduced models include the maturity. Model 1 excludes slope, coupon rate, and portfolio size logarithm. Model 2 excludes issue size logarithm, the long and short-term levels of interest rates.

BBB	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.917	0.908	99.55			0.4095	1	6	1.146	1.437	0.809
Model1	0.883	0.875	111.10	-0.034**	10.16	0.4769	0	0	1.424	1.618	0.756
Model2	0.871	0.863	99.61	-0.046**	13.67	0.5002	0	0	1.512	1.706	0.506
Model3	0.844	0.833	79.48	-0.073**	21.88	.05511	0	0	1.707	1.901	0.414
Model4	0.883	0.875	111.24	-0.034**	10.12	0.4766	0	0	1.4123	1.617	0.745

Model 1 excludes the issue size logarithm, the coupon rate, maturity, the interest rates slope. Model 2 excludes the portfolio size logarithm, the coupon rate, maturity and the short=term level of interest rates. Model 3 excludes the issue and portfolio size logarithms, maturity, and the slope of interest rates Model 4 excludes the issue and portfolio size logarithms, the coupon rate, short-term interest rates level

BB	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.532	0.478	9.84			0.9630	1	6	2.867	3.167	0.469
Model1	0.446	0.413	13.43	-0.086	3.51	1.022	0	0	2.942	3.117	0.423
Model2	0.450	0.417	13.66	-0.082	3.33	1.018	0	0	2.937	3.112	0.389
Model3	0.470	0.32	12.52	-0.063	3.19	1.002	0	0	2.920	3.119	0.394
Model4	0.476	0.445	15.15	-0.056	2.29	0.9935	0	0	2.888	3.063	0.450

All BB reduced models include the coupon rate. Model 1 includes the issue size logarithm and the short-term interest rate level. Model 2 allows the portfolio size logarithm and the slope of interest rates in. Model 3 encompasses maturity, the slope and long-term level of interest rates. Model 4 includes the coupon rate and the short-term level of interest rates.

TABLE 18 ***(continued)*** **– Summaries of Full and Reduced Models**

B	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.890	0.879	80.38			0.527	6	0	1.649	1.917	1.011
Model 1	0.572	0.538	16.88	-0.318	143.68	1.032	0	0	2.969	3.189	0.528
Model 2	0.791	0.774	47.77	-0.099	44.86	0.7212	0	0	2.256	2.476	0.620

Two versions of B full model exist including alternatively the issue or the portfolio size logarithm. All the reduced models include the coupon rate. Model 1 excludes the portfolio size logarithm, interest rates slope and short-term level. Model 2 excludes the issue size logarithm, the maturity and the long-term interest rate level. Model 3 excludes maturity and short-term interest rate level.

Financials	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.815	.788	30.2			.6355	2	7	1.223	1.587	1.214
Model 1	0.719	.697	32.6	-0.096	8.31	.7599	0	0	1.688	1.980	0.676
Model 2	0.797	.781	50.1	-0.018	1.53	.6454	0	0	1.810	2.077	0.595
Model 3	0.711	.689	34.4	-0.104	8.95	.7699	0	0	1.745	1.855	0.781
Model 4	0.744	.723	36.9	-0.071	6.18	.7258	0	0	1.825	2.001	0.602

Model 1 includes the issue size logarithm, the coupon rate, the short-term interest rate level and the rating drift ratio. Model 2 includes the portfolio size logarithm, the short and long-term levels of interest rates, the rating activity ratio. Model 3 includes the issue size logarithm, the maturity, the slope of interest rates, the rating drift ratio. Model 4 includes the issue size logarithm, the short-term level of interes rates and the rating score and activity ratio.

Industrials	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	.983	.981	399.6			.1642	2	5	-0.629	-0.264	0.517
Model 1	.978	.975	379.3	-0.005	10.02	.1853	0	0	-0.445	-0.154	0.407
Model 2	.889	.877	79.78	-0.095	134.2	.4135	0	0	1.182	1.449	0.472
Model 3	.928	.920	115.5	-0.055	105.1	. 3397	0	0	0.804	1.095	0.824

All Industrials reduced models include the portfolio size logarithm the rating score, and the rating drift and activity ratios.. Model 1 includes the logarithm of the issue size, the maturity, the short-term level of interest rates. Model 2 includes the coupon rate, the slope of interest rates. Model 3 includes the maturity, the slope and long-term levels of interest rates.

TABLE 18 *(continued)*– **Summaries of Full and Reduced Models**

Utilities	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.917	0.905	76.18			0.436	3	6	1.341	1.705	1.206
Model 1	0.840	0.824	52.66	-0.077	22.39	0.594	0	0	1.890	2.157	0.750
Model 2	0.817	0.800	49.99	-0.101	23.43	0.633	0	0	2.005	2.248	0.515

All the reduced models include the coupon rate. Model 1 includes the maturity, slope and long-term level of interest rates, the rating score and rating activity ratio. Model 2 includes the coupon rate, the slope and long-term level of interest rates, the rating score and the rating activity ratio.

LT	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.909	0.897	73.83			0.314	1	6	0.632	0.974	1.252
Model 1	0.834	0.817	49.82	-0.075	26.39	0.418	0	0	1.177	1.445	0.818
Model 2	0.846	0.832	60.85	-0.063	16.76	0.401	0	0	1.086	1.330	0.866
Model 3	0.799	0.789	50.74	-0.110	23.32	0.456	0	0	1.335	1.555	0.751

Two versions of the full model exist including alternatively the rating drift or rating activity ratio. All the reduced models include the issue size logarithm. Model 1 includes the maturity, slope and long-term level of interest rates, the rating score and rating activity ratio. Model 2 includes the portfolio size logarithm, the slope and short-term level of interest rates, the rating activity. Model 3 includes the coupon, the interest rate slope, the rating drift and activity ratios.

MT	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.901	0.887	67.70			0.447	0	8	1.642	1.682	0.833
Model 1	0.870	0.858	74.79	-0.031	76.62	0.502	0	0	1.545	1.787	0.824
Model 2	0.838	0.824	58.26	-0.062	15.21	0.558	0	0	1.761	2.004	0.452
Model 3	0.883	0.873	84.66	-0.018	4.34	0.475	0	0	1.439	1.682	0.774

Two versions of the full model exist including alternatively the rating drift or rating activity ratio. Model 1 includes the portfolio size logarithm, maturity, the short and long-term levels of interest rates, and the rating activity ratio. Model 2 encompasses the issue size logarithm, the interest rates slope and long-term level, the rating score and activity ratio. Model 3 includes the coupon rate, the short and long-term levels of interest rates, the rating score and drift ratio.

TABLE 18 ***(continued)*****– Summaries of Full and Reduced Models**

ST	R^2	AdjR2	F	ΔR^2	F(DR2)	SE	VIF>5	VIF>10	AIC	SW	DW
Full model	0.978	0.973	209.32			0.217	1	8	-0.014	0.412	1.740
Model 1	0.962	0.958	214.80	-0.015	8.49	0.271	0	0	0.347	0.621	1.172
Model 2	0.932	0.924	114.25	-0.046	25.62	0.365	0	0	0.974	1.248	0.700
Model 3	0.927	0.918	105.61	-0.051	28.40	0.379	0	0	1.053	1.326	0.661
Model 4	0.953	0.948	171.26	-0.024	13.52	0.302	0	0	0.571	0.845	0.928

Two versions of the ST full model exist including alternatively the issue or the portfolio size logarithm. All the reduced models include changes in the CPI and real GDP, as well as TSE total and excess returns. Model 1 includes the portfolio size logarithm, the short and long-term interest rate levels, as well as the rating drift ratio. Model 2 examines the issue size logarithm, the slope and long-term level of interest rates, and the rating activity ratio. Model 3 includes the issue size logarithm, maturity, the slope and long-term level of interest rates. Model 4 includes the coupon rate, the short and long-term levels of interest rates, and the rating score.

TABLE 19 – Final estimation results for Reduced Models (February 1993 – May 2002)

The following tables provide a complete model summary and coefficient estimates for each reduced model.

TOTAL 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
MAT	0.014397	0.017094	0.842229	0.402	0.807	1.239
CPI	-0.11392	0.126719	-0.89903	0.3711	0.686	1.459
GDP	0.000849	0.099914	0.008495	0.9932	0.846	1.182
Slope	1.167749	0.214319	5.448661	0	0.771	1.298
TSE_T	-0.59879	0.672896	-0.88986	0.376	0.93	1.075
TSE_X	0.001609	0.007448	0.216038	0.8295	0.874	1.144
RS	-0.07412	1.682809	-0.04404	0.965	0.431	2.321
RD	-7.38434	4.14361	-1.7821	0.0782	0.511	1.957
AR(1)	0.704073	0.136454	5.159794	0		
AR(2)	0.21108	0.158179	1.33444	0.1855		
AR(3)	0.102147	0.155417	0.657242	0.5128		
AR(4)	-0.24103	0.169949	-1.41823	0.1597		
AR(5)	0.522536	0.17437	2.996712	0.0036		
AR(6)	-0.76385	0.216672	-3.52539	0.0007		
AR(7)	-0.06622	0.279888	-0.23658	0.8135		

R-squared	0.865667	Mean dependent var	2.629319
Adjusted R-squared	0.840962	S.D. dependent var	1.280189
S.E. of regression	0.510534	Akaike info criterion	1.64172
Sum squared resid	22.67609	Schwarz criterion	2.073977
Log likelihood	-68.3695	F-statistic	35.04023
Durbin-Watson stat	1.94313	Prob(F-statistic)	0

TOTAL 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
CPN	-1.27011	0.734577	-1.72903	0.0874	0.319	3.132
MAT	0.022804	0.015511	1.470148	0.1451	0.812	1.231
CPI	-0.15658	0.12001	-1.30469	0.1954	0.701	1.427
GDP	-0.07502	0.095516	-0.78539	0.4344	0.814	1.228
ST_IR	-0.57088	0.097097	-5.87946	0	0.623	1.606
TSE_T	-1.09997	0.625285	-1.75916	0.0821	0.933	1.072
TSE_X	-0.00035	0.006914	-0.05055	0.9598	0.873	1.145
RA	7.447497	3.469233	2.146727	0.0346	0.495	2.022
AR(1)	0.761039	0.132682	5.735802	0		
AR(2)	0.224659	0.169084	1.328682	0.1874		
AR(3)	0.178621	0.163953	1.089459	0.279		
AR(4)	-0.17141	0.175996	-0.97396	0.3328		
AR(5)	0.56902	0.183069	3.108219	0.0025		
AR(6)	-0.9245	0.215944	-4.28121	0		
AR(7)	-0.07518	0.276348	-0.27206	0.7862		

R-squared	0.86113	Mean dependent var	2.629319
Adjusted R-squared	0.835591	S.D. dependent var	1.280189
S.E. of regression	0.519083	Akaike info criterion	1.674936
Sum squared resid	23.44194	Schwarz criterion	2.107192
Log likelihood	-70.0967	F-statistic	33.71782
Durbin-Watson stat	1.922964	Prob(F-statistic)	0

<u>TABLE 19</u> ***(continued)*- Final estimation results for Reduced Models**

TOTAL 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	0.176704	0.484799	0.364489	0.7164	0.234	4.265
MAT	0.017382	0.016945	1.025773	0.3079	0.78	1.282
CPI	-0.12578	0.117221	-1.07299	0.2863	0.729	1.371
GDP	0.093336	0.094	0.992929	0.3235	0.802	1.246
Slope	0.797837	0.29544	2.700504	0.0083	0.235	4.251
ST_IR	-0.26464	0.134292	-1.97064	0.052	0.251	3.991
TSE_T	-0.94527	0.605257	-1.56177	0.122	0.927	1.079
TSE_X	8.09E-05	0.00667	0.012127	0.9904	0.874	1.145
RA	5.00583	3.296761	1.518408	0.1326	0.495	2.019
AR(1)	0.735261	0.132611	5.54449	0		
AR(2)	0.212876	0.160916	1.322905	0.1894		
AR(3)	0.200711	0.157626	1.273332	0.2063		
AR(4)	-0.29813	0.175978	-1.69412	0.0939		
AR(5)	0.585252	0.178764	3.273877	0.0015		
AR(6)	-0.75494	0.232608	-3.24555	0.0017		
AR(7)	-0.36304	0.299252	-1.21316	0.2284		
R-squared		0.86878		Mean dependent var		2.629319
Adjusted R-squared		0.842841		S.D. dependent var		1.280189
S.E. of regression		0.507509		Akaike info criterion		1.637507
Sum squared resid		22.15065		Schwarz criterion		2.09519
Log likelihood		-67.1504		F-statistic		33.49328
Durbin-Watson stat		1.940895		Prob(F-statistic)		0

TOTAL 4	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
MAT	0.013226	0.015122	0.874589	0.3842	0.91	1.099
CPI	-0.04885	0.124001	-0.39393	0.6946	0.7	1.428
GDP	-0.03602	0.099276	-0.36284	0.7176	0.86	1.163
Slope	1.186469	0.194584	6.097454	0	0.798	1.253
LT_IR	0.167988	0.127547	1.317062	0.1913	0.583	1.716
TSE_T	-0.484	0.691775	-0.69964	0.486	0.93	1.075
TSE_X	0.004817	0.00798	0.603664	0.5476	0.869	1.151
RD	-8.76243	4.110305	-2.13182	0.0358	0.546	1.832
AR(1)	0.696721	0.136994	5.08577	0		
AR(2)	0.145408	0.162477	0.894948	0.3733		
AR(3)	0.115321	0.153552	0.75102	0.4547		
AR(4)	-0.24021	0.17062	-1.40785	0.1627		
AR(5)	0.564078	0.175333	3.217173	0.0018		
AR(6)	-0.76435	0.213336	-3.58284	0.0006		
AR(7)	-0.04425	0.277976	-0.1592	0.8739		
R-squared		0.867404		Mean dependent var		2.629319
Adjusted R-squared		0.843018		S.D. dependent var		1.280189
S.E. of regression		0.507222		Akaike info criterion		1.628706
Sum squared resid		22.38289		Schwarz criterion		2.060962
Log likelihood		-67.6927		F-statistic		35.57046
Durbin-Watson stat		1.929275		Prob(F-statistic)		0

TABLE 19 ***(continued)*** **– Final estimation results for Reduced Models**

TOTAL 5	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-1.31887	4.209099	-0.31334	0.7548	0.428	2.336
MAT	0.012872	0.016158	0.79664	0.4278	0.831	1.203
CPI	-0.10304	0.125912	-0.81838	0.4154	0.672	1.487
GDP	-0.00079	0.100204	-0.00789	0.9937	0.856	1.168
Slope	1.156013	0.218154	5.299074	0	0.758	1.319
TSE_T	-0.59461	0.674928	-0.881	0.3807	0.93	1.075
TSE_X	0.001859	0.007507	0.247651	0.805	0.882	1.134
RD	-7.76319	4.217488	-1.84071	0.0691	0.518	1.932
AR(1)	0.695664	0.13691	5.08118	0		
AR(2)	0.207662	0.158317	1.311684	0.1931		
AR(3)	0.100707	0.154664	0.651133	0.5167		
AR(4)	-0.23576	0.169914	-1.38751	0.1688		
AR(5)	0.522602	0.174156	3.000776	0.0035		
AR(6)	-0.75863	0.2152	-3.52522	0.0007		
AR(7)	-0.07011	0.278042	-0.25215	0.8015		
R-squared		0.865773		Mean dependent var		2.629319
Adjusted R-squared		0.841087		S.D. dependent var		1.280189
S.E. of regression		0.510333		Akaike info criterion		1.640932
Sum squared resid		22.65823		Schwarz criterion		2.073189
Log likelihood		-68.3285		F-statistic		35.07214
Durbin-Watson stat		1.939439		Prob(F-statistic)		0

FIN 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	1.476587	2.062007	0.716092	0.4756	0.577	1.732
CNP	-0.23797	0.573719	-0.41479	0.6792	0.336	2.977
CPI	-0.14833	0.093588	-1.58498	0.1162	0.76	1.315
GDP	-0.04396	0.070732	-0.62155	0.5357	0.85	1.177
ST_IR	-0.39851	0.094129	-4.23364	0.0001	0.496	2.017
TSE_T	-0.37304	0.604949	-0.61665	0.5389	0.919	1.089
TSE_X	0.00891	0.006316	1.410799	0.1614	0.876	1.142
RD	0.464669	1.140894	0.407285	0.6847	0.604	1.657
AR(1)	0.947334	0.102303	9.260115	0		
AR(2)	0.003148	0.101765	0.030936	0.9754		
R-squared		0.931008		Mean dependent var		2.546085
Adjusted R-squared		0.924039		S.D. dependent var		1.285228
S.E. of regression		0.354221		Akaike info criterion		0.856848
Sum squared resid		12.42177		Schwarz criterion		1.126896
Log likelihood		-36.1266		F-statistic		133.5955
Durbin-Watson stat		2.000797		Prob(F-statistic)		0

FIN 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	0.038838	0.165483	0.234697	0.8149	0.312	3.206
CPI	-0.14175	0.094319	-1.50291	0.136	0.772	1.296
GDP	-0.04406	0.071122	-0.61956	0.537	0.849	1.178
ST_IR	-0.41393	0.0936	-4.42233	0	0.499	2.005
LT_IR	0.128118	0.136481	0.938727	0.3502	0.218	4.588
TSE_T	-0.41502	0.607724	-0.68291	0.4963	0.934	1.07
TSE_X	0.010221	0.006508	1.570593	0.1195	0.885	1.13
RA	-1.08548	1.776914	-0.61088	0.5427	0.63	1.588
AR(1)	0.912851	0.101431	8.999695	0		
AR(2)	0.025127	0.102522	0.245088	0.8069		
R-squared		0.931241		Mean dependent var		2.546085
Adjusted R-squared		0.924296		S.D. dependent var		1.285228
S.E. of regression		0.353623		Akaike info criterion		0.853467
Sum squared resid		12.37985		Schwarz criterion		1.123515
Log likelihood		-35.9407		F-statistic		134.0814
Durbin-Watson stat		2.001147		Prob(F-statistic)		0

TABLE 19 *(continued)*– Final estimation results for Reduced Models

FIN 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.884501	1.655687	0.53422	0.5944	0.698	1.432
MAT	0.033473	0.09183	0.364512	0.7163	0.546	1.831
CPI	-0.19618	0.097483	-2.01246	0.0469	0.765	1.308
GDP	0.014493	0.070167	0.206546	0.8368	0.84	1.19
Slope	0.74631	0.17818	4.188524	0.0001	0.539	1.857
TSE_T	0.09989	0.62422	0.160024	0.8732	0.93	1.075
TSE_X	0.01035	0.0065	1.592273	0.1145	0.887	1.127
RD	0.491006	1.255887	0.390963	0.6967	0.515	1.942
AR(1)	0.965673	0.101117	9.550011	0		
AR(2)	-0.08759	0.10235	-0.85574	0.3942		
R-squared		0.928375		Mean dependent var		2.546085
Adjusted R-squared		0.92114		S.D. dependent var		1.285228
S.E. of regression		0.360918		Akaike info criterion		0.89431
Sum squared resid		12.89595		Schwarz criterion		1.164358
Log likelihood		-38.1871		F-statistic		128.3192
Durbin-Watson stat		2.026543		Prob(F-statistic)		0

FIN 4	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.833303	1.90401	0.437657	0.6626	0.652	1.533
CPI	-0.00357	0.157505	-0.02264	0.982	0.76	1.316
GDP	-0.15289	0.094154	-1.6238	0.1076	0.85	1.176
ST_IR	-0.4041	0.093649	-4.31502	0	0.584	1.712
TSE_T	-0.41838	0.60439	-0.69224	0.4904	0.925	1.082
TSE_X	0.008245	0.006244	1.32045	0.1897	0.881	1.135
RS	-0.14651	1.147403	-0.12768	0.8987	0.411	2.436
RA	-0.8496	1.956803	-0.43418	0.6651	0.632	1.583
AR(1)	0.933228	0.102018	9.147714	0		
AR(2)	0.007559	0.102027	0.074084	0.9411		
R-squared		0.930763		Mean dependent var		2.546085
Adjusted R-squared		0.92377		S.D. dependent var		1.285228
S.E. of regression		0.354849		Akaike info criterion		0.860392
Sum squared resid		12.46588		Schwarz criterion		1.13044
Log likelihood		-36.3216		F-statistic		133.0877
Durbin-Watson stat		2.002402		Prob(F-statistic)		0

IND 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	1.908967	0.082448	23.15356	0	0.349	2.862
ln_PF	-1.67351	0.804374	-2.08051	0.0401	0.515	1.941
MAT	0.019661	0.020915	0.940011	0.3496	0.233	4.291
CPI	-0.02602	0.027843	-0.93436	0.3525	0.672	1.488
GDP	-0.04143	0.019343	-2.14165	0.0348	0.756	1.323
ST_IR	-0.10577	0.029656	-3.5666	0.0006	0.316	3.169
TSE_T	-0.05523	0.17276	-0.31967	0.7499	0.887	1.127
TSE_X	0.000974	0.001798	0.541617	0.5893	0.843	1.186
RS	-0.00729	0.0133	-0.54833	0.5847	0.602	1.662
RA	-2.31167	1.473733	-1.56858	0.12	0.244	4.093
RD	-1.62685	0.790727	-2.05742	0.0424	0.223	4.478
AR(1)	1.057724	0.104081	10.16256	0		
AR(2)	-0.20827	0.104776	-1.98773	0.4976		
R-squared		0.993872		Mean dependent var		2.629172
Adjusted R-squared		0.993042		S.D. dependent var		1.183377
S.E. of regression		0.098709		Akaike info criterion		-1.67487
Sum squared resid		0.935374		Schwarz criterion		-1.33117
Log likelihood		106.1177		F-statistic		1197.693
Durbin-Watson stat		1.985569		Prob(F-statistic)		0

TABLE 19 *(continued)*– Final estimation results for Reduced Models

IND 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	-2.61795	1.838556	-1.42392	0.1577	0.815	1.228
CPN	-0.06749	0.337545	-0.19994	0.8419	0.396	2.524
CPI	-0.07622	0.062856	-1.21258	0.2282	0.748	1.337
GDP	0.011453	0.04072	0.281272	0.7791	0.771	1.297
Slope	0.676379	0.121052	5.587485	0	0.518	1.929
TSE_T	0.435781	0.366543	1.188896	0.2374	0.921	1.085
TSE_X	0.001964	0.003805	0.516174	0.6069	0.865	1.156
RS	0.009063	0.027812	0.325864	0.7452	0.629	1.589
RA	-1.70442	3.291259	-0.51786	0.6057	0.295	3.391
RD	-0.42487	1.785641	-0.23794	0.8124	0.306	3.27
AR(1)	1.28929	0.093152	13.84074	0		
AR(2)	-0.36203	0.093362	-3.87775	0.0002		
R-squared		0.966302		Mean dependent var		2.629172
Adjusted R-squared		0.962134		S.D. dependent var		1.183377
S.E. of regression		0.230277		Akaike info criterion		0.011523
Sum squared resid		5.143647		Schwarz criterion		0.33067
Log likelihood		12.36625		F-statistic		231.7954
Durbin-Watson stat		2.059683		Prob(F-statistic)		0

IND 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	-2.93023	1.84046	-1.59212	0.1146	0.642	1.558
MAT	-0.03887	0.063968	-0.60757	0.5449	0.247	4.048
CPI	-0.07432	0.062766	-1.18413	0.2393	0.746	1.341
GDP	0.016495	0.040712	0.405172	0.6863	0.758	1.32
Slope	0.630882	0.122898	5.133366	0	0.589	1.698
LT_IR	-0.07971	0.086995	-0.91624	0.3618	0.345	2.899
TSE_T	0.434732	0.361116	1.203856	0.2316	0.913	1.096
TSE_X	0.001104	0.004004	0.275626	0.7834	0.851	1.175
RS	0.017121	0.029336	0.58361	0.5609	0.615	1.625
RD	-1.63184	3.254168	-0.50146	0.6172	0.245	4.087
RA	-0.00144	1.770001	-0.00081	0.9994	0.264	3.786
AR(1)	1.32532	0.092426	14.3393	0		
AR(2)	-0.38366	0.09235	-4.15442	0.0001		
R-squared		0.966593		Mean dependent var		2.629172
Adjusted R-squared		0.962069		S.D. dependent var		1.183377
S.E. of regression		0.230472		Akaike info criterion		0.021042
Sum squared resid		5.099284		Schwarz criterion		0.36474
Log likelihood		12.84268		F-statistic		213.6657
Durbin-Watson stat		2.056282		Prob(F-statistic)		0

UTI 1	**Coefficient**	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-2.36182	2.763086	-0.85478	0.3948	0.254	3.935
ln_PF	0.568105	0.690217	0.823082	0.4125	0.27	3.709
CPN	0.055322	0.027436	2.016431	0.0465	0.657	1.523
MAT	-0.23316	0.129782	-1.79655	0.0755	0.323	3.099
CPI	-0.40271	0.112372	-3.58372	0.0005	0.545	1.836
GDP	0.034007	0.084122	0.404258	0.6869	0.811	1.234
ST_IR	-0.32961	0.112736	-2.92371	0.0043	0.658	1.52
TSE_T	-0.00658	0.731009	-0.009	0.9928	0.919	1.088
TSE_X	-0.00439	0.007438	-0.58985	0.5567	0.86	1.163
RD	-0.1793	2.520424	-0.07114	0.9434	0.598	1.672
AR(1)	0.925982	0.102023	9.0762	0		
AR(2)	0.029207	0.102568	0.284755	0.7764		
R-squared		0.92156		Mean dependent var		2.903809
Adjusted R-squared		0.911856		S.D. dependent var		1.422751
S.E. of regression		0.422402		Akaike info criterion		1.224875
Sum squared resid		17.30706		Schwarz criterion		1.544023
Log likelihood		-54.3681		F-statistic		94.96741
Durbin-Watson stat		2.005098		Prob(F-statistic)		0

<u>TABLE 19</u> ***(continued)*** **– Final estimation results for Reduced Models**

UTI 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
CPN	0.052881	0.022964	2.302731	0.0234	0.595	1.681
CPI	-0.40469	0.108673	-3.72395	0.0003	0.624	1.604
GDP	0.109746	0.078241	1.402674	0.1639	0.839	1.192
Slope	0.95787	0.20175	4.747813	0	0.781	1.28
LT_IR	-0.01197	0.148318	-0.08072	0.9358	0.476	2.099
TSE_T	0.13818	0.694035	0.199097	0.8426	0.928	1.078
TSE_X	-0.00506	0.007405	-0.68319	0.4961	0.862	1.16
RS	4.52703	3.555394	1.273285	0.2059	0.291	3.438
RA	1.186413	2.439979	0.486239	0.6279	0.424	2.356
AR(1)	0.964723	0.09987	9.659801	0		
AR(2)	-0.06618	0.100743	-0.65688	0.5128		

R-squared	0.928906	Mean dependent var	2.903809
Adjusted R-squared	0.920926	S.D. dependent var	1.422751
S.E. of regression	0.400079	Akaike info criterion	1.108359
Sum squared resid	15.68619	Schwarz criterion	1.402957
Log likelihood	-48.9598	F-statistic	116.405
Durbin-Watson stat	2.034043	Prob(F-statistic)	0

AA - 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-0.23676	2.916463	-0.08118	0.9355	0.333	3.003
ln_PF	-0.41648	0.366976	-1.13489	0.2592	0.189	5.297
MAT	-0.01605	0.028206	-0.56905	0.5706	0.435	2.298
CPI	-0.31387	0.093291	-3.36439	0.0011	0.666	1.503
GDP	0.030744	0.067755	0.453754	0.651	0.85	1.176
Slope_IR	0.882521	0.162603	5.427462	0	0.797	1.255
LT_IR	0.086909	0.122621	0.708755	0.4802	0.299	3.339
TSE_T	0.20762	0.606626	0.342254	0.7329	0.945	1.058
TSE_XS	0.010806	0.006375	1.695101	0.0932	0.882	1.134
AR(1)	0.942317	0.102276	9.213431	0		
AR(2)	-0.10033	0.10346	-0.96975	0.3346		

R-squared	0.936331	Mean dependent var	2.509588
Adjusted R-squared	0.929185	S.D. dependent var	1.300878
S.E. of regression	0.346178	Akaike info criterion	0.818943
Sum squared resid	11.74426	Schwarz criterion	1.113541
Log likelihood	-33.0419	F-statistic	131.0199
Durbin-Watson stat	2.01554	Prob(F-statistic)	0

AA - 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-2.08672	2.575264	-0.81029	0.4197	0.385	2.598
CPN	0.250174	0.446592	0.560185	0.5766	0.352	2.84
MAT	-0.0153	0.030636	-0.49927	0.6187	0.439	2.276
CPI	-0.29336	0.093443	-3.13942	0.0022	0.688	1.453
GDP	-0.01976	0.067969	-0.29072	0.7719	0.84	1.191
ST_IR	-0.41436	0.093359	-4.43836	0	0.685	1.459
TSE_T	-0.28987	0.599196	-0.48377	0.6296	0.936	1.068
TSE_XS	0.007558	0.006026	1.254173	0.2127	0.891	1.122
AR(1)	0.984854	0.101029	9.748265	0		
AR(2)	-0.05937	0.101099	-0.58726	0.5584		

R-squared	0.934445	Mean dependent var	2.509588
Adjusted R-squared	0.927824	S.D. dependent var	1.300878
S.E. of regression	0.349489	Akaike info criterion	0.829951
Sum squared resid	12.09212	Schwarz criterion	1.099999
Log likelihood	-34.6473	F-statistic	141.1193
Durbin-Watson stat	1.999002	Prob(F-statistic)	0

TABLE 19 ***(continued)*–** **Final estimation results for Reduced Models**

A – 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	-0.32334	0.343639	-0.94092	0.349	0.29	3.452
CPN	-0.12795	0.615426	-0.2079	0.8357	0.195	5.123
MAT	-0.02741	0.068695	-0.39904	0.6907	0.307	3.257
CPI	-0.24189	0.097795	-2.47337	0.0151	0.512	1.954
GDP	0.044367	0.068763	0.645217	0.5203	0.853	1.172
Slope	0.71668	0.18343	3.907095	0.0002	0.567	1.764
TSE_T	0.04067	0.621746	0.065412	0.948	0.934	1.071
TSE_XS	-0.00265	0.006334	-0.41809	0.6768	0.886	1.129
AR(1)	1.012393	0.091315	11.08678	0		
AR(2)	-0.10906	0.090709	-1.20232	0.2321		
R-squared	0.934484		Mean dependent var		2.739564	
Adjusted R-squared	0.927867		S.D. dependent var		1.35798	
S.E. of regression	0.364722		Akaike info criterion		0.915275	
Sum squared resid	13.16917		Schwarz criterion		1.185323	
Log likelihood	-39.3401		F-statistic		141.2088	
Durbin-Watson stat	2.052279		Prob(F-statistic)		0	

A 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-8.79678	1.646559	-5.34253	0	0.201	4.979
MAT	-0.23674	0.052731	-4.48964	0	0.266	3.759
CPI	-0.29647	0.086964	-3.40914	0.0009	0.418	2.39
GDP	-0.06629	0.09645	-0.68732	0.4935	0.866	1.154
ST_IR	-0.67787	0.061531	-11.0168	0	0.493	2.029
LT_IR	0.542638	0.094181	5.761643	0	0.241	4.151
TSE_T	-0.04717	0.783354	-0.06022	0.9521	0.932	1.073
TSE_XS	0.007643	0.007901	0.967372	0.3357	0.884	1.132
AR(1)	0.478442	0.077943	6.138344	0		
R-squared	0.922259		Mean dependent var		2.743216	
Adjusted R-squared	0.915332		S.D. dependent var		1.352341	
S.E. of regression	0.393501		Akaike info criterion		1.058303	
Sum squared resid	15.63913		Schwarz criterion		1.302405	
Log likelihood	-48.7358		F-statistic		133.1325	
Durbin-Watson stat	1.925617		Prob(F-statistic)		0	

BBB 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	0.009389	0.542982	0.017292	0.9862	0.256	3.899
CPI	-0.11292	0.074572	-1.51417	0.1331	0.746	1.341
GDP	0.010521	0.044838	0.234647	0.815	0.865	1.157
ST_IR	-0.33247	0.078609	-4.22936	0.0001	0.647	1.546
LT_IR	-0.07915	0.103297	-0.76625	0.4453	0.225	4.447
TSE_T	0.1343	0.445496	0.301461	0.7637	0.943	1.061
TSE_X	-0.00262	0.004619	-0.56753	0.5716	0.897	1.115
AR(1)	1.247831	0.09548	13.06897	0		
AR(2)	-0.28427	0.095625	-2.97275	0.0037		
R-squared	0.960901		Mean dependent var		2.913464	
Adjusted R-squared	0.957382		S.D. dependent var		1.35409	
S.E. of regression	0.279539		Akaike info criterion		0.375161	
Sum squared resid	7.814228		Schwarz criterion		0.620659	
Log likelihood	-10.6339		F-statistic		273.0685	
Durbin-Watson stat	2.129358		Prob(F-statistic)		0	

TABLE 19 ***(continued)*** **– Final estimation results for Reduced Models**

BBB 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-5.60996	4.278272	-1.31127	0.1928	0.428	2.336
CPI	-0.09814	0.071442	-1.37366	0.1726	0.811	1.233
GDP	0.04078	0.042995	0.94848	0.3452	0.852	1.173
Slope	0.733952	0.139065	5.277761	0	0.81	1.235
LT_IR	0.024341	0.097629	0.249324	0.8036	0.399	2.506
TSE_T	0.596667	0.417881	1.42784	0.1565	0.927	1.079
TSE_X	0.000984	0.004417	0.222845	0.8241	0.863	1.158
AR(1)	1.290931	0.092334	13.98107	0		
AR(2)	-0.35568	0.092657	-3.83864	0.0002		
R-squared		0.964574		Mean dependent var		2.913464
Adjusted R-squared		0.961385		S.D. dependent var		1.35409
S.E. of regression		0.266087		Akaike info criterion		0.276519
Sum squared resid		7.080215		Schwarz criterion		0.522017
Log likelihood		-5.20856		F-statistic		302.5297
Durbin-Watson stat		2.065148		Prob(F-statistic)		0

BBB 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
MAT	0.02511	0.082923	0.302805	0.7627	0.288	3.472
CPI	-0.10819	0.071948	-1.50367	0.1358	0.754	1.326
GDP	0.054686	0.042591	1.28397	0.2021	0.862	1.16
Slope	0.743379	0.140224	5.301377	0	0.81	1.235
LT_IR	-0.0072	0.099778	-0.07218	0.9426	0.295	3.386
TSE_T	0.590669	0.42342	1.394998	0.1661	0.937	1.067
TSE_X	-0.00018	0.004462	-0.04111	0.9673	0.876	1.141
AR(1)	1.290357	0.092521	13.94669	0		
AR(2)	-0.36125	0.093442	-3.866	0.0002		
R-squared		0.964002		Mean dependent var		2.913464
Adjusted R-squared		0.960762		S.D. dependent var		1.35409
S.E. of regression		0.268225		Akaike info criterion		0.292526
Sum squared resid		7.194461		Schwarz criterion		0.538024
Log likelihood		-6.08895		F-statistic		297.5492
Durbin-Watson stat		2.088435		Prob(F-statistic)		0

BBB 4	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
CPN	-0.09341	0.752044	-0.12421	0.9014	0.228	4.386
CPI	-0.11158	0.074536	-1.497	0.1375	0.743	1.346
GDP	0.010384	0.044708	0.23227	0.8168	0.862	1.16
ST_IR	-0.33104	0.07852	-4.21599	0.0001	0.65	1.538
LT_IR	-0.07933	0.103093	-0.7695	0.4434	0.205	4.875
TSE_T	0.134598	0.444477	0.302824	0.7627	0.942	1.062
TSE_XS	-0.00263	0.004616	-0.57044	0.5697	0.894	1.119
AR(1)	1.252837	0.095351	13.13922	0		
AR(2)	-0.28866	0.09545	-3.02416	0.0032		
R-squared		0.960906		Mean dependent var		2.913464
Adjusted R-squared		0.957388		S.D. dependent var		1.35409
S.E. of regression		0.279522		Akaike info criterion		0.375035
Sum squared resid		7.813242		Schwarz criterion		0.620533
Log likelihood		-10.6269		F-statistic		273.1044
Durbin-Watson stat		2.131007		Prob(F-statistic)		0

TABLE 19 *(continued)*– Final estimation results for Reduced Models

BB 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	1.077234	3.945901	0.273001	0.7854	0.76	1.316
CPI	-0.08634	0.133914	-0.64471	0.5207	0.887	1.128
GDP	-0.11738	0.0787	-1.49147	0.1391	0.864	1.158
ST_IR	0.093242	0.144902	0.643486	0.5214	0.749	1.335
LT_IR	0.1929	0.786824	0.245163	0.8069	0.922	1.085
TSE_T	0.009423	0.007825	1.204135	0.2315	0.892	1.121
TSE_X	1.27916	0.094898	13.47927	0		
AR(2)	-0.3734	0.095497	-3.91007	0.0002		
R-squared	0.87695		Mean dependent var		3.021404	
Adjusted R-squared	0.866695		S.D. dependent var		1.331673	
S.E. of regression	0.486206		Akaike info criterion		1.477447	
Sum squared resid	22.69404		Schwarz criterion		1.70493	
Log likelihood	-68.566		F-statistic		85.52099	
Durbin-Watson stat	1.967172		Prob(F-statistic)		0	

BB 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	0.136127	0.422556	0.322151	0.748	0.661	1.512
CPI	-0.08448	0.133772	-0.63151	0.5292	0.799	1.251
GDP	-0.12983	0.079806	-1.62682	0.1071	0.851	1.175
Slope	-0.18291	0.289401	-0.63204	0.5289	0.7	1.428
LT_IR	0.051846	0.78038	0.066437	0.9472	0.929	1.076
TSE_T	0.008689	0.007812	1.112273	0.2688	0.911	1.098
TSE_X	1.286438	0.094908	13.55464	0		
AR(2)	-0.37261	0.095622	-3.89665	0.0002		
R-squared	0.876798		Mean dependent var		3.021404	
Adjusted R-squared	0.866532		S.D. dependent var		1.331673	
S.E. of regression	0.486505		Akaike info criterion		1.478676	
Sum squared resid	22.72193		Schwarz criterion		1.706158	
Log likelihood	-68.6305		F-statistic		85.40127	
Durbin-Watson stat	1.962244		Prob(F-statistic)		0	

BB 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
MAT	0.104944	0.130922	0.801581	0.4248	0.249	4.01
CPI	-0.05212	0.133812	-0.38952	0.6978	0.759	1.318
GDP	-0.13264	0.079951	-1.65899	0.1004	0.853	1.172
ST_IR	-0.07562	0.279891	-0.27016	0.7876	0.735	1.36
LT_IR	0.189994	0.173719	1.093684	0.2769	0.28	3.57
TSE_T	0.0269	0.78709	0.034177	0.9728	0.928	1.078
TSE_X	0.011643	0.008161	1.426644	0.157	0.889	1.125
AR(1)	1.272584	0.095689	13.2992	0		
AR(2)	-0.37746	0.098544	-3.83038	0.0002		
R-squared	0.879657		Mean dependent var		3.021404	
Adjusted R-squared	0.868256		S.D. dependent var		1.331673	
S.E. of regression	0.483352		Akaike info criterion		1.474249	
Sum squared resid	22.19476		Schwarz criterion		1.727007	
Log likelihood	-67.3981		F-statistic		77.1565	
Durbin-Watson stat	1.974118		Prob(F-statistic)		0	

TABLE 19 *(continued)*– Final estimation results for Reduced Models

BB 4	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
CPN	-0.18857	0.589726	-0.31975	0.7498	0.659	1.517
CPI	-0.08808	0.134308	-0.65583	0.5135	0.838	1.193
GDP	-0.11961	0.078067	-1.53217	0.1288	0.849	1.178
ST_IR	0.094474	0.143953	0.656284	0.5132	0.676	1.48
TSE_T	0.185007	0.786945	0.235095	0.8146	0.934	1.071
TSE_XS	0.009492	0.007817	1.214341	0.2276	0.903	1.107
AR(1)	1.278679	0.095075	13.44922	0		
AR(2)	-0.37251	0.095457	-3.90236	0.0002		
R-squared	0.876981		Mean dependent var		3.021404	
Adjusted R-squared	0.86673		S.D. dependent var		1.331673	
S.E. of regression	0.486144		Akaike info criterion		1.477191	
Sum squared resid	22.68821		Schwarz criterion		1.704673	
Log likelihood	-68.5525		F-statistic		85.54603	
Durbin-Watson stat	1.968839		Prob(F-statistic)		0	

B 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
C	799.1144	298610.6	0.002676	0.9979		
ln_IS	0.514795	0.649314	0.792829	0.4298	0.397	2.518
CPN	-0.03734	0.028548	-1.30807	0.1939	0.518	1.93
MAT	0.325491	0.254569	1.278594	0.2041	0.208	4.818
CPI	-0.00694	0.119606	-0.05804	0.9538	0.745	1.342
GDP	0.004861	0.08235	0.059027	0.9531	0.83	1.206
LT_IR	0.572415	0.16722	3.423127	0.0009	0.263	3.807
TSE_T	-0.11151	0.7435	-0.14997	0.8811	0.921	1.086
TSE_X	-0.00267	0.007792	-0.3424	0.7328	0.932	1.073
AR(1)	1.068773	0.104513	10.22622	0		
AR(2)	-0.06885	0.108955	-0.63186	0.5289		
R-squared		0.921964	Mean dependent var			2.858205
Adjusted R-squared		0.914001	S.D. dependent var			1.523783
S.E. of regression		0.446857	Akaike info criterion			1.322299
Sum squared resid		19.56876	Schwarz criterion			1.593902
Log likelihood		-61.0653	F-statistic			115.7835
Durbin-Watson stat		2.021911	Prob(F-statistic)			0

B 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
C	1.535416	2.117145	0.725229	0.47		
ln_PF	0.573856	0.32987	1.739641	0.085	0.447	2.239
CPN	-0.01569	0.020213	-0.77639	0.4394	0.544	1.839
CPI	-0.04256	0.121906	-0.34913	0.7277	0.73	1.369
GDP	0.051284	0.09138	0.561219	0.5759	0.817	1.225
Slope	0.200562	0.300297	0.667879	0.5057	0.51	1.959
ST_IR	-0.27357	0.156558	-1.74737	0.0836	0.367	2.725
TSE_T	-0.45604	0.800157	-0.56994	0.57	0.892	1.121
TSE_X	-0.01051	0.007771	-1.35225	0.1793	0.874	1.145
AR(1)	0.939508	0.040584	23.14997	0		
R-squared		0.918129		Mean dependent var		2.864886
Adjusted R-squared		0.910761		S.D. dependent var		1.518394
S.E. of regression		0.453589		Akaike info criterion		1.343256
Sum squared resid		20.57426		Schwarz criterion		1.588754
Log likelihood		-63.8791		F-statistic		124.6042
Durbin-Watson stat		2.125843		Prob(F-statistic)		0

TABLE 19 ***(continued)*– Final estimation results for Reduced Models**

LT 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-0.04855	1.38091	-0.03516	0.972	0.488	2.049
MAT	-0.06898	0.113307	-0.60881	0.5441	0.248	4.038
CPI	-0.06195	0.090747	-0.68267	0.4965	0.706	1.417
GDP	0.044983	0.070901	0.634452	0.5273	0.822	1.217
Slope	0.612187	0.165989	3.688116	0.0004	0.311	3.218
LT_IR	0.281737	0.115168	2.446314	0.0163	0.217	4.607
TSE_T	0.763276	0.57743	1.321851	0.1894	0.93	1.076
TSE_X	0.005647	0.006046	0.934041	0.3526	0.869	1.151
RS	-0.1328	1.498919	-0.0886	0.9296	0.255	3.922
RA	-0.17504	3.084792	-0.05674	0.9549	0.685	1.459
AR(1)	0.802772	0.113959	7.044405	0		
AR(2)	0.029157	0.108627	0.268417	0.789		
R-squared		0.903712		Mean dependent var		2.138048
Adjusted R-squared		0.891676		S.D. dependent var		0.97926
S.E. of regression		0.3223		Akaike info criterion		0.684867
Sum squared resid		9.972248		Schwarz criterion		1.005854
Log likelihood		-24.3253		F-statistic		75.08395

LT 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.274925	1.401685	0.196139	0.8449	0.631	1.584
ln_PF	-0.44983	0.448854	-1.00218	0.3187	0.352	2.845
CPI	-0.07974	0.080381	-0.99199	0.3237	0.743	1.345
GDP	0.014243	0.072332	0.196908	0.8443	0.793	1.261
Slope	-0.04469	0.213935	-0.20889	0.835	0.208	4.812
ST_IR	-0.39582	0.10675	-3.70789	0.0003	0.286	3.502
TSE_T	0.372375	0.559267	0.665827	0.5071	0.945	1.058
TSE_X	0.00219	0.005459	0.401156	0.6892	0.886	1.129
RA	-2.53351	3.036702	-0.8343	0.4062	0.648	1.542
AR(1)	0.712734	0.106308	6.704446	0		
AR(2)	0.206861	0.104906	1.971867	0.0515		
R-squared		0.909512		Mean dependent var		2.138048
Adjusted R-squared		0.899251		S.D. dependent var		0.97926
S.E. of regression		0.310827		Akaike info criterion		0.604386
Sum squared resid		9.371506		Schwarz criterion		0.900682
Log likelihood		-20.9391		F-statistic		88.63362
Durbin-Watson stat		2.058309		Prob(F-statistic)		0

LT 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	-0.19186	1.408985	-0.13617	0.892	0.542	1.844
CPN	0.090809	0.499569	0.181774	0.8561	0.381	2.623
CPI	-0.09998	0.091191	-1.09643	0.2756	0.506	1.975
GDP	0.047392	0.071556	0.662304	0.5093	0.826	1.21
Slope	0.507704	0.168299	3.016682	0.0033	0.6	1.666
TSE_T	0.762362	0.578879	1.316962	0.1909	0.948	1.054
TSE_X	0.002027	0.005833	0.347531	0.7289	0.893	1.12
RD	1.348045	3.215767	0.419199	0.676	0.584	1.713
AR(1)	0.822307	0.111555	7.371326	0		
AR(2)	0.059345	0.106134	0.559151	0.5773		
R-squared		0.897647		Mean dependent var		2.138048
Adjusted R-squared		0.887203		S.D. dependent var		0.97926
S.E. of regression		0.328887		Akaike info criterion		0.709248
Sum squared resid		10.60032		Schwarz criterion		0.980852
Log likelihood		-27.654		F-statistic		85.94745
Durbin-Watson stat		2.006522		Prob(F-statistic)		0

TABLE 19 *(continued)*– Final estimation results for Reduced Models

MT 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	0.416336	0.513042	0.811506	0.419	0.473	2.113
MAT	0.170268	0.239128	0.712038	0.4781	0.296	3.382
CPI	-0.22273	0.086554	-2.57329	0.0116	0.687	1.456
GDP	0.003101	0.053139	0.058353	0.9536	0.832	1.203
ST_IR	-0.26629	0.089685	-2.96916	0.0038	0.559	1.79
LT_IR	-0.06972	0.117915	-0.59126	0.5557	0.4	2.501
TSE_T	-0.02828	0.521405	-0.05424	0.9569	0.913	1.095
TSE_X	-0.00141	0.005593	-0.25188	0.8017	0.867	1.153
RA	0.026174	0.070913	0.369099	0.7129	0.59	1.695
AR(1)	1.19394	0.09863	12.10523	0		
AR(2)	-0.23904	0.099108	-2.41189	0.0177		
R-squared	0.949095		Mean dependent var		2.816823	
Adjusted R-squared	0.943381		S.D. dependent var		1.336628	
S.E. of regression	0.318048		Akaike info criterion		0.649438	
Sum squared resid	9.913119		Schwarz criterion		0.944035	
Log likelihood	-23.7191		F-statistic		166.1039	
Durbin-Watson stat	2.056168		Prob(F-statistic)		0	

MT 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.696017	1.640946	0.424156	0.6724	0.202	4.956
CPI	-0.2115	0.082104	-2.57602	0.0115	0.724	1.381
GDP	0.041618	0.050262	0.828029	0.4097	0.835	1.197
Slope	0.722298	0.161308	4.477744	0	0.513	1.948
LT_IR	-0.02439	0.111285	-0.2192	0.8269	0.292	3.425
TSE_T	0.264158	0.4906	0.538438	0.5915	0.913	1.095
TSE_X	0.000334	0.005239	0.06377	0.9493	0.858	1.166
RS	1.553377	0.985612	1.576053	0.1182	0.366	2.732
RA	0.027839	0.066456	0.418913	0.6762	0.601	1.664
AR(1)	1.225967	0.096945	12.64601	0		
AR(2)	-0.2933	0.098106	-2.9896	0.0035		
R-squared	0.954136		Mean dependent var		2.816823	
Adjusted R-squared	0.948989		S.D. dependent var		1.336628	
S.E. of regression	0.301887		Akaike info criterion		0.54514	
Sum squared resid	8.9313		Schwarz criterion		0.839738	
Log likelihood	-17.9827		F-statistic		185.3431	
Durbin-Watson stat	2.013546		Prob(F-statistic)		0	

MT 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
CPN	-0.36409	0.659635	-0.55196	0.5822	0.221	4.53
CPI	-0.21479	0.085655	-2.50765	0.0138	0.683	1.463
GDP	0.000524	0.052887	0.009901	0.9921	0.806	1.24
ST_IR	-0.25278	0.088786	-2.84711	0.0054	0.519	1.925
LT_IR	-0.09501	0.119217	-0.79691	0.4274	0.204	4.901
TSE_T	-0.04047	0.520846	-0.0777	0.9382	0.916	1.092
TSE_X	-0.00114	0.005528	-0.20621	0.8371	0.874	1.144
RS	0.838659	0.928598	0.903145	0.3687	0.575	1.739
RD	-0.02733	0.070202	-0.38926	0.6979	0.548	1.824
AR(1)	1.199817	0.09902	12.11686	0		
AR(2)	-0.23562	0.098925	-2.38179	0.0192		
R-squared	0.949265		Mean dependent var		2.816823	
Adjusted R-squared	0.94357		S.D. dependent var		1.336628	
S.E. of regression	0.317517		Akaike info criterion		0.646095	
Sum squared resid	9.880042		Schwarz criterion		0.940693	
Log likelihood	-23.5352		F-statistic		166.6899	
Durbin-Watson stat	2.065739		Prob(F-statistic)		0	

<u>TABLE 19</u> *(continued)*– Final estimation results for Reduced Models

ST 1	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_PF	0.106312	0.074297	1.430903	0.1572	0.193	4.19
CPI	-0.13345	0.075812	-1.76031	0.083	0.624	1.602
GDP	0.016287	0.05172	0.314912	0.7538	0.861	1.162
ST_IR	-0.85044	0.119046	-7.14379	0	0.533	1.876
LT_IR	0.203282	0.134895	1.506971	0.1366	0.253	3.945
TSE_T	-0.38282	0.45892	-0.83418	0.4072	0.899	1.112
TSE_X	-0.00099	0.004691	-0.21171	0.833	0.863	1.159
RD	-5.692686	3.253017	-1.749971	0.0848	0.447	2.236
AR(1)	0.935388	0.045315	20.64199	0		
R-squared		0.971577		Mean dependent var		2.384247
Adjusted R-squared		0.967701		S.D. dependent var		1.32076
S.E. of regression		0.237366		Akaike info criterion		0.083655
Sum squared resid		3.718624		Schwarz criterion		0.390331
Log likelihood		6.821097		F-statistic		250.6718
Durbin-Watson stat		2.026619		Prob(F-statistic)		0

ST 2	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	0.812749	0.350669	2.317712	0.0238	0.288	3.477
CPI	-0.16081	0.078329	-2.05305	0.0443	0.661	1.513
GDP	0.087479	0.044244	1.977218	0.0525	0.848	1.179
Slope	1.487437	0.151182	9.838736	0	0.419	2.385
LT_IR	0.31144	0.130352	2.389231	0.0199	0.246	4.067
TSE_T	0.262659	0.468626	0.560488	0.5772	0.908	1.101
TSE_X	0.002078	0.004884	0.425562	0.6719	0.866	1.155
RA	-3.18954	2.361404	-1.3507	0.1817	0.574	1.741
AR(1)	0.933595	0.118622	7.870304	0		
AR(2)	-0.46956	0.157709	-2.97737	0.0041		
AR(3)	0.388153	0.12082	3.212654	0.0021		
R-squared		0.975811		Mean dependent var		2.383232
Adjusted R-squared		0.971519		S.D. dependent var		1.338635
S.E. of regression		0.225912		Akaike info criterion		0.010048
Sum squared resid		3.164235		Schwarz criterion		0.38368
Log likelihood		11.62824		F-statistic		227.3751
Durbin-Watson stat		1.902035		Prob(F-statistic)		0

ST 3	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
ln_IS	1.013996	0.349901	2.897955	0.0052	0.265	3.771
MAT	0.185772	0.148985	1.246921	0.2173	0.421	2.377
CPI	-0.08807	0.076134	-1.15682	0.2519	0.602	1.661
GDP	0.063011	0.034615	1.820374	0.0737	0.846	1.181
Slope	1.133506	0.176428	6.424741	0	0.59	1.696
LT_IR	0.164381	0.122893	1.337594	0.1861	0.246	4.058
TSE_T	0.186727	0.43278	0.431459	0.6677	0.913	1.096
TSE_X	0.003127	0.00433	0.72227	0.4729	0.881	1.135
AR(1)	1.2518	0.12616	9.922324	0		
AR(2)	-0.72511	0.186075	-3.89684	0.0002		
AR(3)	0.69657	0.189112	3.683375	0.0005		
AR(4)	-0.29363	0.130938	-2.24249	0.0286		
R-squared		0.977079		Mean dependent var		2.377318
Adjusted R-squared		0.972495		S.D. dependent var		1.346925
S.E. of regression		0.223382		Akaike info criterion		0.000183
Sum squared resid		2.993974		Schwarz criterion		0.408074
Log likelihood		12.9933		F-statistic		213.1431
Durbin-Watson stat		2.092914		Prob(F-statistic)		0

TABLE 19 ***(continued)*** **– Final estimation results for Reduced Models**

ST 4	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF
CPN	0.302889	0.851042	0.355904	0.7231	0.374	2.672
CPI	-0.11802	0.077878	-1.51541	0.1346	0.584	1.713
GDP	0.00846	0.053798	0.157252	0.8755	0.837	1.195
ST_IR	-0.82943	0.117096	-7.08335	0	0.787	1.271
LT_IR	0.173524	0.139495	1.24394	0.2181	0.272	3.672
TSE_T	-0.28903	0.468826	-0.61649	0.5398	0.909	1.1
TSE_X	0.000883	0.004588	0.192399	0.848	0.872	1.147
RS	-0.2693	0.175808	-1.53179	0.1305	0.379	2.642
AR(1)	0.929888	0.126715	7.33841	0		
AR(2)	-0.01008	0.126058	-0.07992	0.9365		
R-squared		0.971803		Mean dependent var		2.384933
Adjusted R-squared		0.967397		S.D. dependent var		1.329641
S.E. of regression		0.240083		Akaike info criterion		0.119063
Sum squared resid		3.688947		Schwarz criterion		0.458962
Log likelihood		6.53512		F-statistic		220.5749
Durbin-Watson stat		2.008657		Prob(F-statistic)		0

<u>TABLE 20</u> - Corporate bond return volatility components (February 1993 – May 2002)

Panel A – Historical evolution of the a bond return volatility components

This table presents the monthly variations in the volatility components of a Canadian corporate bond's excess returns. MKTt, INDt and FIRMt refer to the volatility components in Campbell et al. (2001) market-adjusted model. Twelve-month weighed averages (MA) are computed to enlighten the historical trend in each volatility component. The relative share of a volatility component is presented as a percentage of the total bond excess return volatility

	1993-2002		**1993-1997**		**1998-2002**	
	Mean	Stdev	Mean	Stdev	Mean	Stdev
MKTt (%)	**0.850**	**2.106**	**1.366**	**3.058**	**0.476**	**0.794**
12-month MA	*0.737*	*0.606*	*1.078*	*0.755*	*0.485*	*0.269*
MKT_t as % total volatility	**10.49**	**15.99**	**12.96**	**20.17**	**8.71**	**11.96**
12-month MA as % total volatility	*9.70*	*5.80*	*9.59*	*5.30*	*9.60*	*6.20*
INDt (%)	**4.127**	**3.831**	**5.798**	**2.820**	**2.920**	**4.026**
12-month MA	*3.625*	*2.542*	*5.453*	*1.614*	*2.269*	*2.241*
IND_t as % total volatility	**44.50**	**21.19**	**61.82**	**18.15**	**31.97**	**12.73**
12-month MA as % total volatility	*44.60*	*17.70*	*62.40*	*11.40*	*32.10*	*9.20*
FIRMt (%)	**4.624**	**8.216**	**2.103**	**0.778**	**6.447**	**10.421**
12-month MA	*3.544*	*4.542*	*2.181*	*0.474*	*4.554*	*5.795*
$FIRM_t$ as % total volatility	**45.01**	**21.13**	**25.22**	**10.69**	**59.32**	**14.02**
12-month MA as % total volatility	*45.70*	*17.80*	*28.01*	*6.00*	*58.30*	*10.20*
TOTALt (%)	**9.60**	**11.20**	**9.27**	**4.34**	**9.84**	**14.27**
12-month MA	*7.91*	*6.11*	*8.71*	*2.02*	*7.31*	*7.85*
Standard deviation of daily returns	12.30	10.80	15.20	13.80	10.30	7.50

Panel B – Explanatory power of their changing term to maturity for studied bond volatility components evolution

	MARKET VOLATILTIY		**INDUSTRY VOLATILITY**		**FIRM VOLATILITY**		**TOTAL VOLATILITY**	
	MKTt	MA_{12}	**INDt**	MA_{12}	**FIRMt**	MA_{12}	**$Total_t$**	MA_{12}
R^2	8.22%	45.50%	3.62%	24.22%	20.83%	20.62%	0.47%	4.91%
Time to maturity	**0.285****	**0.222****	**0.023****	**0.656****	**-1.802**	**-1.112****	**-1.172****	**-0.234****
t Stat	3.138	9.062	3.375	5.518	-5.496	-5.210	-2.383	-0.726
P-value	0.002	1.21E-14	0.001	2.75E-07	2.54-07	1.03E-06	0.019	0.469

*** denotes significance at the 1% level*

TABLE 20 *(continued)* – **Decomposition of a corporate bond return volatility (February 1993 –May 2002)**

Panel C – Historical evolution of the a bond return volatility components in sub-periods

This table presents the means and standard deviations of volatility components for corporate bond returns for four equal time sub-periods. Consecutive increases (decreases) in the mean of a volatility component could indicate that an upward (downward) trend exists.

	1993-1994		1995-1996		1997-1998		1999-2000		2001-2002	
	Mean	Stdev	Mean	Stdev	Mean	Stdev	Mean	Stdev	Mean	Stdev
MKTt (%)	**1.436**	**2.529**	**1.298**	**3.546**	**0.708**	**1.001**	**0.217**	**0.262**	**0.517**	**0.895**
12-month MA	*1.373*	*0.639*	*0.845*	*0.769*	*0.693*	*0.222*	*0.241*	*0.088*	*0.570*	*0.177*
MKT_t as % total volatility	**14.70**	**22.90**	**11.30**	**17.50**	**13.60**	**16.30**	**8.20**	**8.40**	**2.50**	**3.40**
12-month MA as % total volatility	*14.50*	*3.60*	*8.80*	*6.20*	*13.90*	*6.50*	*8.00*	*3.10*	*3.10*	*5.00*
INDt (%)	**7.256**	**2.922**	**4.400**	**1.891**	**2.736**	**2.478**	**0.875**	**0.280**	**6.064**	**6.250**
12-month MA	*6.288*	*1.591*	*4.791*	*1.320*	*2.408*	*2.061*	*0.943*	*0.167*	*5.118*	*2.671*
IND_t as % total volatility	**64.50**	**19.30**	**59.20**	**17.00**	**37.40**	**17.10**	**33.40**	**7.00**	**22.40**	**3.50**
12-month MA as % total volatility	*62.00*	*13.80*	*61.60*	*9.40*	*35.90*	*11.60*	*32.30*	*4.80*	*22.70*	*6.00*
FIRMt (%)	**2.183**	**0.856**	**2.026**	**0.705**	**2.992**	**2.112**	**1.551**	**0.524**	**18.236**	**15.036**
12-month MA	*2.173*	*0.545*	*2.187*	*0.420*	*2.804*	*1.487*	*1.887*	*0.836*	*15.158*	*7.293*
$FIRM_t$ as % total volatility	**20.80**	**9.30**	**29.50**	**10.40**	**49.00**	**13.00**	**58.40**	**8.50**	**75.10**	**3.70**
12-month MA as % total volatility	*23.50*	*6.70*	*29.70*	*3.90*	*50.20*	*5.60*	*59.70*	*6.70*	*73.40*	*4.00*
TOTALt (%)	**10.876**	**3.988**	**7.724**	**4.171**	**6.435**	**4.155**	**2.643**	**0.728**	**24.817**	**21.350**
12-month MA	*9.834*	*2.257*	*7.823*	*1.271*	*5.905*	*3.402*	*3.071*	*0.918*	*20.846*	*10.093*
Standard deviation daily returns	16.60	12.60	13.90	15.00	12.80	8.90	7.60	4.20	10.60	8.30

TABLE 21 - Autocorrelation coefficients the time series of a bond returns' volatility components (February 1993 –May 2002)

This table reports the autocorrelation structure of monthly volatility measures constructed from daily data.

"MKT" denotes the market volatility component, "IND" the industry-specific volatility component and "FIRM" the idiosyncratic volatility component.
Correlation coefficients are compared with the critical Pearson value of 0.1638 (N-2=100 degrees of freedom and a α=0.05).
The null hypothesis states that $\rho = 0$ against the Ha, $\rho > 0$. The lags are in months.

	MKT	**IND**	**FIRM**
lag1	0.0375	0.8866*	0.9441*
lag2	-0.0093	0.6772*	0.8117*
lag3	-0.0228	0.4914*	0.6619*
lag6	-0.0058	0.3088*	0.4181*
lag12	0.0023	0.1284	0.2146*

* denotes significance at the 5 percent level.

TABLE 22 – Stochastic vs. deterministic trends: Augmented Dickey-Fuller tests (February 1993 –May 2002)

Panel A – Performed tests

	Null model	Alternative model	H_0	F-test	T-test
Model(*a*) Constant	$Y_t=Y_{t-1}+\varepsilon_t$	$Y_t=\alpha+\rho Y_{t-1}+\varepsilon_t$	$(\alpha,\varphi)=(0,1)$	$\phi_1=\frac{(RSS_0-RSS_2)}{(2RSS_0/(T-3))}$	$\tau_\mu=\hat{\mu}/S_\mu$
Model(*b*)	$Y_t=Y_{t-1}+\varepsilon_t$	$Y_t=\alpha+\beta t+\rho Y_{t-1}+\varepsilon_t$	$(\alpha,\beta,\varphi)=(0,0,1)$	$\phi_2=\frac{(RSS_0-RSS_2)}{(3RSS_2/(T-4))}$	$\tau_\mu=\hat{\mu}/S_\mu$
Constant & Trend	$Y_t=\alpha+Y_{t-1}+\varepsilon_t$	$Y_t=\alpha+\beta t+\rho Y_{t-1}+\varepsilon_t$	$(\alpha,\beta,\varphi)=(\alpha,0,1)$	$\phi_3=\frac{(RSS_1-RSS_2)}{(2RSS_2/(T-4))}$	$\tau_\beta=\hat{\beta}/S_\beta$

Panel B – Results

(a) Constant	**MKT**	**IND**	**FIRM**
Number of lags	4	2	2
(1) Durbin-Watson	1.99	1.98	1.84
Φ_1	**0.05**	**0.01**	**0.07**
Critical Φ_1*$_{(5\%)}$	4.71	4.71	4.71
$H_0(\alpha,\varphi)=(0,1)$	*Accept H_0*	*Accept H_0*	*Accept H_0*
τ_α	**-0.30**	**-0.10**	**0.36**
Critical (τ_u *)	2.54	2.54	2.54
$H_0(\alpha,\varphi)=(0,1)$	*Accept H_0*	*Accept H_0*	*Accept H_0*

(b) Constant & Trend	**MKT**	**IND**	**FIRM**
Number of lags	0	2	2
(2) Durbin-Watson	2.28	2.06	1.89
Φ_2	**-2.90**	**3.49**	**2.44**
Critical- Φ_2* $_{(5\%)}$	4.88	4.88	4.88
H_0: $(\alpha,\beta,\varphi)=(0,0,1)$	*Accept H_0*	*Accept H_0*	*Accept H_0*
$\tau_{..}$	**4.23**	**1.88**	**-0.71**
Critical-($\tau_{..}$ *)	3.11	3.11	3.11
H_0: $(\alpha,\beta,\varphi)=(0,0,1)$	*Reject H_0*	*Accept H_0*	*Accept H_0*
Φ_3	**-4.39**	**5.23**	**3.58**
Critical- Φ_3* $_{(5\%)}$	6.49	6.49	6.49
H_0: $(\alpha,\beta,\varphi)=(\alpha,0,1)$	*Accept H_0*	*Accept H_0*	*Accept H_0*
τ_β	**-2.68**	**-0.72**	**1.73**
Critical-(τ_β *)	2.79	2.79	2.79
H_0: $(\alpha,\beta,\varphi)=(0,0,1)$	*Accept H_0*	*Accept H_0*	*Accept H_0*

(1) Upper (d_u) and lower (d_l) critical values correspond respectively for 4 and 2 lags to d_l = 1.57 and 1.61 and d_u=1.78 and 1.74 (5 and 3 variables in model *a*). The corresponding intervals for H_0 are [1.78;2.22][1.74 ;2.26], respectively.

(2) Upper (d_u) and lower (d_l) critical values correspond respectively for 0 and 2 lags to d_l = 1.63 and 1.59 and d_u=1.72 and 1.76 (2 and 4 variables in model *b*). The corresponding intervals for H_0 are [1.72;2.28][1.76 ;2.26], respectively

6. FIGURES

Figure 1 – **Annual number of Canadian corporate debt issuers recorded in S&P's CreditPro database (1981-2001)**

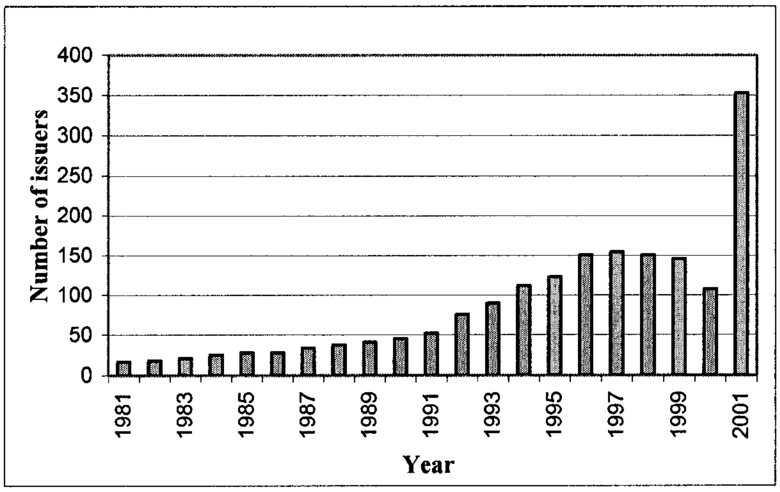


Figure 2 – **Repartition of corporate debt issuers across rating classes (1981-2001)**

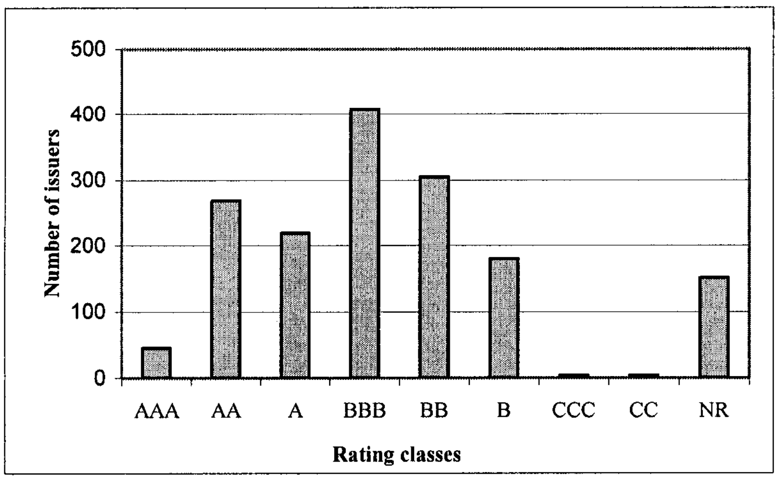
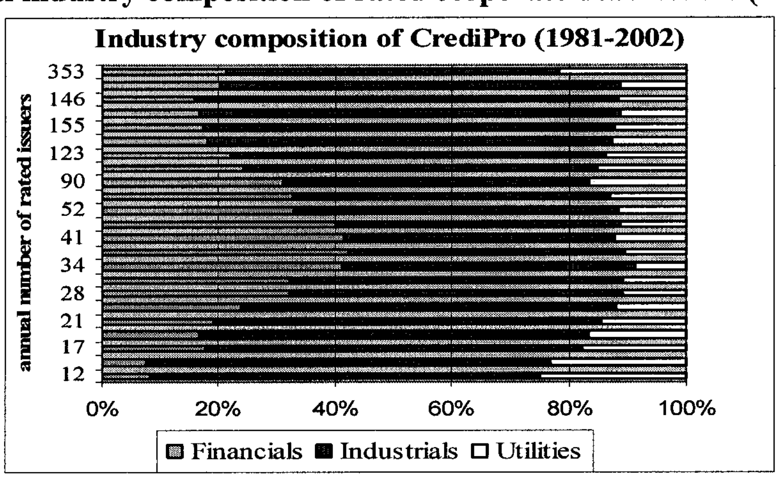


Figure 3 – **Annual industry composition of rated corporate debt issuers (1981-2001)**[9]



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[9] ***"Financials"*** include Financial institutions, Insurance and Real estate. ***"Industrials"*** includes Energy & natural resources, Forest & building products, Homebuilders, Consumer services, Leisure & media, Healthcare, Chemicals, High technology, Computers & Office equipment, Aerospace & Automobiles, Capital goods & Metals. ***"Utilities"*** includes Utilities, Transportation and Telecommunications.

FIGURE 4- **Unconditional annual rating drift and rating activity (1981-2001)**

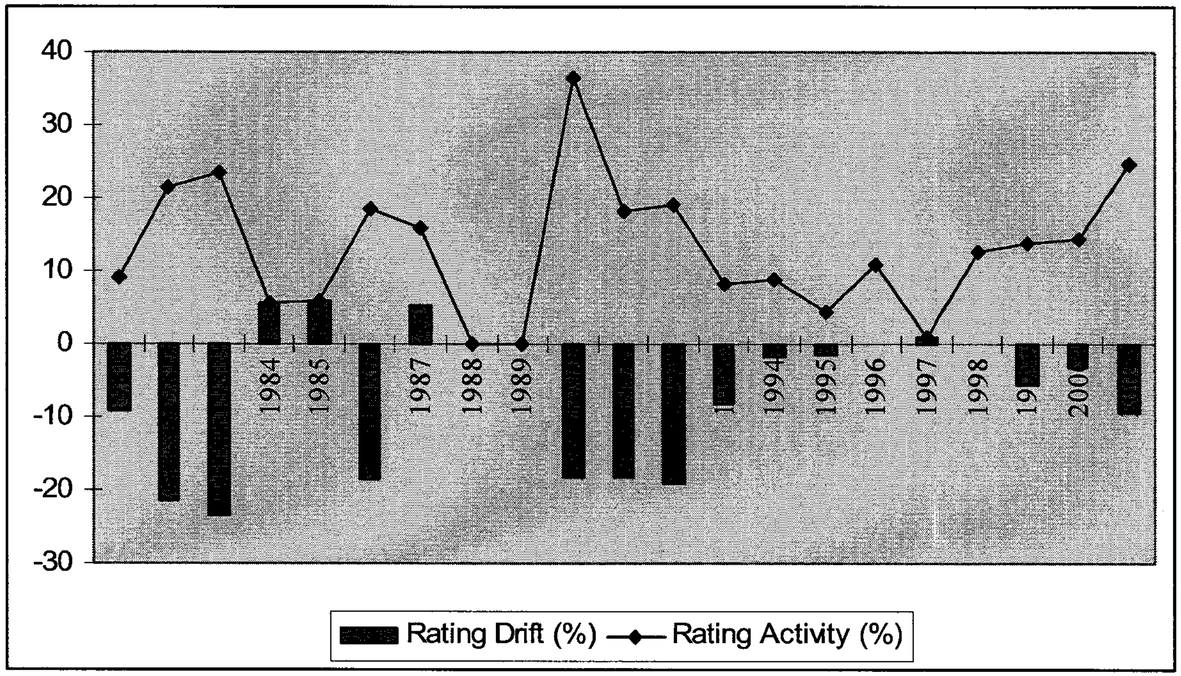
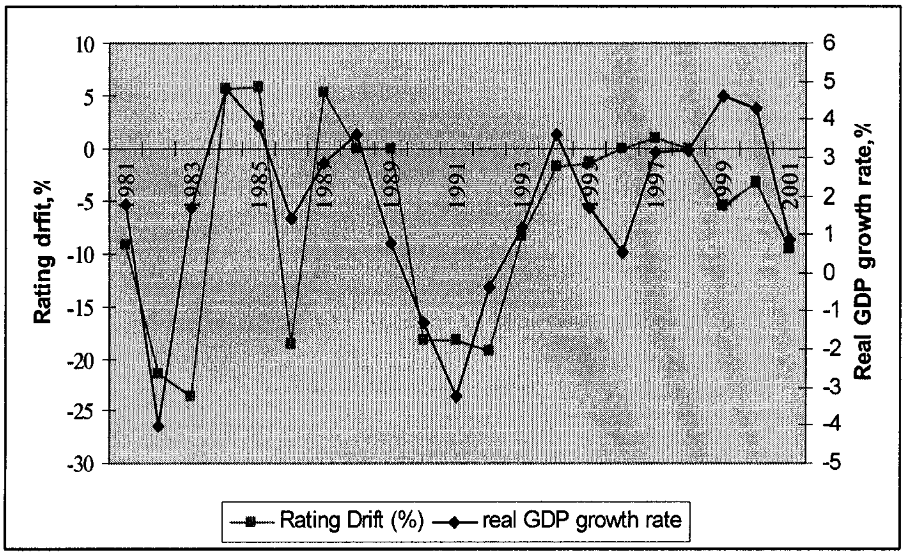


FIGURE 5 - Annual unconditional rating migration dynamics and the real GDP growth rate (1981-2001)

The graphs below show the positive (negative) relation between the rating drift (activity) ratio and the annual GDP growth rate (%).



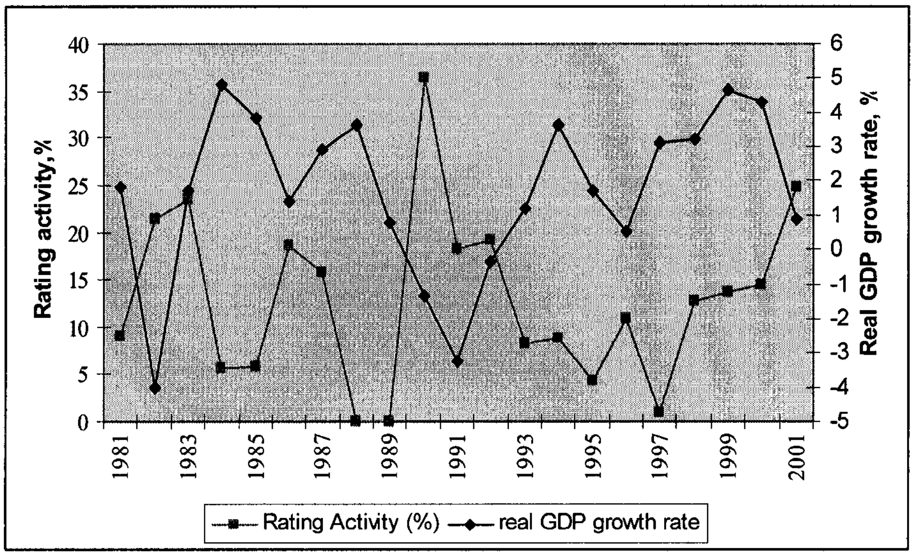
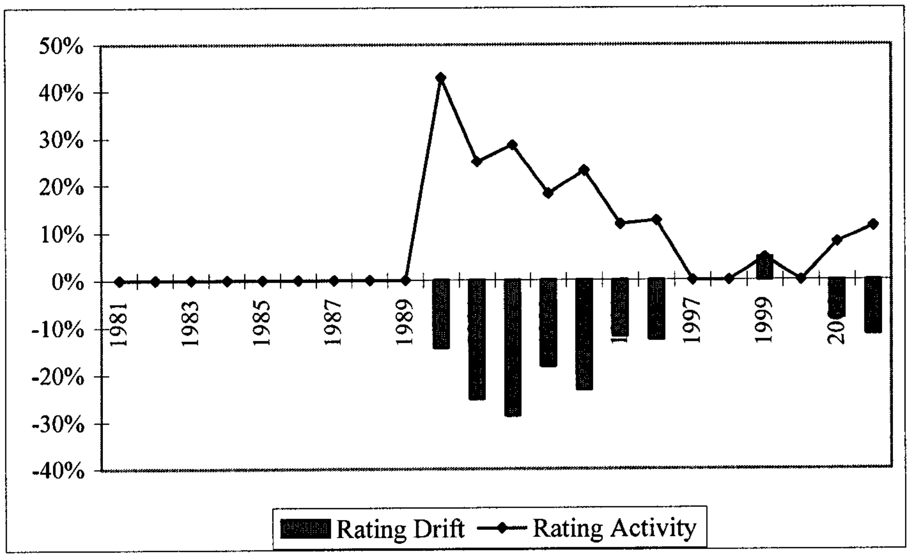
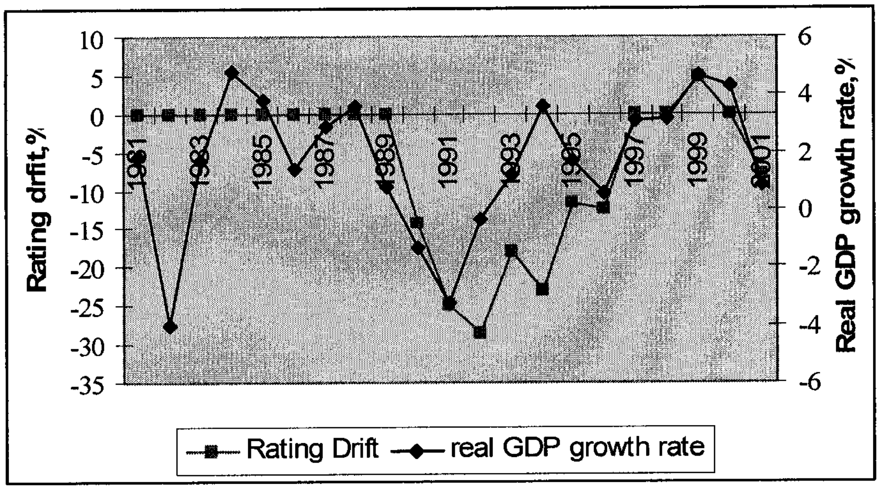


FIGURE 6 – **Rating migration dynamics of obligors sorted by industry**

Panel A - "Financial" obligors (Jan 1981-Dec2001)



The charts below plot the real GDP growth rate on the left scale and on the right scale is the Rating drift (upper graph) or the rating activity ratios (lower graph).



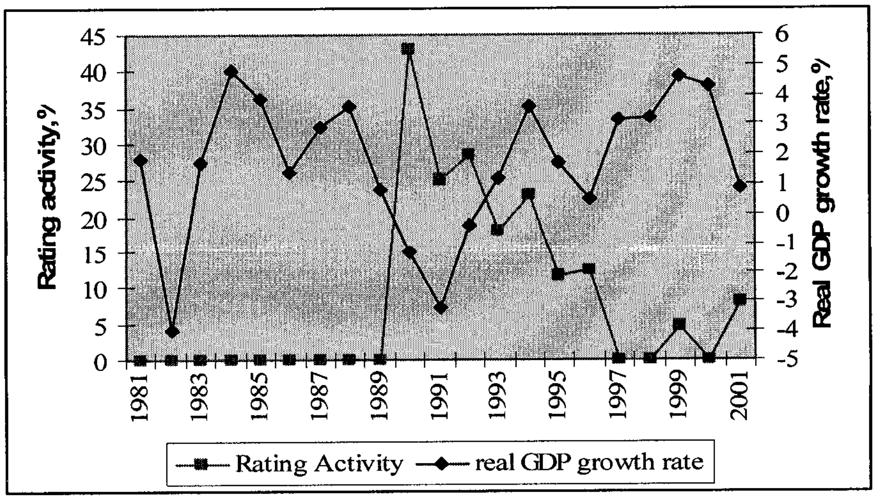
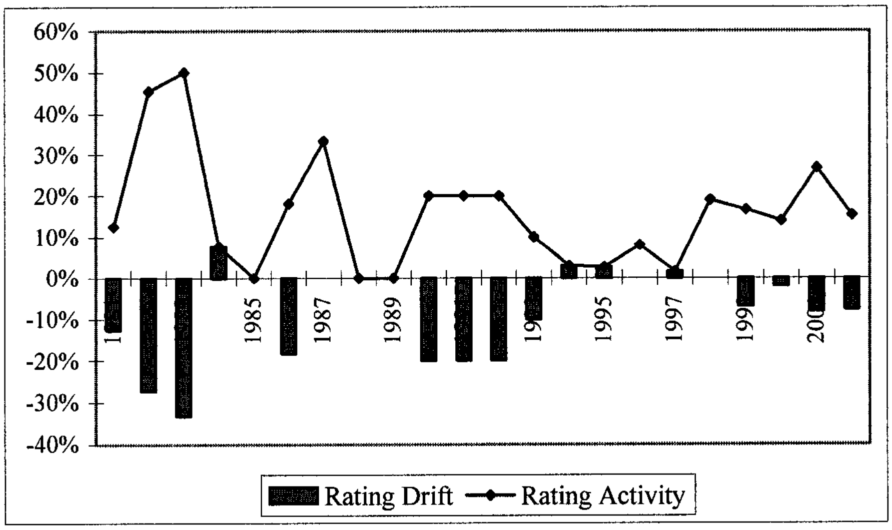
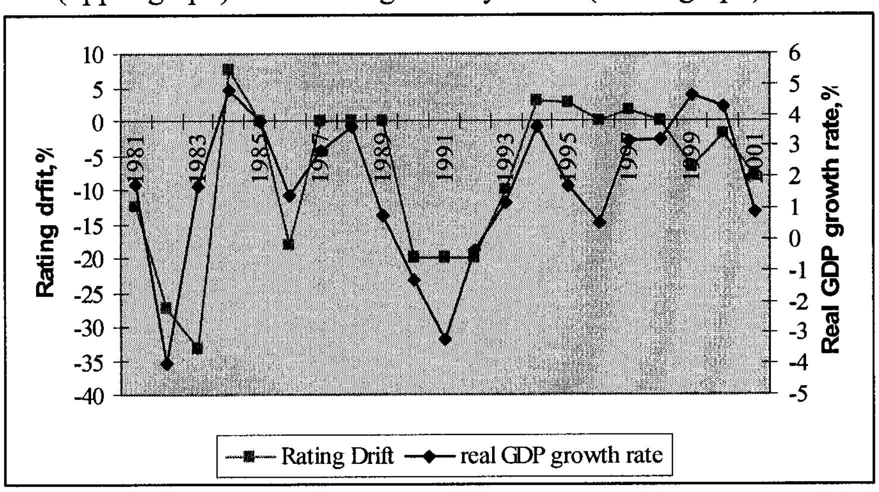


FIGURE 6 ***(continued)*** **–Rating migration dynamics of obligors sorted by industry**

Panel B - "Industrial" obligors (Jan 1981-Dec2001)



The charts below plot the real GDP growth rate on the left scale and on the right scale is the rating drift (upper graph) or the rating activity ratios (lower graph).



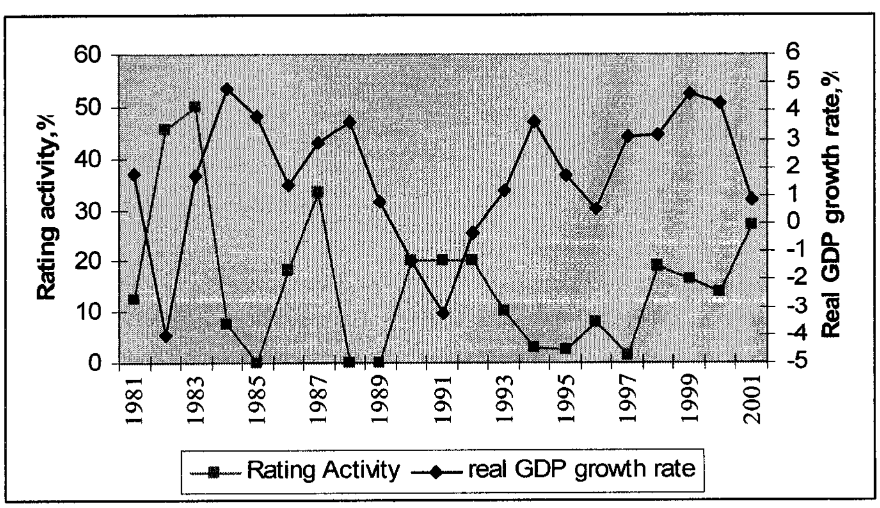
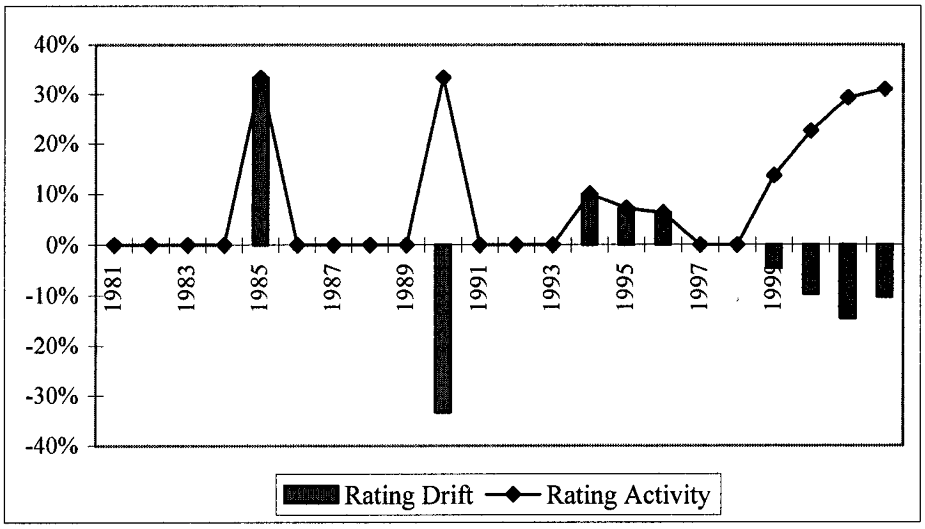
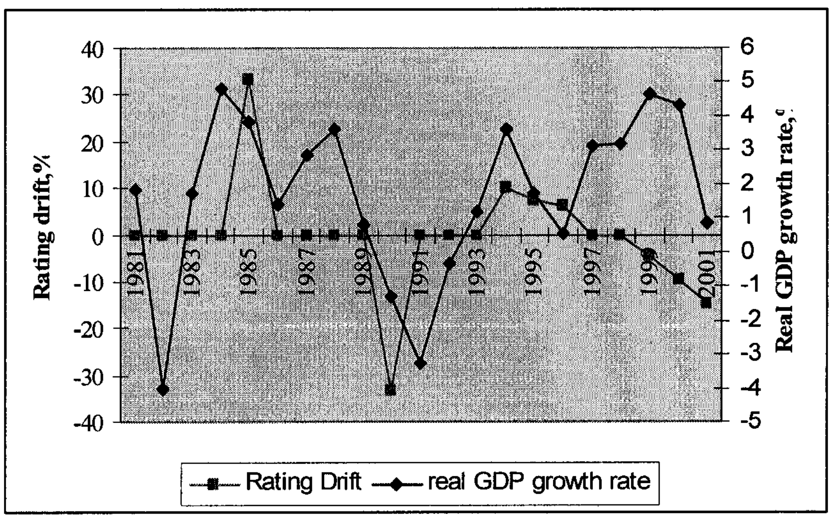


FIGURE 6*(continued)*– **Rating migration dynamics of obligors sorted by industry**

Panel C - "Utilities" obligors (Jan 1981- Dec 2001)



In the two charts below, the left scale is the GDP growth rate, and the right scale is either the rating drift or activity ratio.



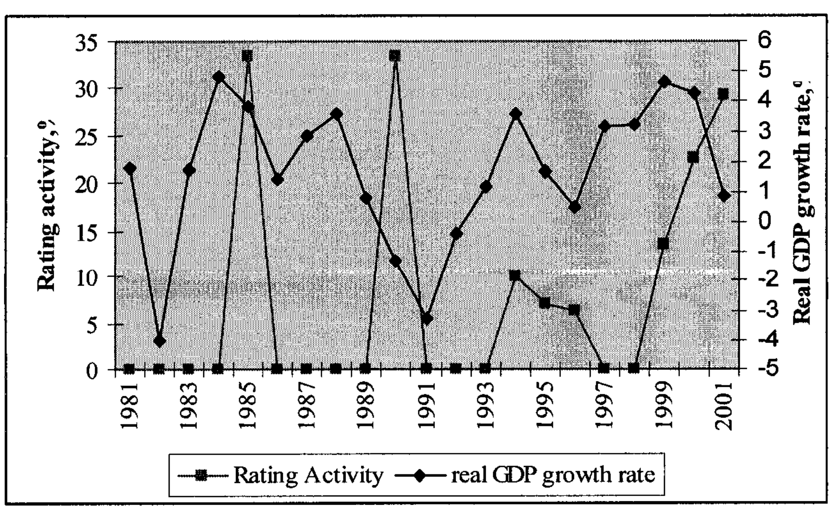
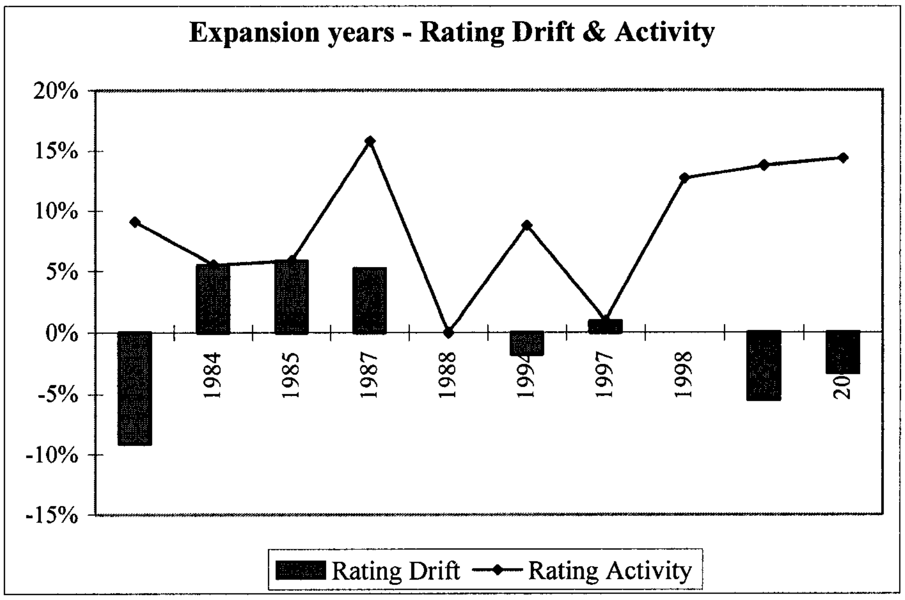


FIGURE 7 – Conditional rating drift and rating activity: years of economic expansion and recession in the studied period (1981-2001)



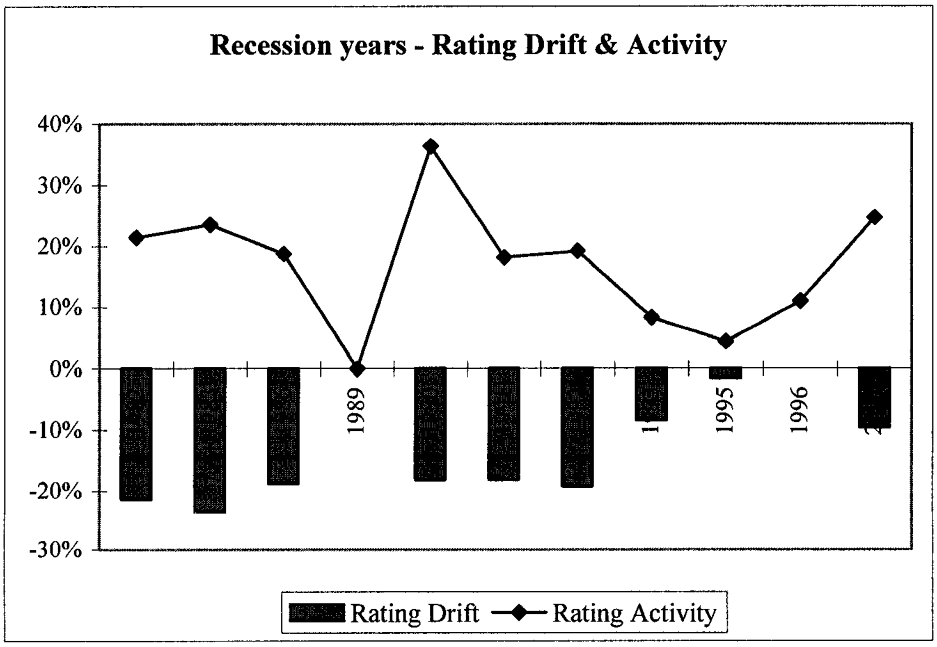


FIGURE 8 - **Autocorrelation coefficients for the time-series of portfolios' monthly excess returns (February 1993 – May 2002)**

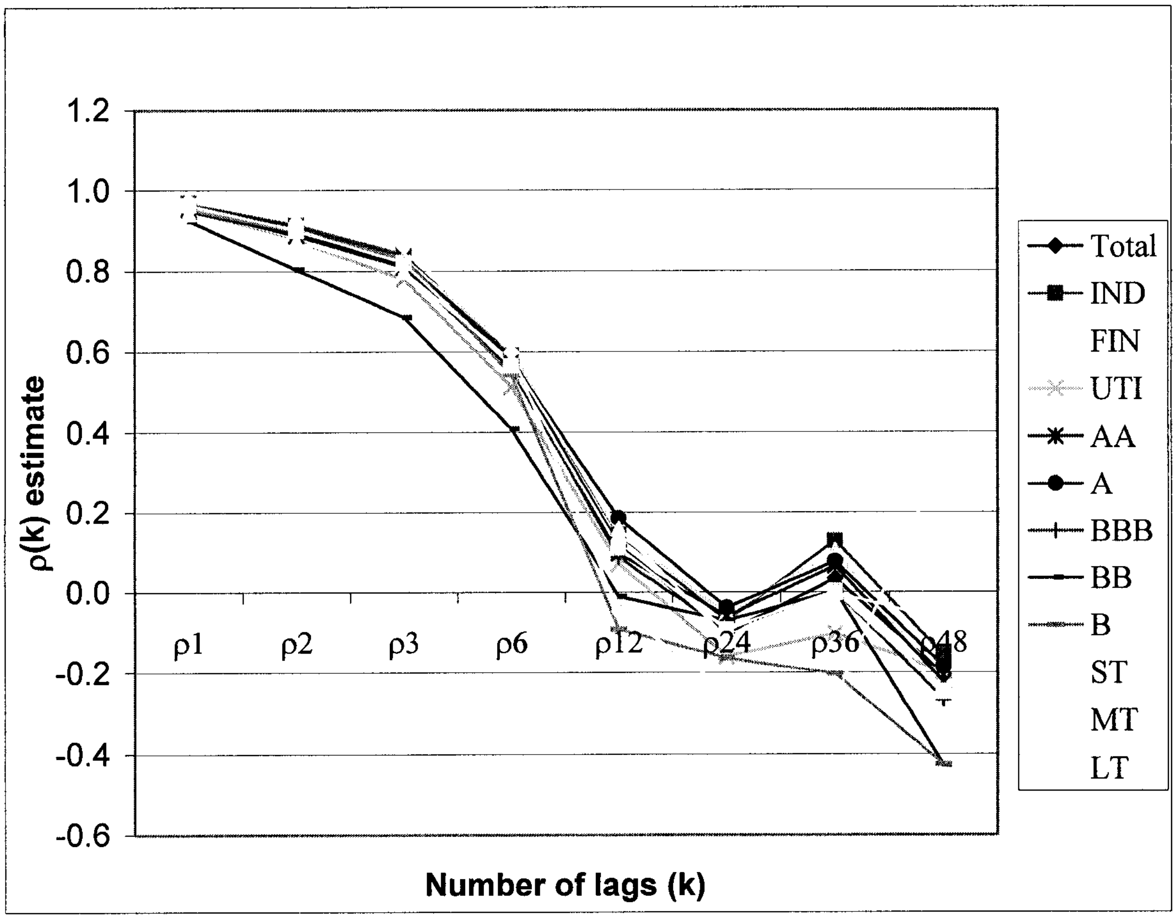


FIGURE 9– **Standard deviation of monthly returns on the value-weighted portfolio of all studied Canadian corporate bonds (February 1993 – May 2002)**

The standard deviations are monthly estimates computed from daily return data for the 192 Canadian corporate bonds in our dataset.

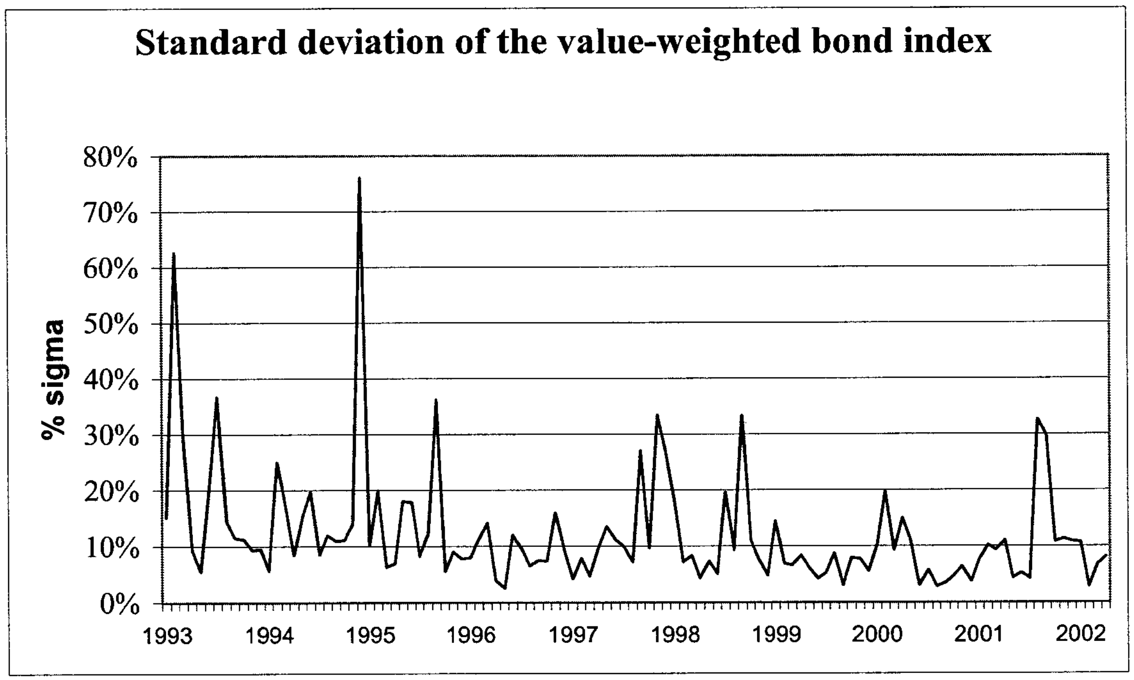
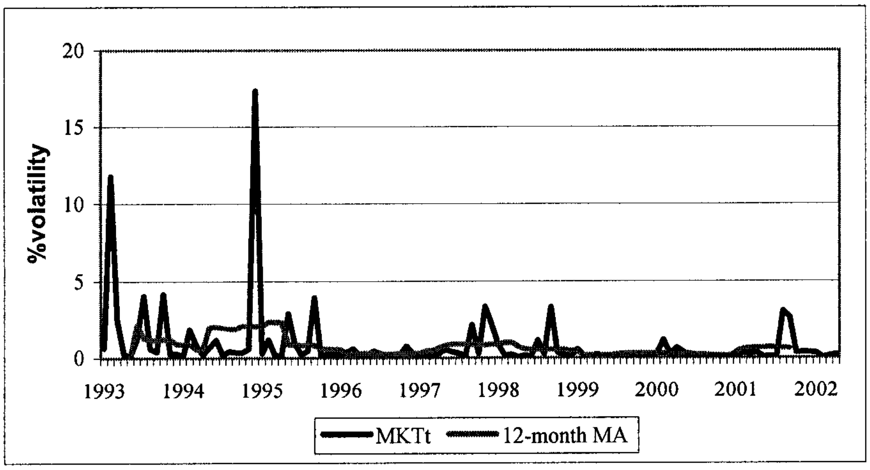
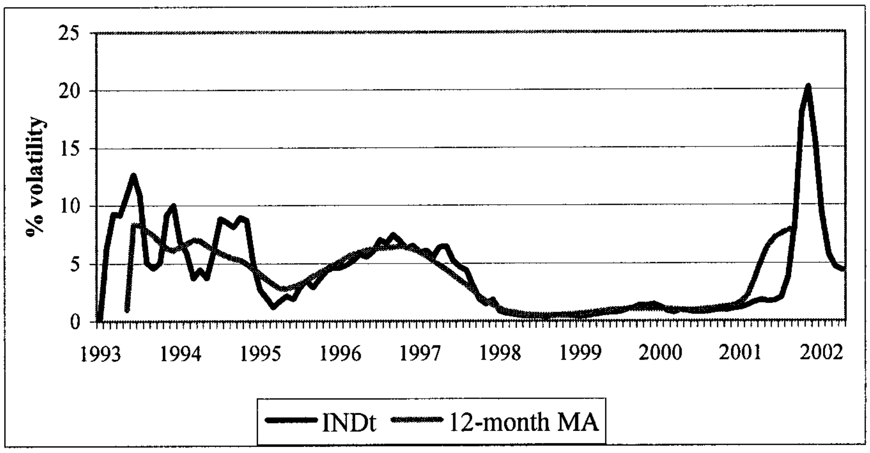


FIGURE 10- **Historical movements in the return volatility components for a Canadian corporate bond (February 1993 –May 2002)**

Panel A - "Market" volatility



Panel B - "Industry" volatility



Panel C - "Firm-specific" volatility

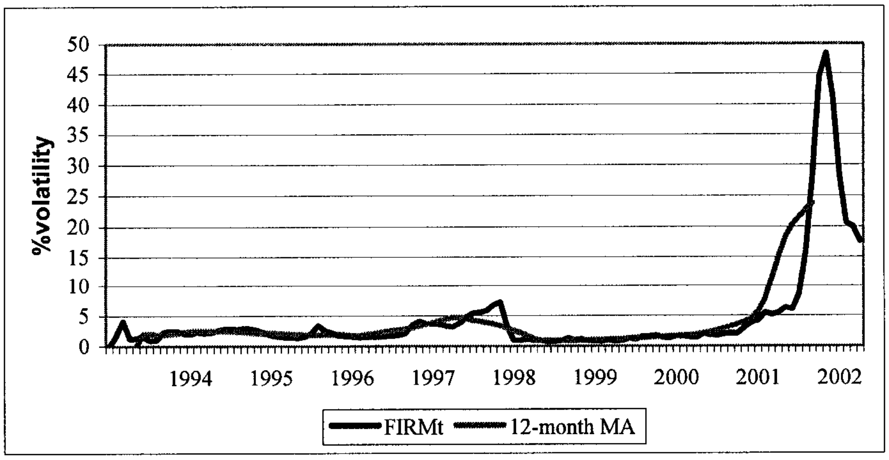
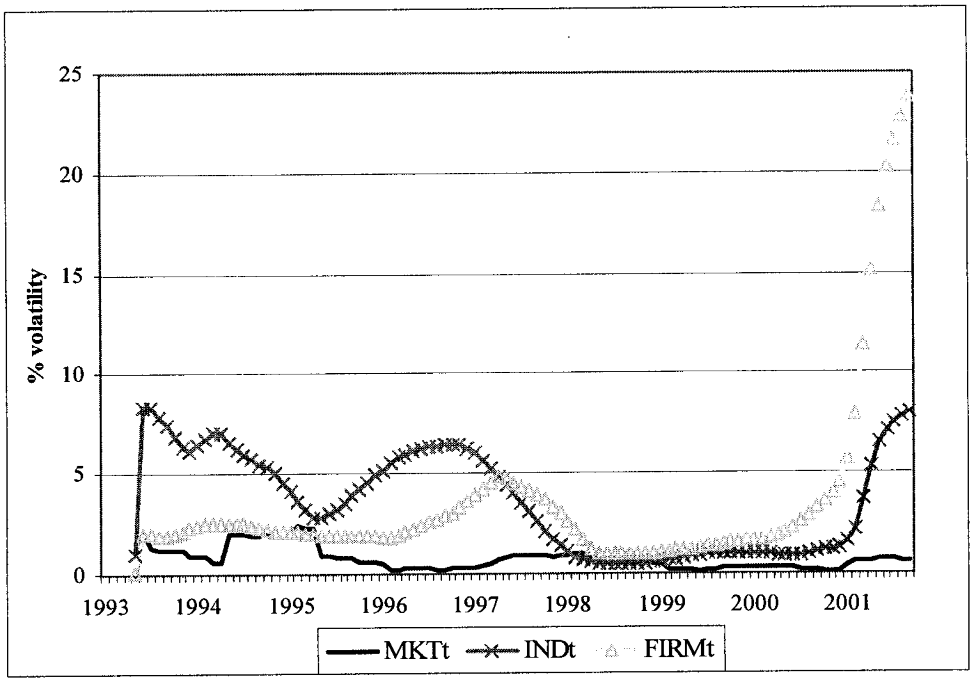


FIGURE 11- **Moving averages of the return volatility components for a Canadian corporate bond (February 1993 – May 2002)**

Panel A – Absolute levels of the volatility components in %.



Panel B – Relative levels of the volatility components as % of the total volatility