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For presentation at ACEA 2012, St. Mary's University, Halifax, NS

Estimating Risk and the Cost of Capital in Canadian Cable Television and Telecommunications

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1. Introduction

1.1. Introductory Remarks

The three decades from 1982 to 2012 were marked by a wide variety of events which significantly affected the Canadian telecommunications and re-broadcasting firms (the "TARB" sector). Re-broadcasting services include cable television (CATV) services and direct-to-home (DTH) satellite services. The primary regulatory body tasked with overseeing firms in these industries is the Canadian Radio-television and Telecommunications Commission, CRTC, under four enabling pieces of legislation: the *Canadian Radio-television and Telecommunications Commission Act*, the *Broadcasting Act*, the *Telecommunications Act*, and the *Bell Canada Act*. During the last thirty years, entry restrictions and regulatory constraints were relaxed for long distance telephony, cable television services, local telephony, satellite services and cellular telephone services. In addition, this period was marked by rapid and wide-reaching technical change. Given the speed and the dramatic extent of the changes in operating environment, we ask: What was the trajectory of risk premia for the major Canadian firms in these industries?

1.2. Historical Events

The anticipated impact of the events which unfolded in the Canadian TARB sector can be characterized by their origin and their speed. For example, the takeover of Cantel by Rogers was privately-instigated and gradual. In contrast, the opening of the market for Canadian long distance telephone service to competition was driven by the regulator and entry barriers were dropped abruptly (although market participants were likely well-aware of this impending decision well in advance). The following list presents some additional examples of events which we hypothesize could be significant determinants of shifts in risk premia, *inter alia*:

1983 [RESTRUCTURING] Bell Canada Enterprises (BCE) is created as the parent company of **Bell Canada** and **Northern Telecom**

1985 [ENTRY & RESTRUCTURING] **Rogers** Communications Inc. enters the mobile phone market as a founding shareholder of **Cantel** Inc., which is granted CRTC approval to provide cellular telephone service.[1] In 1986, Rogers acquires a controlling interest in Cantel.[2] In 1988, Rogers purchases the 12.9% equity interest in Cantel formerly held by Telemedia Enterprises Inc., bringing its ownership of Cantel to 62.8%.[3] Later in 1988 Rogers acquires a 16.6% First City

[1] Report on Business, *The Globe and Mail*, Thursday, January 31, 1985, page B05.

[2] Surtees, Lawrence, Report on Business, *The Globe and Mail*, Tuesday, May 27, 1986, page B01.

[3] Report on Business, *The Globe and Mail*, Thursday, October 20, 1988, page B15.

stake in Cantel, bringing its ownership of Cantel to about 80%.[4] Finally, Rogers announces plans to purchase those shares in Cantel held by Ted Rogers, bringing Rogers' ownership of Cantel to just under 97%.[5]

1986 [REGULATORY CHANGE] Simplification of CRTC's licensing scheme for **CATV** which is now limited to three classes of license agreement. The **CRTC** moves to a rule-based regime for the granting of rate increases.[6]

1987 [RESTRUCTURING] **Cogeco** increases its number of cable subscribers by 86,000 to 130,000 through several acquisitions and reorganizes itself under a new umbrella company, Telecom GCO Inc., a wholly owned subsidiary of Cogeco.[7]

1991 [REGULATORY CHANGE & ENTRY] De-regulation and entry into long-distance telephony by first entrant **Unitel** with a significant ownership stake of **Rogers** and, later, **AT&T.**

1994 [RESTRUCTURING] **Rogers** Communications announces that it had reached an agreement in principle with **Shaw** Communications to exchange certain cable-TV franchises. This move by Rogers neutralizes Shaw as a potential rival suitor for **Maclean-Hunter**.[8] The merger of Rogers, the biggest cable TV operator in Canada, and Maclean Hunter, which has interests in cable, newspapers and magazines, forms the biggest communications company in Canada, with annual revenues of about $2.5 billion.[9]

1995 [ENTRY] **Bell ExpressVu** and **Power DirecTv** receive the first licenses for direct-to-home (DTH) satellite service.[10]

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[4] Report on Business, *The Globe and Mail*, Tuesday, November 15, 1988, page B10.

[5] Partridge, John, *The Globe and Mail*, Tuesday, December 20, 1988, page B01 – Special Sections.

[6] *Cable Television Regulations*, 1986, SOR/86-831

[7] Report on Business, *The Globe and Mail*, Friday, December 11, 1987, page B15.

[8] Report on Business, *The Globe and Mail*, Saturday, March 5, 1994, page B01

[9] Garneau, George, "Maclean Hunter agrees to be bought by Rogers" *Neilsen Business Media*, New York, Vol. 127, Issue 12 (Mar 19, 1994).

[10] *Decision* CRTC 95-901, http://www.crtc.gc.ca/eng/archive/1995/DB95-901.htm and http://www.crtc.gc.ca/eng/backgrnd/brochures/b19903.htm

1996 [ENTRY] **Fundy Cable** Ltd. announces plans to create a province-wide telecommunications network in New Brunswick that would compete with the provincial government's telephone company, **NB Tel**.[11]

1996 [ENTRY] CRTC approves the application for a broadcasting license to carry on a new, national direct-to-home (DTH) satellite distribution undertaking, **Star Choice** Television Network, Inc.[12]

1997 [REGULATORY CHANGE] Partial deregulation of **CATV** by the **CRTC**: undertakings which see subscription losses of 5% or greater are no longer rate-regulated. Overbuilds are permitted.

1999 [RESTRUCTURING] **Shaw** purchases **Fundy Cable.**

2000 [RESTRUCTURING] In February of 2000, **BCE** sells **Nortel** to its shareholders, such that BCE's 500,000 shareholders receive 0.78 Nortel share for each BCE share they own.[13] In the subsequent two years, Nortel's market capitalization decreases from $398 billion in September 2000 to less than $5 billion in August 2002, as Nortel's share price falls from $124 to $0.47.

2000 [RESTRUCTURING] **Rogers** and **Shaw** unite internet forces and undertake other important changes: (1) Rogers proposes to swap its 623,000 customer base in British Columbia for Shaw's 600,000 customers in Southern Ontario and New Brunswick plus $75.9-million; (2) Shaw plans to sell to Rogers its 9.1 percent interest in Cogeco Cable Inc. and its 9.6 percent interest in Cogeco Inc. for $198-million and in exchange, Rogers agrees to sell its stake in Canadian Satellite Communications Inc. to Shaw for $94-million; (3) Shaw and Rogers agree to merge their respective internet sites @home Canada and Excite Canada such that Rogers would own 51 percent of the new combined entity to be called Excite @Canada and Shaw would take control of 22.5 percent; and (4) Shaw announces that it would take a $100-million equity stake in telecommunications company 360networks Inc., acquiring from it a national fiber network for $225-million, agreeing to purchase $25-million worth of high speed capacity over a three-to-four-year period and a new company was formed to manage these new assets, in which Rogers invested $125-million for a 49 percent interest and Shaw retained a 51 percent interest.[14]

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[11] Report on Business, *The Globe and Mail*, Thursday, February 1, 1996, page B05

[12] *Decision* CRTC 96-529 and *Public Notice* CRTC 1995-217, 20 December 1995, as modified in *Notice of Public Hearing* CRTC 1996-6, 10 May 1996; http://www.crtc.gc.ca/eng/archive/1996/DB96-529.htm

[13] Laver, Ross "BCE Sells Nortel" *Maclean's Magazine*, February 7, 2000

[14] Report on Business, *The Globe and Mail*, Friday, March 24, 2000, page B04

2000 [RESTRUCTURING] **Telus** Corp. agrees to acquire **Clearnet** Communications Inc. for C$4.6 billion (US$3.1 billion); Telus also assumes C$2 billion of Clearnet debt.[15]

2000 [RESTRUCTURING] The **CRTC** approved an exchange of cable systems between **Rogers** and **Shaw** that allowed the two companies to rationalize their cable holdings in Canada. Rogers acquired Shaw cable systems in New Brunswick, Southern Ontario and Quebec and Shaw acquired the Rogers cable systems located in British Columbia.

2001 [REGULATORY CHANGE] The **CRTC** approves the application by **Star Choice** Television Network Inc. to amend the licence for its national direct-to-home satellite distribution undertaking. The Commission authorizes the licensee to distribute its service to subscribers in multiple unit dwellings (MUDs) using a variety of technologies including terrestrial distribution techniques (land lines) that may cross property lines, public streets or highways. This will enable the licensee to locate reception equipment on one site and to connect subscribers in MUDs on other sites.[16]

2001 [RESTRUCTURING] The **CRTC** grants approval to **Quebecor** Inc. to acquire Groupe Vidéotron Ltée's cable assets. Quebecor would own a 55 percent stake and the Caisse de depot et placement du Québec, the provincial government's pension fund, would gain the remaining 45-percent, leaving Quebecor in control.[17]

2001 [REGULATION] The **CRTC** approves a rate deregulation for **Rogers** cable systems in St. Thomas and Woodstock, Ontario.

2002 [ENTRY] **Eastlink** Cable began to offer phone service in Halifax.

2004 [ENTRY] **Shaw** applies for telephone license: Shaw Telecom Inc., a unit of Shaw Communications Inc., filed an application to the CRTC for a license to become a competitive local exchange carrier, a regulatory designation for new telephone companies.

2006 [ENTRY] **Rogers** Home Phone voice-over-cable local telephony was introduced in a high-profile Canada Day launch.

2006 [ENTRY] Vidéotron Ltée (partly owned by **Quebecor**) entered the wireless telephone market when it launched a new cellular phone service in Quebec City using **Rogers** Communications Inc.'s wireless network.

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[15] Carlisle, Tamsin, "Canada's Telus to Buy Clearnet for $3.1 Billion" *Wall Street Journal*, 22 Aug 2000, B6

[16] http://www.crtc.gc.ca/eng/archive/2001/DB2001-168.htm

[17] Marotte, Bertrand, Report on Business, *The Globe and Mail*, Thursday, May 24, 2001, page B05

2006 / 2007 [REGULATORY CHANGE] The federal government issues a directive to the **CRTC** such that the regulator is to rely on market forces to the "maximum extent feasible" under the Telecommunications Act and to regulate only when absolutely necessary, signaling a major shift in favour of incumbent carriers.

2010 [REGULATORY CHANGE] **CRTC** decides on the fee-for-carriage rules for cable television and satellite re-broadcasting companies

1.3. Purpose of Study

(1) To determine the size and inter-temporal profile of the risk premia which are an important component of the price of capital;
(2) To investigate the stability of systematic risk premia with respect to changes in regulation, the competitive environment, and technological change; and
(3) To examine the changes in the weighted average cost of capital and its composition over the sample period.

2. Model and Hypotheses

2.1. Discounted Cash Flow

This method relies on market and accounting data to generate an estimate of the risk premium, assuming stability in the expected growth rate of future dividends and share prices, *g*. The levered cost of common equity, C_e, is given by:

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where *d* is the expected dividend rate in the next period and *s* is the current share price.[18] This measure is sensitive to the formulation of the expected growth rate. In practice, measures of investor expectations are unavailable and a proxy value for *g* is used, such as the realized growth rate in dividend per share or other measures of expected future ability to pay dividends including earnings per share, value of common equity per share, or cash flow per share (see, e.g., Patterson (1990)). Conditions under which the DCF method fails to provide a useful estimate of C_e are common. The practical application of the DCF method requires:[19]

(1) $d > 0$, for all observations;
(2) *g* stable, i.e., the standard deviation of *g* should be less than ½ of its mean value;

[18] Gordon and Shapiro (1956) as cited in Perold (2004).

[19] The conditions in the text are our formalized version of the practitioner's requirements set out in Patterson (1990).

(3) consistency among the different proxies for *g*; and
(4) no significant changes in firm structure which might cause discontinuities or breaks in the sequences of the underlying components of C_e.

In addition, practitioners may reject, as excessively inaccurate, estimates of C_e for which

(5) –

The DCF approach is not computationally complicated and it usually requires less data than other methods. However, for the TARB sector, it is unlikely to be suitable since the sample period includes a number of significant changes in firm structure for the firms in the sample.

Since we are seeking an estimate of the systemic risk premium, we need to account for the effects of debt and preferred shares to arrive at the weighted average cost of capital (*WACC*), that is, the unlevered opportunity cost of investing. We develop this cost of capital in Section 3. However, we do not use the DCF methodology to calculate *WACC* due to problems with its results (see Section 5.1 below). Instead, we turn to the Capital Asset Pricing Model as in the next section.

2.2. The Capital Asset Pricing Model (CAPM)

One of the standard approaches in estimating the systematic risk of a firm is based on the following return-generating process of the Capital Asset Pricing Model (e.g. Ross 1994):

$$R - R^* = a + b\left(R_M - R^*\right) + e$$

where R is the firm's rate of return, R^*, is the rate of return of a risk- free asset, R_M, is the rate of return of a general market portfolio, and e, is the random error term. The coefficients a and b can be estimated. If the value of a, also known as Jensen's alpha, is nonzero, the firm's stock is mispriced. Thus, to see whether the market is efficient, we can perform a test for the value of a. The value of $b$tells us how the market evaluates the risks of the firm (systematic). The higher the value of b, the higher the risks associated with the particular firm.

CAPM is usually estimated by considering approximately 5 years of monthly data. It is argued that longer periods should not be used; business conditions and therefore business risk may change substantially, making the beta estimated of a longer period unreliable.

There exists theoretical reasoning behind time variation of the response to systematic risk. It associates with systemic risk firm-specific fundamentals such as firm size, liquidity, profitability, financial and operational leverage, business cyclicality, operating efficiency and growth.

Blume (1971) showed that such a time-variation could be exhibited by the existence of a mean reversion in the beta estimates. The arguments in favor of such an approach are:

1. Any change in the firm's financial leverage (capital structure) will change the beta of the equity. Any new project the firm takes on which is of a different (systematic) risk profile than the average risk of its existing assets will change the level of business risk of the firm, and thus it will lead to changes in the systematic risk of the equity.
2. With regard to business risk, any new project the firm undergoes will be selected from a set of investment opportunities that it is not known beforehand. Thus, any given project will randomly increase or decrease the risk. Furthermore, temporary changes in the competitive environment may also change temporarily the business risk of the firm.
3. If we assume that there exists an "optimal" capital structure for a firm, as market prices fluctuate the debt-to-equity ratio won't be constant. As a result this ratio will need to be readjusted towards to the "target", i.e. there will be a mean-reversion of the capital structure, and thus in the firm's systematic risk.

For the above reasons, if a specific form for the betas is not assumed, the stability of CAPM is examined by considering rolling window estimates. That is, statistical testing for the stability of beta is not often done in the literature. This paper besides examining rolling estimates, it will also employ formal tests regarding the stability of beta over time.

In what follows, we present three statistical methodologies used for formally testing whether a firms' beta has changed over time.

2.2.1. Bai & Perron (1998) Methodology

A method of least squares estimation for testing for structural breaks has been developed by Jushan Bai and coauthors. Consider the following regression model (in matrix format):

$$y_i = x_i' \beta + u_i$$

In many applications it is reasonable to assume that there are *k* breakpoints, with different coefficients across the different *k+1* segments. Given that within each segment the regression coefficients are constant the model can be rewritten as:

$$y_i = x_i' \beta_j + u_i$$

$$i = i_{j-1} + 1, \ldots, i_j, \; j = 1, \ldots, k + 1$$

where *j* denotes the segment index. Since the breakpoints are rarely given exogenously, and they have to be estimated, they are identified by minimizing the residual sum of squares (RSS) of the equation above.

Bai (1994, 1997a) derived the asymptotic distribution of the break point estimator and showed how to construct confidence intervals for it. Additionally, Bai and Perron (1998) developed tests for multiple structural changes and suggested procedures for the simultaneous estimation of multiple break dates. We will refer to their approach as the B&P methodology.

The algorithm for computing the optimal breakpoints given the number of breaks is based on a dynamic programming approach. The underlying idea is that of the Bellman principle. The main computational effort is to compute a triangular RSS matrix, which gives the residual sum of squares for a segment starting at observation i and ending at i' with $i < i'$. Given the computational complexity of the approach, Bai and Perron (2003) suggest an efficient way of implementing their algorithm.

2.2.2. QLR Methodology

The Quandt Likelihood Ratio (*QLR*) test (Quandt, 1960), or sup-Wald statistic, is a modified version of the Chow test used to identify break dates. In effect, it examines whether the maximum value of the Chow statistic over a sequence of observations exceeds a (non-standard) critical threshold. In more detail, let $F(\tau)$ be the Chow test statistic for testing the hypothesis of no break at date τ. The *QLR* test statistic is the maximum of all the Chow *F*-statistics, over a range of τ, where $\tau_0 \leq \tau \leq \tau_1$:

$$QLR = \max\left[F(\tau_0), F(\tau_0+1), \ldots, F(\tau_1-1), F(\tau_1)\right]$$

A conventional choice for τ_0 and τ_1 are such that the *QLR* test statistic is calculated over the inner 70% of the sample, that is, the first and last 15% of observations are excluded.

Even though the test statistic for the Chow test is known, the *QLR* test uses the maximum of many Chow statistics. Thus, *QLR* has a non-standard asymptotic distribution (Andrews 1993). In particular, its distribution is a combination of independent continuous-time “Brownian Bridges” process. Critical values have been tabulated and can be found in Stock and Watson (2003).

2.2.3. A note on B&P and QLR

It should be noted that the above methodologies do not allow for potential break dates in the beginning and the end of the available sample. That is, the Bai and Perron (1998) approach does not look for breaks in the first and last 10% of observations, effectively searching for a break in dates from 1985 until 2009, whereas the QLR methodology search leaves out the first and last 15% of observations.

This may have an effect of “missing” changes that may occur towards the end of our available sample. The consequence of removing from consideration 3 years (under B&P) or 5 years (under QLR) is that potentially significant changes occurring after 2008 cannot appear in our results.

2.2.4. Regime Switching Methodology: ICL-BIC

Finally, an alternative approach to identifying the existence of structural breaks is to turn to Regime Switching Models. In this setting, breaks can be defined points in time such that there is some significant change from one regime to another.

A Regime Switching Model is a discrete-time stochastic process including an underlying finite-state Markov Chain (state sequence) and a sequence of random variables whose distributions depend on the state sequence only through the current state (observation sequence). The state (regime) sequence, conventionally denoted by X_t, is not observable, and hence all the conclusions about the process must be made using only the observation sequence, which is denoted by Y_t.

The estimation of a Regime Switching Model is straightforward and is based on variants of the Expectation Maximization Algorithm (see Hamilton 1989 for details). Nevertheless, it requires that the number of the different regimes is known *a priori*. This may not the case; unless there are theoretical grounds, the researcher is in the dark in terms of the appropriate number of regimes. In most of the work on inference on the number of states in HMMs, the main approach has been to separate the problem of testing for the number of regimes *n*, from the fitting of the model, and hence estimation, for a fixed value *n*.

In this paper the Integrated Classification Likelihood (ICL) information criterion proposed by Biernacki et al. (1998), and in particular its variant the ICL-BIC is employed[20]. This criterion is based on the classification likelihood, i.e. the likelihood that takes also into account the classification of the data points to each regime, thus making it theoretically superior to other information criteria for the case of a Hidden Markov Model. Furthermore, McLachlan and Peel (2000) verified its ability to correctly assess the number of components within finite mixture model specifications. Another advantage for the employment of the ICL-BIC criterion is its easy computation; it is essentially the BIC plus a term that is obtained during the model estimation. Ntantamis (2011) compared this approach to the Bai and Perron (1998) methodology, within the setting of a monetary rule estimation, and found that it has a better performance.

[20] The most common examples of information criteria used in the literature are the Akaike Information Criterion (AIC), proposed by Akaike (1974), and the Bayesian Information Criterion (BIC), proposed by Schwarz (1978).

3. Cost of Capital

Following the corporate finance literature regarding a firm's cost of capital, we define the Weighted Average Cost of Capital (*WACC*) as

$$WACC = r_e(L)\frac{E}{D+E+P} + r_D\left(1-t_c\right)\frac{D}{D+E+P} + r_P\frac{P}{D+E+P}$$

for a firm whose capital structure involves common and preferred equity and debt. The *WACC* can be assumed to be equal to the unlevered cost of equity (or assets)

The following variables are involved in calculating *WACC*:

$r_e(L)$: levered cost of equity
r_D : cost of debt
r_P: return on preferred stock
t_c: Corporate tax rate
D, *E*, *P*: market value for the existing debt, common equity, and preferred stock respectively.

In what follows, we elaborate on how the above quantities are obtained. In order to derive the levered cost of capital, $r_e(L)$, we use the betas obtained from estimation of the CAPM. Given the estimated equity beta β_E, the following steps are used to generate $r_e(L)$:

1. Estimate the market risk-free rate on debt rf_D. We use the AAA corporate bond yield. Using the T-Bill rate may underestimate the cost of risk-free debt for the corporations in our sample.
2. Obtain $E\left(r_M\right)$, the expected value for the market return. If this is not feasible, historical returns can be used.
3. Estimate return on equity:
   $r_e(L) = rf_D + \beta_E\left(E\left(r_M\right) - rf_D\right)$

The cost of debt, r_D, can be roughly approximated by the ratio of interest expenses over the total amount of debt , whereas the return on preferred stock, r_P, is approximated by the ratio of the dividends paid to the preferred stock over the value of the preferred stock (see Appendix for details).

An important element in the calculation of *WACC* is the corporate tax rate, which relates to the tax benefits that the firm is having by financing its capital by using debt. Even though one may be tempted to use the corporate tax rate set by the tax authorities, on federal and provincial level, this may not be related to the tax rate that the firms are actually facing.

Since tax avoidance is legal, many large companies push into legal grey areas with aggressive strategies designed to increase "tax efficiency". As a result, there is an extensive literature in Accounting discussing the notion of *Effective Tax Rate (ETR)*, i.e., the implied tax rate that the firm is facing if it uses various provisions in the tax code to reduce its tax burden. Furthermore, the amount of tax a firm pays is also related to projections of future profits among others. As a result, the calculation of tax is not solely based on data that can be obtained by the firm's reported Income Statements. Thus, different methods have been proposed in order to obtain estimates for the effective tax rates using reported data (see Plesko 2003 for a comparison). The main attribute of these methods is to construct ratios of the form: tax paid over pretax income. Furthermore, there are variations that use either data from a single year or a moving average over a number of years.

We use the approach suggested by Gupta and Newberg (1997). Gupta and Newberg propose that the Effective Tax Rate should be calculated as the ratio of the current income tax expense over the book income before interest and taxes. Both quantities are calculated using annual data available via COMPUSTAT (see Appendix). This method allows for Effective Tax Rates to be in the [-1,1] range.

Finally, the derivation of *WACC* requires the use of market values for all the forms of financing (equity or debt). Regardless, we concentrated in obtaining the market value for the common equity. There are two reasons: i) the preferred stock is for most firms only a small fraction of the ways capital is financed, and ii) for the firms under consideration and for the period involved, we would expect small differences between the market and the book value for debt. Employing book values may lead to underestimating the cost of capital. Nevertheless, the focus of this paper is on examining the changes in the cost of capital, so we should not expect our results to be sensitive to this choice.

In order to obtain the market value of common equity, *E*, we need two items: the number of common shares outstanding, and the price of common equity. We use as the price of common equity, for a given year, the average monthly close price during that year, whereas the number of common shares outstanding is the number reported at the end of the same year (see Appendix).

4. Data

We examine seven Canadian firms whose primary business is in Telecommunications and/or Re-broadcasting: Bell, Telus, Quebecor, Rogers, Shaw, Cogeco, and Manitoba Telecommunications.

4.1 DCF Data

For the DCF approach, we are seeking readily-available series to understand how investors might have viewed returns in these firms over the later years of the sample period. Data are drawn from a publicly-accessible source: the system for electronic data analysis and retrieval (sedar) of the Canadian Securities Administrators. The following series were extracted from the audited annual financial statement for each corporation for 1999 to 2011: number of shares, revenues, common equity, net cash flow, operation cash flow, net income, price of stock, shareholder's equity, and dividends. Descriptive statistics for growth rates of accounting measures per share, dividends per share, and the resulting estimates for C_e are provided in Appendix A.1.

4.2 CAPM Data

When estimating the risk premia using the CAPM approach, in addition to the seven firms listed above, we also considered two portfolios of the given companies, one assigning equal weights and the other using equity-value weights, and the Telecommunications Index from the Toronto Stock Exchange. The period over which data for each firm are available can be found in Appendix A.2.

In order to obtain the risk premia and the cost of capital, according to the methodologies described above, we need two types of data. Estimation of CAPM requires monthly data for the firms' stock returns. Calculation of *WACC* requires annual data about the firms' fundamentals, as reported in their Balance Sheets and Income Statements. Data for these two tasks were retrieved using the COMPUSTAT database. The identifiers (TIC) for each firm are also provided in Appendix A.2.

The excess returns for each of the series are consideration and their descriptive statistics are provided in Appendix A.3. In order to obtain the excess returns, we used the 10-year, Canadian Treasury Bond as a proxy for the risk-free rate.

Overall, we observe that during the time period under consideration, the telecommunication firms', and index, exhibit substantial variation. If the coefficient of variation is used, we see values ranging from around 6 to approximately 11, i.e. the standard deviation is at least 6 times higher than the mean of the given series.

5. Results

5.1. DCF Results

The estimates for C_e for the firms in the sample fail to satisfy the conditions presented above for the validity or accuracy of the DCF method. No calculations are presented for BCE since the episodes of significant corporate restructuring that occurred during the sample period produced serious discontinuities in the accounting measures for the firm.

For all of the remaining firms, conditions (2), (3), and (4) are not satisfied, that is, g is not stable, there is no consistence among proxies for g and all firms experienced at least some change in firm structure (particularly the growth of new business segments) which render the estimates of g less than satisfactory. In addition, all firms except for Shaw fail to satisfy – Rogers fails to satisfy condition (1), since in some years $d = 0$.

We cannot conclude much from the results of the DCF method. Although the data and computation requirements are lower, we reject this method in favour of CAPM. Further, the suggestions of instability in the measures that we observe in the DCF method provide additional motivation for determining the extent of stability for risk premia in capital prices using the CAPM measures.

5.2. Rolling CAPM

Given the preceding discussion about the inherent instability of the firm's systematic risk, captured by the CAPM beta, we estimate CAPM betas by using rolling samples of 5 years each (60 monthly observations). The results are depicted in Appendix B. In general, there exists a substantial variation of the beta coefficients for most of the firms under consideration. There appears to be some sort of mean reversion, with the exceptions of Rogers (declining trend), and Telus (slightly increasing trend). The variation is smaller for the case of the Portfolios, especially for the one constructed using equal weights. Even though the 90% confidence intervals are relatively wide, they are not wide enough to suggest that the values are constant over time.

To summarize, the 60-month beta estimates show dramatic but declining instability as one would expect from an industry in rapid transition, experiencing many shocks.

5.3. Econometric Analysis: B&P, QLR, ICL-BIC

There are two dimensions to be considered in our results. The first involves the stability of the CAPM estimates over time, that is, whether the three statistical methodologies identify the existence of breaks or not. The second involves the values of the estimates themselves, i.e., the values that the beta and alpha coefficients have taken.

Note that these statistical tests examine whether there is a break not only in the beta coefficient but also in the alpha coefficient in CAPM. Thus, for a break date to be identified, it must be that there is change in either both or at least in one of the two coefficients which is deemed to be statistically significant.

All methodologies show that the betas have remarkable stability. The only sign of instability appears to be in Bell (BCE), likely as a result of Nortel (see Appendix C for details). In particular, for the B&P methodology, the only series for which breaks are identified are the BCE, the Portfolio constructed using equity weights, and the S&P\TSX Telecom Index. We can attribute the Portfolio's breaks to BCE, due to large size of Bell, as the dates almost coincide.

If we turn our attention to the results obtained by the QLR methodology, three series appear to exhibit breaks: Bell (BCE), the Portfolio with Equal Weights, and Rogers (RCI). As in the B&P methodology, the dates for BCE and Portfolio coincide, most probably the latter being caused by the former. The date is also similar to the one identified by the B&P: March 2000.

Finally, when we attempt to obtain the optimal number of regimes using the ICL-BIC criterion, we cannot identify any more than a single regime for the parameters of CAPM for the time period under consideration, that is, there is no evidence of a break in the distributions for any of the firms under scrutiny.

We can now turn to the values of the CAPM estimates.

In terms of the values of beta coefficients, we summarize our results as follows:

- For most of the series under scrutiny, the value of beta is significantly lower than unity. The exceptions are Rogers and Cogeco.
- The smallest value for beta is reported for Manitoba Telecom Services (0.25). This is rather small, but it is within the values allowed for the CAPM.

If we now consider the values of the beta coefficients before and after the breaks, when such breaks are identified, we find that for the B&P approach:

- BCE: betas are different across all three segments: 0.44, 1.3, 0.28 respectively. Note that the middle segment (Sep 96-Feb 00) with the high beta also appears in the rolling beta estimates.
- Portfolio, Equity Weights: first and last segments have very similar beta values of 0.5, with the middle one having a high value (~ 1.05). The latter result is possibly caused by the value for BCE.
- Telecom Index: reduction in beta by half (from 0.6 to 0.3). This big reduction in beta is also indicated by the reduction in betas that we observe by the rolling estimation.

whereas for the QLR approach, in all cases there is a reduction in the values of the betas in the second segment identified.

It is also of interest to examine the results for the estimates for the alpha of CAPM. It should be noted that the CAPM model stipulates that the excess return of an asset is only related to the excess return of the market, i.e., there is no intercept in the specification. The existence of an intercept would imply a “mispricing effect”. The existence of mispricing can be examined by estimating CAPM including an intercept. If the intercept is found to be statistically significant, then the stock is mispriced (according to CAPM).

The CAPM specification that we estimated included an intercept. The results suggest that only for two stocks no mispricing effect is identified: Cogeco and MBT. For all other series, the alpha coefficient is statistically significant. Although this result is evocative, since our primary focus in the analysis of firms’ systemic risk, we will leave investigation of the mispricing result to future research.

Given the discussion in Section 2.2, where we provided theoretical reasons for the CAPM beta to vary over time, why do our statistical tests not reveal any significant change in the betas? The apparent volatility in the betas from the rolling 60-month estimates suggests that there should be evidence of variation in the betas. There are at least two potential explanations for why we did not find any evidence of variation:

1. If betas are in fact mean-reverting, then the value estimated may be just the mean value over all this period, any variation being averaged out.
2. The process of deregulation is usually carried in several phases over time, and firms are aware of the details of this process. Thus, the firms have time to absorb to any shocks and adjust their business operations. Changes in the regimes generating the betas would have come only as a consequence of unanticipated regulation changes.

5.4. Weighted Average Cost of Capital

The Weighted Average Cost of Capital was obtained in an annual basis for each of the firms. Before proceeding with the discussion of the *WACC* results, we offer some explanatory comments regarding our calculations.

- As was discussed before, the definition of the Effective Tax Rate allows for outcomes in the [-1,1] range. In the entire sample, there was one firm-year observation that was outside this range (-3.2). We truncated this value to -1.
- The expected monthly return for the market, $E(r_M)$, was proxied by the historical monthly average over the entire sample (~0.64%).
- The average monthly return for Canadian Treasury Bonds during a given year was used for the "risk-free rate".
- The return on equity was obtained in monthly terms (see Appendix) to be compatible with our estimation of CAPM using monthly data. The CAPM betas used were obtained by the B&P methodology.
- Since the cost of debt and the cost of preferred stock are provided in annual terms, the monthly average of the levered cost of common equity over a year was considered, after being converted to annual values.

We divide our discussion of results in two parts. First, we explore the evolution of the WACC over the years for each of the firms. Second, we examine how the components of WACC have changed over the years, i.e., we compare the contributions, to the overall cost of capital, of the cost of equity and the cost of debt. Graphical results are provided in detail in Appendix D.

The cost of capital varies substantially across time for most of the firms, taking values as low as 4% and as high as 11%. Although it appears that, for some firms, their minimum costs occur around 2000-2001, this result cannot be generalized. In terms of the contributions of the cost of equity and of the cost of debt in WACC, we notice that there is also a large degree of variation, for most of the firms.

In what follows, the detailed results for each of the firm are provided.

- Telus
  - The WACC ranges between 7-8% during the 80's and the 90's, when we also observe a decreasing contribution of the cost of debt to the overall cost, and the disappearing contribution of the cost of preferred stock. After reaching a minimum value of 5.2% in 2000, the WACC increases substantially, with the

cost of debt contribution becoming more important, till it peaks at 9.1% in 2003. After that point, there is a steady decline in WACC with the contribution of the cost of common equity becoming more important.

- Quebecor
    - We observe a substantial variation of WACC over the period (minimum value of 4% in 1987 and a maximum value of 10% in 1982). Regardless, the most important finding is that starting in 1988, the largest component of the cost of capital is the cost of debt. For example, during the 00s the cost of debt represents 75% of the total cost of capital.
- Bell
    - Even though there is variation in the values of WACC, we do observe a "regime shift" from values of around 8% during the 80's and 90's, to values of around 5-6% after 2000. Regarding the contribution from the cost components, the most important is the cost of common equity, with the exception of the period between 1989-1995, when the cost of debt becomes more important.
- Rogers
    - We notice a reverse trend compared to the one we have observed for Quebecor. That is, up to 1998, most of the cost of capital comes from the contribution of the cost of debt, whereas afterwards we see increased contributions from the cost of common equity, especially after 2005.
- Shaw
    - We observe a downward trend in the WACC, with the most significant contribution coming from the cost of common equity. The cost of debt is more important only during the years 1995-1998.
- Cogeco
    - There exists a substantial variation, around an average value of 7.5%, with the largest cost component being the cost of debt.
- Manitoba Telecommunications
    - The WACC is stable for most of the period under scrutiny, with the biggest component being the cost of common equity.

6. Preliminary Conclusions

Despite all the events listed in the first section, risk premia remained stable. In particular, neither changes in the nature or degree of regulatory intervention nor market structure changes from entry of competitors seemed to produce any change in the DGPs of the systematic risk premium. We see this result as further evidence for the “big companies” hypothesis.

On the other hand, we notice the cost of capital varies substantially during the same period. Furthermore, the decomposition of the cost to the cost of equity and the cost of debt also presented a substantial variation.

Further research: we would like to be able to decompose the lines of business of each firm to derive the cost of capital for each business line, rather than for the firms as a whole.

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Appendix A: Data

A.1 Data, Sources, and Results for DCF

Data for the DCF method is drawn from SEDAR, the System for Electronic Document Analysis and Retrieval, of the Canadian Securities Administrators (CSA). http://www.sedar.com

The following series were extracted from the audited annual financial statement for each corporation for 1999 to 2011: number of shares, revenues, common equity, net cash flow, operation cash flow, net income, price of stock, shareholder's equity, and dividends. We define estimates of g_i for 2000 to 2011 (except where noted) as follows, choosing the mean of g_4 for the calculation of C_e:
g_1 = annual growth of cash flow per share
g_2 = annual growth of operation flow per share
g_3 = annual growth of earnings per share
g_4 = annual growth common equity per share

Firm	Variable	Mean	Min	Max	Std Dev
Rogers	g_1	0.0214	-7.44	16.3	6.36
	g_2	0.144	-0.404	0.450	0.285
	g_3	-1.21	-7.26	0.583	2.29
	$\mathbf{g_4}$	0.210	-1.56	1.93	0.910
	d/s	0.0162	**0.00**	0.0368	-------
	$\mathbf{C_e}$	**0.226**	**0.210**	**0.247**	**0.0134**
Shaw	g_1 (2004-2011)	-13.9	-97.2	-1.09	33.7
	g_2	0.0629	-0.538	0.605	0.312
	g_3	-0.402	-2.94	0.774	1.26
	$\mathbf{g_4}$	-0.0367	-0.404	0.252	0.202
	d/s	0.0264	0.0105	0.0441	------
	$\mathbf{C_e}$	**-0.0102**	**-0.0261**	**0.0075**	**0.0112**

Firm	**Variable**	**Mean**	**Min**	**Max**	**Std Dev**
Quebecor	g_1	-1.36	-6.02	1.87	2.17
	g_2	-0.0129	-0.286	0.267	0.197
	g_3	-0.551	-2.41	1.01	1.09
	$\mathbf{g_4}$	0.0759	-0.666	1.03	0.439
	d/s	0.0322	0.0214	0.0495	------
	$\mathbf{C_e}$	**0.111**	**0.100**	**0.128**	**0.0089**
Cogeco	g_1 (2007-2011)	-1.67	-6.36	2.98	3.38
	g_2	0.125	-0.100	0.430	0.156
	g_3	-0.336	-4.11	7.07	2.83
	$\mathbf{g_4}$	0.0301	-0.196	0.246	0.133
	d/s	0.0110	0.0069	0.0225	-----
	$\mathbf{C_e}$	**0.0412**	**0.0371**	**0.0527**	**0.0040**
Telus	g_1	3.05	-2.95	56.6	16.9
	g_2	0.201	-0.424	2.76	0.828
	g_3	0.251	-2.31	5.40	1.81
	$\mathbf{g_4}$	0.237	-0.574	2.95	0.885
	d/s	0.044	0.0091	0.100	-----
	$\mathbf{C_e}$	**0.281**	**0.246**	**0.338**	**0.0301**

Firm	Variable	Mean	Min	Max	Std Dev
Manitoba Telecom (MBT)	g_1	0.268	-3.85	5.44	3.28
	g_2	0.0696	-0.506	1.02	0.441
	g_3	0.192	-0.465	2.31	0.827
	g_4	0.0577	-0.386	0.506	0.226
	d/s	0.0188	0.0081	0.0379	-----
	C_e	**0.0765**	**0.0658**	**0.0955**	**0.0111**
Bell Canada (BCE)	***n.a. — Bell excluded since the company experienced at least one major corporate restructuring during the sample period.***				

Firm	(1) $d > 0$	(2) g stable	(3) g_i consistent	(4) no breaks	(5) $d/s > g$
BCE	**Condition (4) violated**				
Cogeco		**no**	**no**	**no**	**no**
MBT		**no**	**no**	**no**	**no**
Quebecor		**no**	**no**	**no**	**no**
Rogers	**no**	**no**	**no**	**no**	**no**
Shaw		**no**	**no**	**no**	
Telus		**no**	**no**	**no**	**no**

A.2 Data Range and Sources for CAPM

Data Identification

The following quantities were required to estimate the Capital Asset Pricing Model (CAPM), and to calculate the Weighted Average Cost of Capital (WACC). The data source was COMPUSTAT, with the variables defined accordingly.

For the calculation of CAPM:

1. Monthly stock return: $TRT1M$
    - $TRT1M$: Monthly Total Return (including & reinvesting dividends)

For the calculation of WACC:

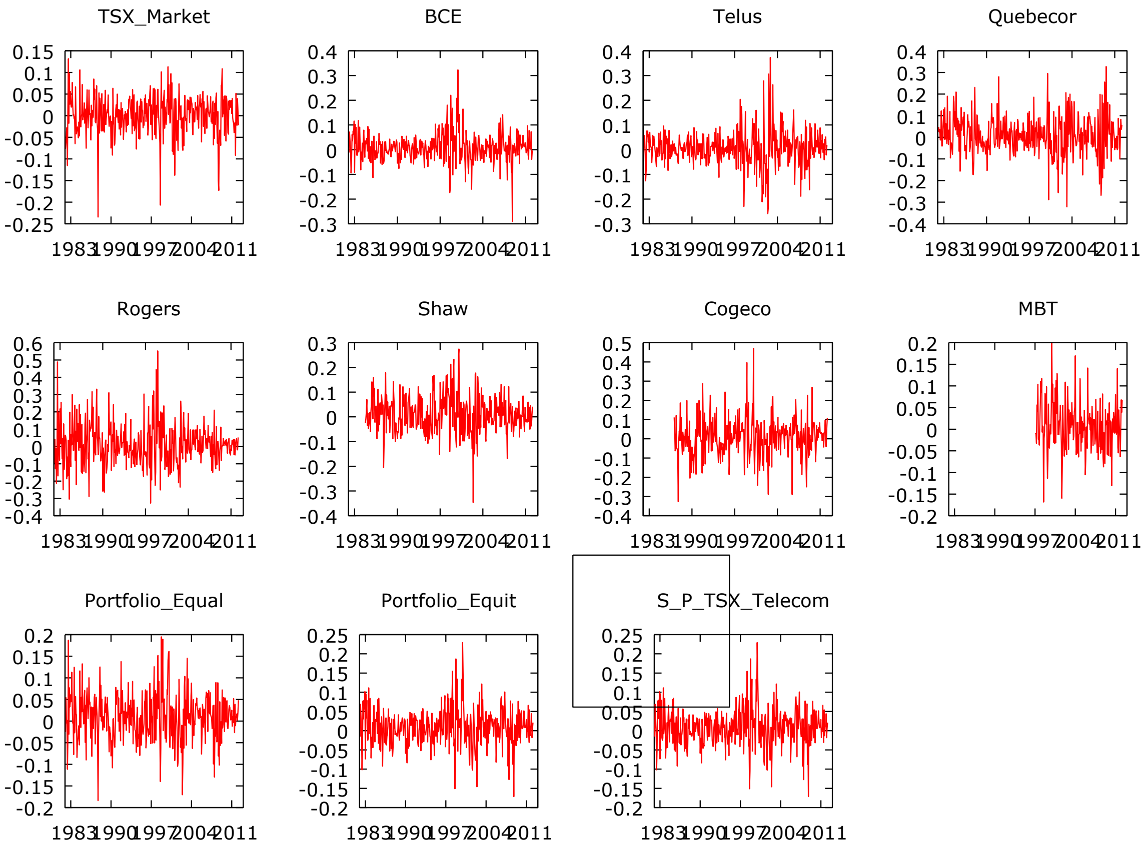
2. Cost of Debt: $r_D = \frac{XINT}{DLTT + DLC}$
    - $XINT$: Interest expenses (total)
    - $DLTT + DLC$: Total debt (long- and short-term debt)
3. Effective Tax Rate: $\frac{TXT\text{-}TXDI}{PI\text{-}ESUB\text{-}SPI+XINT}$
    - TXT : Income taxes - Total
    - $TXDI$: Income taxes -Deferred
    - PI : Pretax income
    - $ESUB$: Equity in earnings- Unconsolidated Subsidiaries
    - SPI : Special items
    - $XINT$: Interest and related expenses- Total
4. Return on Preferred Stock: $r_P = \frac{DVP}{PSTK}$
    - DVP : Dividends paid on preferred stock
    - $PSTK$: Preferred/Preference stock (Capital)-Total
5. Debt (book value): $D = DLTT + DLC$
6. Preferred Stock: $PSTK$
7. Common Equity Price: $PRCCM$
    - $PRCCM$: Price-Close-Monthly
8. Number of Common stocks: $CSHO$
    - $CSHO$: Common Shares Outstanding

Data Range

	Compustat TIC code	Date Range
Bell	BCE	01/1982-03/2012
Telus	TU	01/1982-03/2012
Quebecor	QBCRF	01/1982-03/2012
Rogers	RCI	01/1982-03/2012
Shaw	SJR	11/1984-03/2012
Cogeco	CGO.	01/1987-03/2012
Manitoba Telecommunications	MOBAF	01/1997-03/2012
Portfolio: Equal Weights		01/1982-03/2012
Portfolio: Equity Weights		01/1982-03/2012
Telecom Index		
• **S&P/TSX Communications**	CI4890	01/1982-06/2002
• **S&P/TSX Telecom Services**	TEL.C	03/2002-03/2012

A.3 Excess Returns

Plots



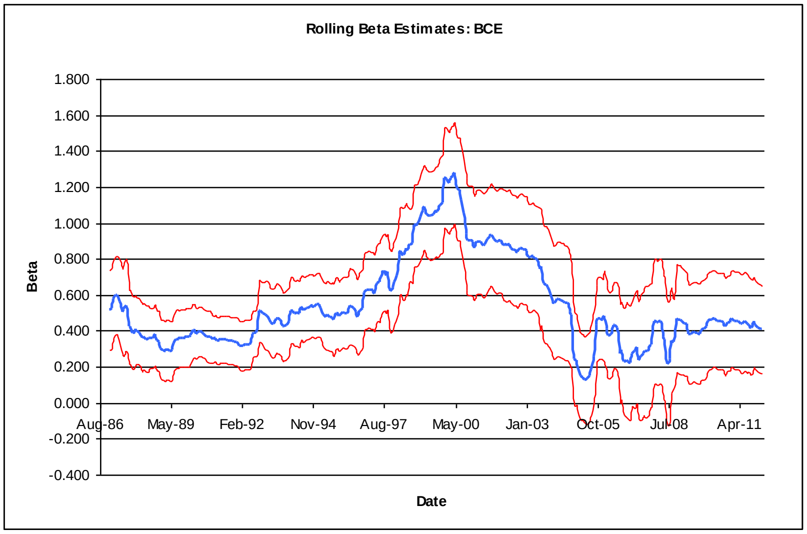
Descriptive Statistics

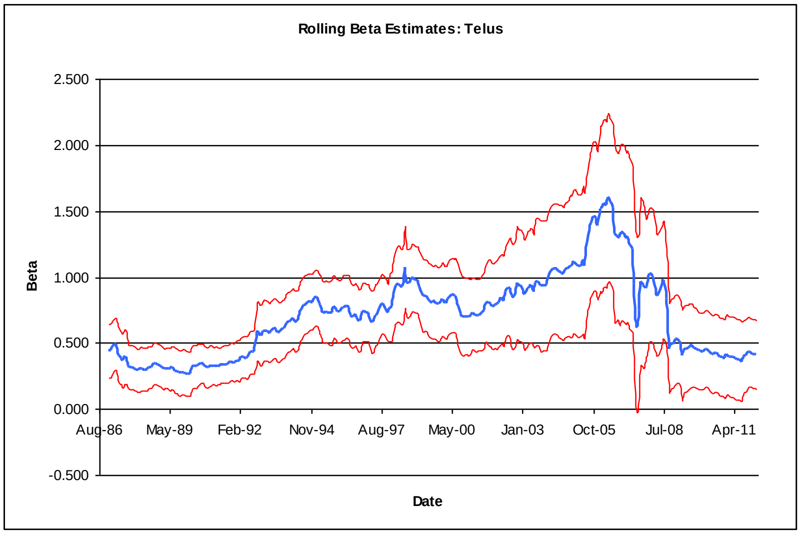
	Mean	Median	Min.	Max	StdDev	Coef.Variation	Skewness	Kurtosis
TSX_Market	0.000	0.003	-0.234	0.132	0.045	99.388	-0.864	3.395
BCE	0.009	0.008	-0.291	0.323	0.058	6.801	0.297	4.732
Telus	0.006	0.009	-0.259	0.373	0.071	11.040	0.317	4.232
Quebecor	0.009	0.000	-0.322	0.327	0.090	10.021	0.081	1.312
Rogers	0.013	0.009	-0.328	0.553	0.121	9.154	0.576	1.822
Shaw	0.011	0.008	-0.347	0.275	0.077	6.870	0.033	1.470
Cogeco	0.008	0.008	-0.327	0.470	0.102	13.403	0.284	2.140
MBT	0.007	0.005	-0.169	0.200	0.057	8.679	0.233	0.905
Portfolio_Equal_W	0.010	0.009	-0.184	0.195	0.055	5.765	0.147	1.085
Portfolio_Equity W	0.008	0.009	-0.172	0.229	0.049	6.061	0.157	2.049
S_P_TSX_Telecom	0.008	0.009	-0.172	0.229	0.049	6.061	0.157	2.049

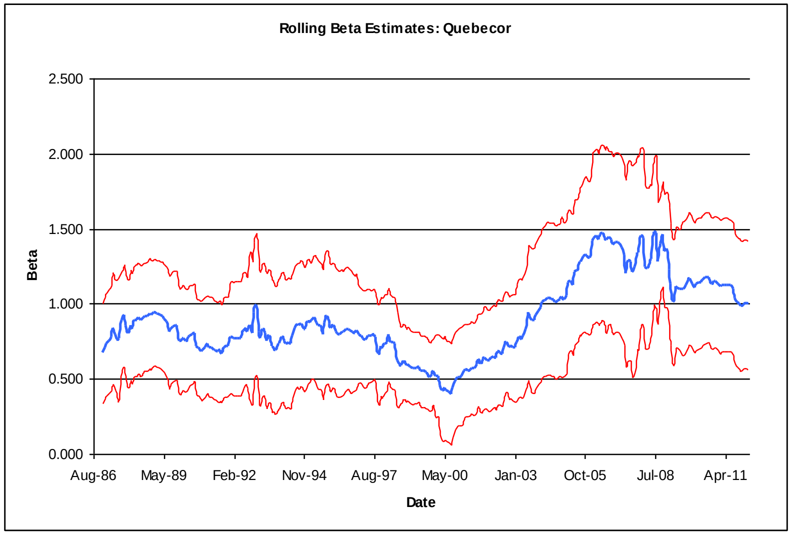
Appendix B: CAPM Rolling-Window Estimates

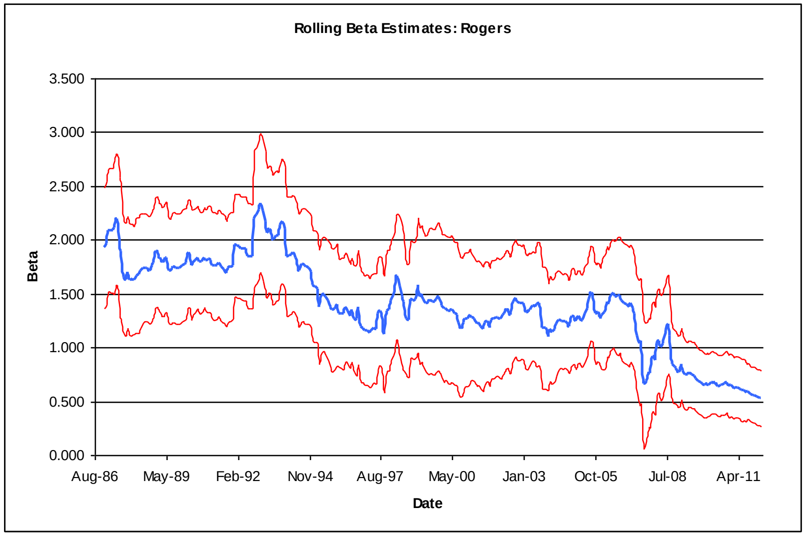
B.1 Time-varying Betas: Plots

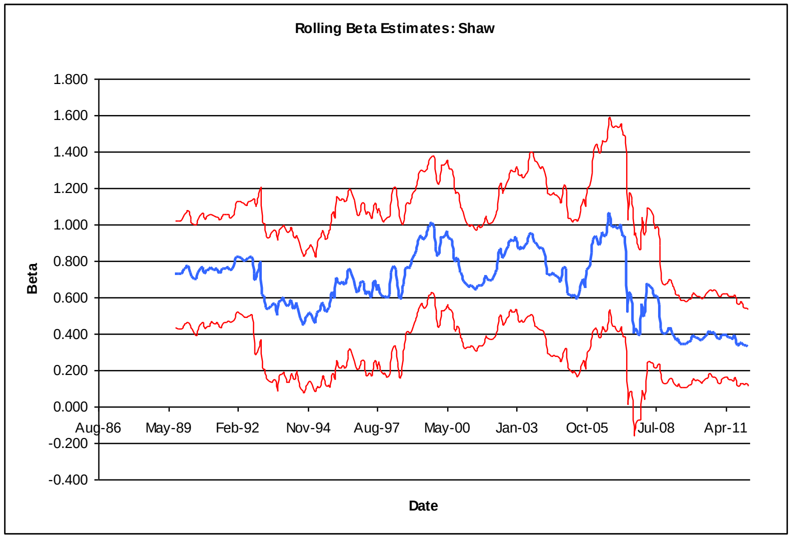
Rolling estimates over a 5-year window (60 monthly observations)
90% Confidence Intervals

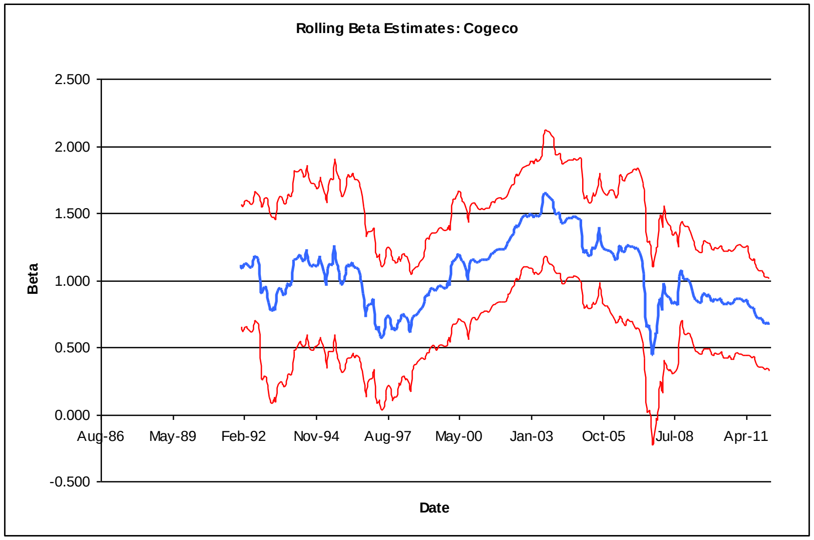


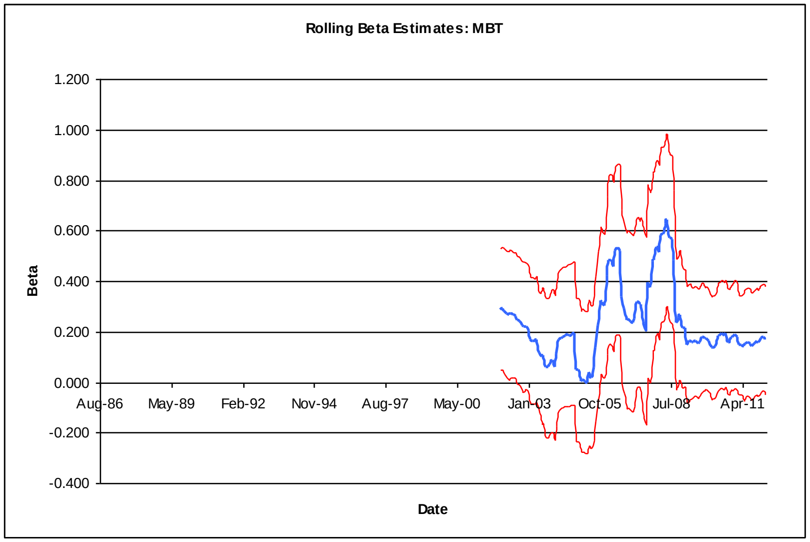


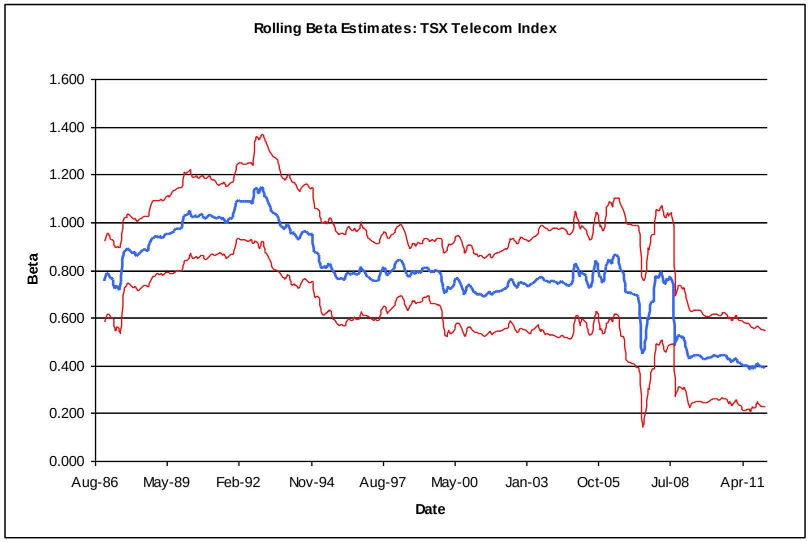

Rolling Beta Estimates: Quebecor
2.500
2.000
1.500
1.000
0.500
0.000
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date

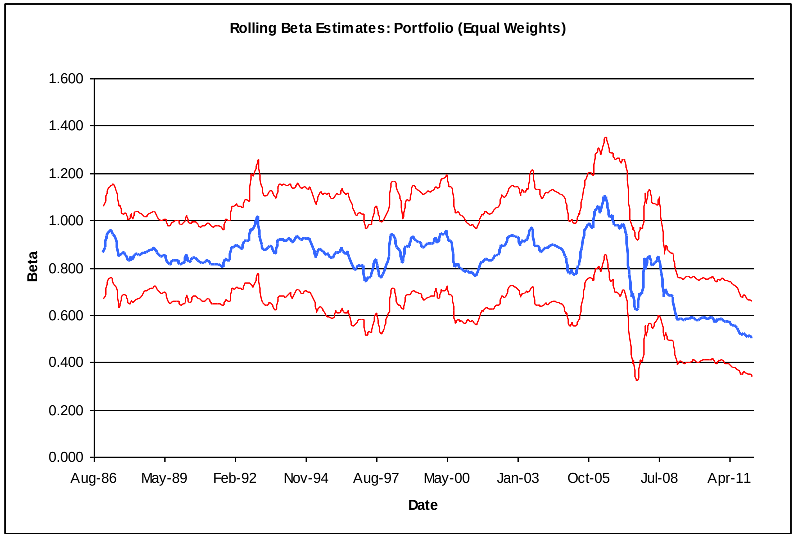

Rolling Beta Estimates: Rogers
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date

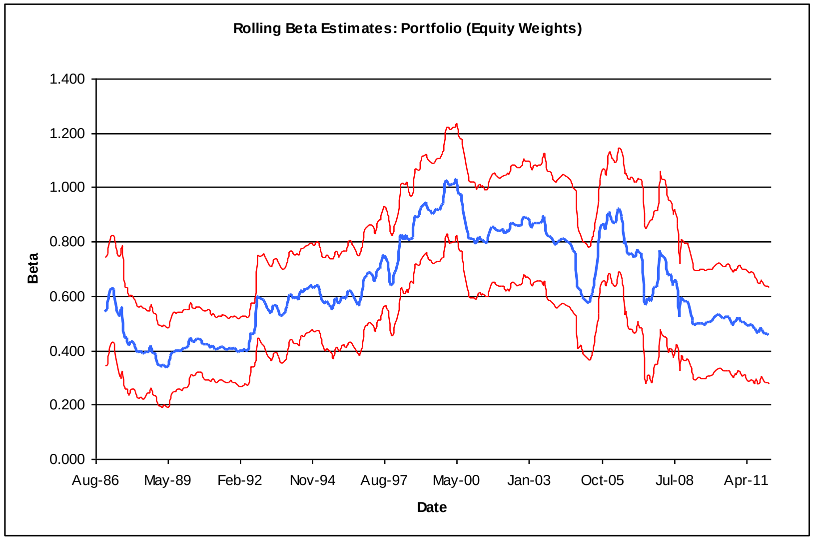

Rolling Beta Estimates: Shaw
1.800
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
-0.200
-0.400
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date


Rolling Beta Estimates: Cogeco
2.500
2.000
1.500
1.000
0.500
0.000
-0.500
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date


Rolling Beta Estimates: MBT
1.200
1.000
0.800
0.600
0.400
0.200
0.000
-0.200
-0.400
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date


Rolling Beta Estimates: TSX Telecom Index
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date


Rolling Beta Estimates: Portfolio (Equal Weights)
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date


Rolling Beta Estimates: Portfolio (Equity Weights)
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Beta
Aug-86
May-89
Feb-92
Nov-94
Aug-97
May-00
Jan-03
Oct-05
Jul-08
Apr-11
Date

Appendix C: Structural Break Detection

C.1 Bai and Perron (1998) methodology

	Break Date (if any)
BCE	Aug 1996, Mar 2000
Telus	-
Quebecor	-
Rogers	-
Shaw	-
Cogeco	-
MBT	-
Portfolio: Equal Weights	-
Portfolio: Equity Weights	Aug 1996, Feb 2000
Telecom Index	Sep 2008

C.2 QLR methodology

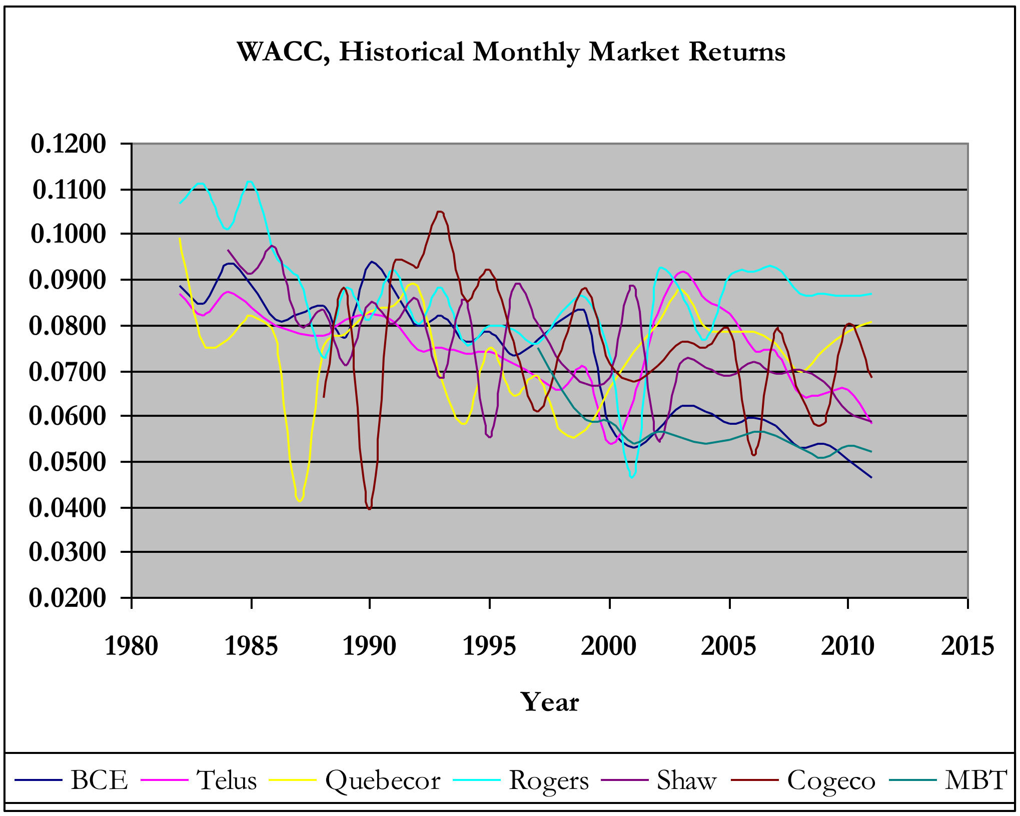
	Break Date (if any)
BCE	Mar 2000
Telus	-
Quebecor	-
Rogers	Feb 1999
Shaw	-
Cogeco	-
MBT	-
Portfolio: Equal Weights	Mar 2000
Portfolio: Equity Weights	-
Telecom Index	-

C.3 Regime Switching Methodology (ICL-BIC determines number of regimes)

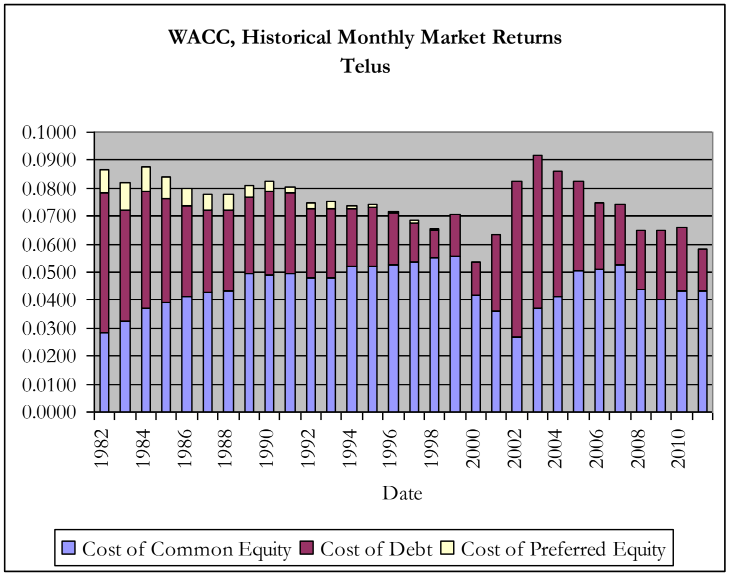
	Break Date (if any)
BCE	-
Telus	-
Quebecor	-
Rogers	-
Shaw	-
Cogeco	-
MBT	-
Portfolio: Equal Weights	-
Portfolio: Equity Weights	-
Telecom Index	-

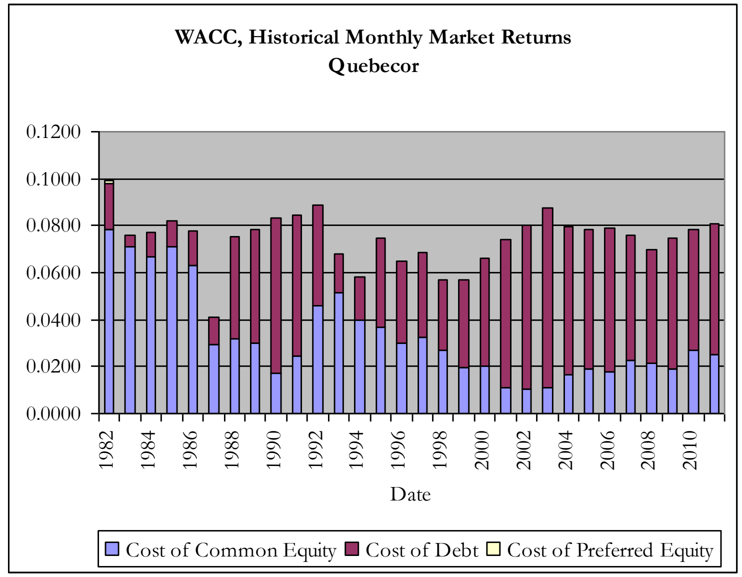
Appendix D

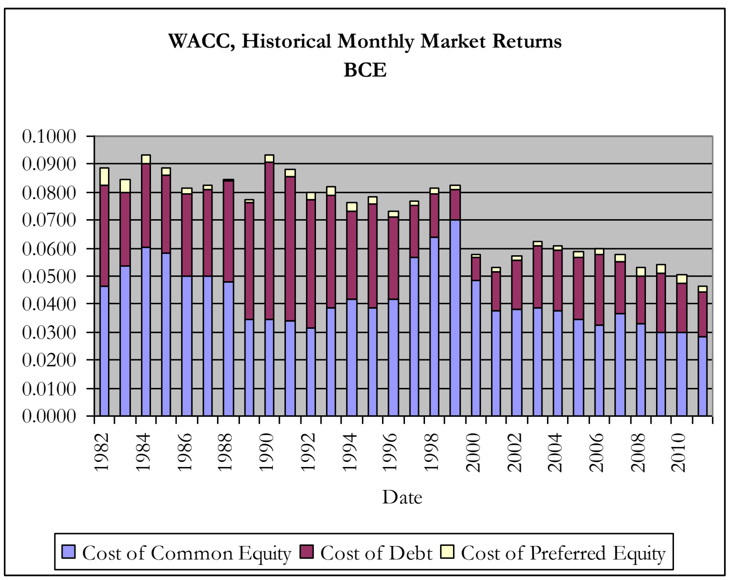
D.1 Weighted Average Cost of Capital: Results

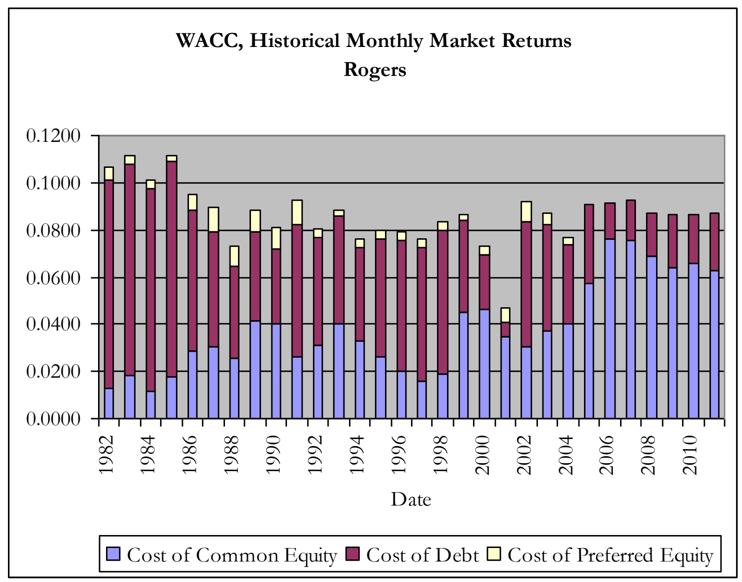


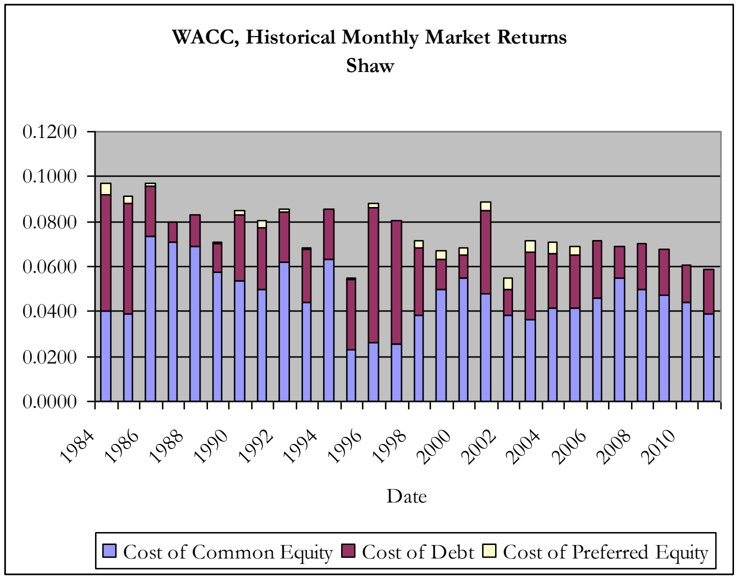
D.2 Decomposition of WACC

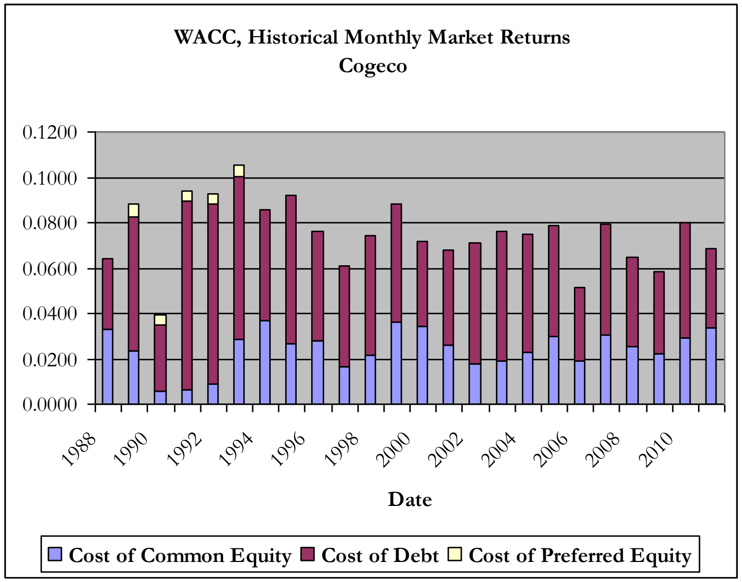


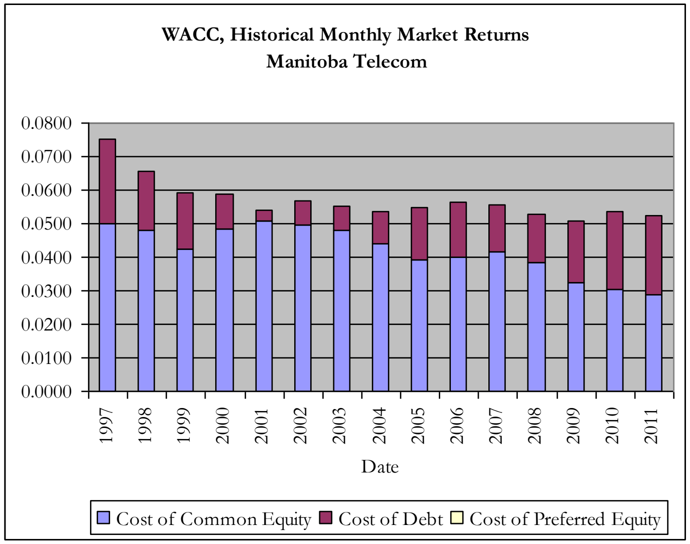







WACC, Historical Monthly Market Returns
Shaw
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date
Cost of Common Equity
Cost of Debt
Cost of Preferred Equity


WACC, Historical Monthly Market Returns
Cogeco
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date
Cost of Common Equity
Cost of Debt
Cost of Preferred Equity


WACC, Historical Monthly Market Returns
Manitoba Telecom
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Date
Cost of Common Equity
Cost of Debt
Cost of Preferred Equity