TOBIN'S Q FOR CANADIAN FIRMS

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Abstract

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Defined as the ratio of market value to replacement cost of tangible assets, Tobin's q is commonly used as a performance measure in research. Although the use of the q ratio is theoretically appealing, its empirical construction is subject to considerable measurement error. In this thesis, we compare and contrast five estimators of q, ranging from the simple q to the estimator based on the Lindenberg and Ross (LR) (1981) procedure. We examine the means, medians and variances of the q estimates and investigate how robust sorting and regression results are to changes in the construction of q. We find that the empirical results are sensitive to the estimation method used in obtaining the q value. The estimator calculated using the Hall (1990) method produces the highest means and variances and has the lowest correlation with the four other estimators. The simple q and the benchmark q are highly correlated, and results from tests for the equality of their coefficient estimates reveal no significant differences. We infer that the Hall estimates are theoretically superior, and the simple q which provides good estimates of the LR q's are satisfactory given the simplicity of their calculations. Finally, we find that the firm's attributes used in Morck, Shleifer and Vishny (1988) and Chung and Jo (1996) have an influence on the q value estimates.

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1. Introduction

The use of Tobin's q to measure performance is becoming increasingly popular. Defined as the ratio of market value to replacement cost of tangible assets, Tobin's q is used to value investment opportunities, management's performance, and the mispricing of stocks. However, because of data unavailability, the calculation of Tobin's q is often not an easy task. In an attempt to deal with data unavailability, several researchers devise their own operational measures of Tobin's q.

The main objective of this thesis is to compare and contrast various estimation techniques for obtaining q ratios for a sample of Canadian firms. We also explore the determinants of the q ratio using regression analyses. While the methodologies and data for the empirical calculation of q values are available for US data, studies involving the estimation of Tobin's q for Canadian firms are scare. Our work in this area contributes to the financial literature in two ways. First, we attempt to establish the primary groundwork for the computation of the q ratios for Canadian firms using different estimation methods. Second, we seek to assess whether determinants of the q values for US firms also affect their Canadian counterparts. The remainder of this thesis is divided into the following sections. Section 2 briefly reviews the literature on the q ratio and its main applications in research. Section 3 outlines the methodology of the estimation techniques used herein. Section 4 deals with the sample selection and data sources and, section 5 presents our findings and interpretations. Finally, section 6 concludes the thesis.

2. Literature Review

2.1 Theoretical Framework for q

Tobin's q is an attractive measure due to its relationship with investment. Since it is a measure of market value to replacement cost, the marginal q is related to the rate of investment. It follows that, under a competitive framework, a firm with value-maximizing objectives will continue to invest capital as long as the marginal returns are greater than the cost of providing the new capital. If the markets are efficient, such investment should induce a positive change in market value. Hence, if investment is considered to be a wealth enhancing activity, the marginal q should exceed one. Conversely, if the decision to invest reveals to be a poor one, the marginal q should be less than one.

According to Tobin and Brainard (1968), the underlying relation between the marginal q and investment should not prevail if the market for capital goods is in a state of equilibrium. In equilibrium, every firm theoretically has a unit marginal q. However, this is not the case in the real world, and deviations from unity arise. Since the production of new capital goods is not instantaneous, there is always a period of adjustment in the short run. The marginal q moves towards the equilibrium level but does not exist at this level since adjustments take time. Due to this continual disequilibrium, the marginal q proves to be a useful measurement tool. If adjustments were immediate, then the marginal q would not be of great relevance in measuring performance.

In practice, there also are some cases where the actual q at equilibrium may differ from unity. Lindenberg and Ross (1981) argue that in the context of a competitive firm, there are two possibilities. First, even though the firm is being correctly valued in the marketplace, its replacement costs may at times be underestimated. This automatically results in an upward bias in the marginal q. Second, the value of replacement costs for some firms may have an opposite effect. This may particularly be true in declining industries. The rate of technological progress may be fast enough to make the capital stock obsolete, thereby disallowing the transfer of assets to more productive uses. Under such circumstances, the marginal q will naturally fall below one. Moreover, q can be expected to be greater than one in a monopoly framework. Given barriers to entry and exit, existing firms can anticipate an increase in market value over investment because their market values exceed their costs of capital. Thus, their marginal q's will be higher than those for competitive firms.

While the marginal q is linked intricately to investment decisions, it is empirically hard to measure. Fortunately, the measurable average q can serve as a reasonable proxy under certain assumptions. Numerous studies [for example, Ciccolo and Fromm (1979), Malkiel et al. (1979) and Chappell and Cheng (1982)] find that under a competitive market structure, the same factors that affect the marginal q generally affect the average q in the same direction. Hence, the average q is used instead of the marginal q in our empirical analysis. They diverge for firms in a declining industry when technological advances render the capital stock obsolete. The marginal value may be below unity and the average greater than one, simply due to previously profitable spending. Alternatively, firms that undergo significant restructuring or uncovered profitable investment opportunities due to new technology may have marginal q's that exceed one while their average q ratios are below one due to their unfavorable pasts.

2.2. Different Estimators of Tobin's q

While the average q ratio is measurable, its calculation is not straightforward, particularly due to the unavailability of data. For example, the replacement costs of firms are generally hard to obtain. As of 1976, the Securities and Exchange Commission (SEC) requires large firms to report estimates of the replacement costs of their fixed assets and cost of goods sold in the 10K reports. For the period 1980 through 1985, FASB 33[1] required that these figures be reported in the annual reports for large corporations. In Canada, no comparable regulations exist for reporting replacement costs. Only large Canadian firms trading on US exchanges provide these figures in their financial statements. Potential problems also exist in obtaining the market value of long term debt and preferred stocks. Because the latter is traded more infrequently than common stocks, their market values are very noisy. To deal with this shortcoming, researchers attempt to devise various estimation techniques to calculate the q ratio.

Lindenberg and Ross (LR) (1981) developed one of the most popular estimation techniques for Tobin's q. They divide the firm's assets into three components (namely, plant and equipment, inventories and other assets) and adopt an appropriate methodology for each. The replacement cost of plant and equipment is adjusted to account for four primary effects, including price level changes, real economic depreciation, technological changes, and investment in new plant. Depending on the accounting method used, inventories are adjusted with a price index. Other fixed asset items are assumed to remain at book value. As for the calculation of the market value of long-term debt, an algorithm calculates bond prices using the firm's specific bond yield and an imputed maturity distribution. The LR estimation

[1] More precisely, this requirement was for firms whose value of inventories, property, plant and equipment summed to more than $125 million or whose value of total assets exceed $1 billion.

technique is used by Chappell and Cheng (1984) for evaluating acquisition decisions, and by Kim, Henderson and Garrison (1993) for examining takeovers.

However, application of the LR methodology also is a daunting task. To calculate the rate of technological progress, at least two replacement costs must be reported by the firm. This requirement is restrictive since only large firms are required to report replacement cost estimates. Moreover, firm-specific bond ratings are not always accessible to calculate the market value of debt. Hence, a modified LR approach is adopted by Lang and Stulz (1994), Perfect and Wiles (1994), Smirlock, Gilligan and Marshall (1984), Lang, Stulz and Walking (1989), Brous and Kini (1994) and Doukas (1995). This method involves several simplifications. First, the rate of technological progress is assumed to be zero, which means that researchers can ignore the subjective estimates reported by firms. Second, the bond yield for a A-rated bond is used to calculate bond prices.

Finding the Lindenberg and Ross (1981) procedure to be too complex, Hall (1990) and Hall et al. (1988) propose a recursive model. The latter approach is more efficient to compute and uses data that is readily accessible from databases like Compustat. This approach uses an age structure to adjust both the market value and the replacement cost. For the market value of debt, the age structure is constructed by rescaling the long-term distribution of long-term debt. One consequence of this rescaling is a potential shortening of the maturity structure which can inflate bond value estimates. To account for this upward bias, Hall adjusts the numerator by subtracting off the value of net short-term assets. The age structure also is employed to adjust the components of the replacement cost. Net plant and equipment is adjusted by an inflation factor based on the average age of the plant and equipment. An estimated inventory age structure and a price index are used to inflate the book value of inventory depending on the accounting method used for inventory. The replacement cost of intangibles due to unconsolidated subsidiaries also is updated using an approach similar to inventory. Unlike other measures of Tobin's q, Hall's measure does not include other asset components in the replacement costs. Hall's procedure is used in Hall (1993), Chung and Jo (1994), and Lewellen and Badrinath (1997).

Another commonly used approximation of the true q is the simple q. Switzer and Emery (1996), and Chung and Pruitt (1994) assume that book values are good estimates of their market values. Hence, when their market values are unavailable, book values of long term debt and preferred shares are simply used to obtain Tobin's q.

Lewellen and Badrinath (LB) (1997) find that the existing methods to calculate q are flawed, and propose an alternative measure of Tobin's q based on a more precise measurement of replacement costs. This is done by attempting to identify the various individual asset vintages on the date when replacement costs are measured. The in-place vintages are used in adjusting for depreciation and price level changes. An advantage of this approach over existing methods is that it does not rely heavily on the base year or the starting point value of fixed assets or subjective estimates of replacement cost values.

The LB technique also may be theoretically superior. It accounts for the retirement of assets, and thereby allows for a better estimate of new investment. In the LR and Hall procedures, retirement is ignored, and new investment is understated. According to Lewellen and Badrinath (1997), an indirect consequence of ignoring the retirement of assets is that these assets are updated for inflation, and the average life of assets tends to exceed its true life. Hence, the overall impact is to overstate replacement costs. The LB methodology also seems to be more flexible since it can potentially incorporate depreciation methods other than the straight line method commonly used in other estimation techniques. While the LB method may be theoretically attractive, it is still hard to implement in practice. The vintage approach involving the backward summation of assets to find the average life requires a long data series, especially for capital intensive industries, which is often unavailable.[2]

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[2] While the LB technique emphasizes the use of data from databases such as Compustat, the availability of such data is not always accessible. For example, as companies go through different business cycles, they are often acquired, merged or simply disappear. At times, they change their fiscal year-ends.

We attempted to use the LB technique to estimate Tobin's q. However, the collection of 10 years of data was not sufficient to calculate the average life of plant and equipment, except for a small number of companies. Thus, we were not able to investigate and compare this methodology to other estimation procedures.

Even if these data are available, the number of firms with such data is small, and suffers from survivorship bias.

Perfect and Wiles (1994) find that the relationship between five alternative constructions of Tobin's q and the performance of a sample of 62 firms differs for the nine-year period 1979-1987. The simple and Hall estimates of q yield significantly different results from the other three estimators,[3] with the Hall estimator having higher mean and variance values than the others. Lewellen and Badrinath (1997) compare their estimates to those from the Hall and modified LR estimators, and conclude that the latter estimators have serious shortcoming both in design and in implementation. Using a large and diverse sample of US nonfinancial firms for the period 1975-1991, they find that their estimates exceed the alternative estimates by 10% to 20%, on average.

The use of the long term q to proxy for the current q value may also not be reliable. Lang et al. (1991) use Tobin's q to investigate a sample of successful takeovers and conclude that their evidence supports the Jensen's free cash flow hypothesis.[4] Lang and Litzenberger (1989) use Tobin's q to investigate the impact of

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[3] The estimators investigated include the simple q, a benchmark ratio, the original and modified LR, and the Hall.

[4] According to the Jensen free cash flow hypothesis, an agency problem arises whenever there is asymmetric information between investors and firms, particularly those that have large cash flows. In such situations, managers may decide to put their vested interests first before those of shareholders.

dividend announcements on stock prices, and find evidence to support the free cash flow hypothesis as the underlying theoretical explanation behind the share price performance. Howe et al. (1992) find that the theory does not hold for self-tender offers. Since share repurchases and cash dividends are alternative methods of maximizing shareholders' wealth, the conflicting conclusions about Jensen's theory led to further investigations. Perfect et al. (1995) attribute the differences to different measures of q. While Lang and Litzenberger (1989) use the current value of q, Howe et al. (1992) use the long-run q value (a three-year average). These empirical findings suggest that empirical results are indeed sensitive to the choice of the q estimates.

Shepherd (1986) also concentrates on the lack of consistency in the estimation of the q ratio. He notes that, while the numerator supposedly represents the market value of the firm, only the market value of the common stock is commonly used. The remaining components are at their book values (as in the simple q), or are arrived at using complex and debatable methods. Similarly, the construction of the denominator is controversial and contains an unknown amount of error and potential biases. Hence, combining two imperfect values results in a q ratio with considerable measurement errors.

2.3 Advantages of Using Tobin's q

The most appealing aspect of Tobin's q is that it accounts for both market and accounting data. It responds to some of the criticisms directed at both accounting measures as well as stock returns as performance measurement tools. For instance, Benston (1985) finds that "accounting rates of return are distorted by a failure to consider differences in systematic risk, temporary disequilibrium effects, tax laws, and accounting conventions regarding R&D and advertising." Thus, accounting rates of return for particular firms are likely to be biased in favor of industry effects. Wernefelt and Montgomery (1988) argue that Tobin's q alleviates these biases. By incorporating a capital market measure of the firm's future cash flow, q implicitly has the potential to use the correct risk-adjusted discount rate, impute equilibrium returns, and minimize distortions due to tax laws and accounting conventions. Landsman and Shapiro (1995) investigate the relation between Tobin's q, the return on investment (ROI), and economic return. Using stock returns as a proxy for economic returns, they observe that stock returns are cross-sectionally correlated only to innovations in ROI, whereas the q ratio with market values in the numerator incorporates expectations of the firm's future economic returns. Hence, they conclude that Tobin's q is a better measure of the firm's economic performance than accounting measures.

Tobin's q also alleviates some of the problems associated with stock returns. Conflicting results are obtained using stock returns as a performance measure, especially in the literature on takeovers. (See Jensen and Ruback (1983) for a good review of this evidence). The use of the q ratio bypasses the problem of choice of sample period since it examines the firm's performance at a point in time rather than over a period of time. Another possible weakness of using stock returns is the choice of asset-pricing model. The CAPM is commonly used to calculate the abnormal returns. Roll (1977), Banz (1981), Fama and French (1992), and Ross and Roll (1994) question the validity of the simple CAPM. Thus, the use of an unreliable asset pricing model likely leads to unreliable abnormal returns and inferences. Since Tobin's q does not assume any pricing models in its computation, it circumvents this problem.

2.4 Empirical Use of Tobin's q

Tobin's q is theoretically attractive, and increasingly used in empirical studies. The ratio is employed to categorize companies according to their relative performance, and most empirical utilizations of q find that across-firm differences are among the key explanatory or explained corporate attributes. Some of the few major areas where q is successfully employed are reviewed in this section of the thesis.

If the market is somewhat inefficient, Tobin's q can capture market mispricing of the firm's physical assets in their current use. Badrinath and Kini (1990) find that low Tobin's q stocks earn a higher risk-adjusted return than high Tobin's q stocks after adjusting for risk, for different types of portfolio construction rules and after controlling for firm size and the E/P ratio. Lang, Stulz and Walking (1989) find that the largest gains are achieved when high q bidders acquire low q firms in successful tender offers. This finding is extended to mergers by Servaes (1991).

Doukas (1995) finds that the average returns associated with foreign acquisition announcements are higher for bidding firms with high q ratios than for those with low q values. Comparing the Tobin's q ratios of diversified and specialized firms, Lang and Stulz (1994) and Servaes (1996) find that the market values single-industry firms more favorably than diversified ones during the late 1970's and the 1980's.

Tobin's q is used to measure the value of intangible assets such as managerial performance. If managers are high performers, the firm is assigned a high q value. If management is poor, the q value is low. Morck, Shleifer and Vishny (1988) find Tobin's q is useful in distinguishing management ability's for friendly and hostile takeovers. Based on 82 Fortune 500 firms acquired by third parties over the period, 1981-1985, they confirm that firms experiencing hostile takeover bids have lower q's. Using q as the measure of managerial performance, Lang, Stulz and Walking (1989) find that well-managed bidders benefit substantially from tender offers, and more so when they acquire poorly managed targets. Morck, Shleifer and Vishny (1988) find evidence of a significant nonmonotonic relationship between Q and ownership.

Tobin's q initially increases for a level of ownership of 0% to 5% , then declines and then rises again slightly when inside ownership is beyond 25% for a sample of 371 Fortune 500 firms in 1980. McConnell and Servaes (1990) examine managerial performance with different equity ownership structures for a different sample, and also obtain a significant curvilinear relation between Q and the level of common stock owned by insiders. The curve slopes upward until the level of inside ownership reaches approximately 40% to 50%, after which it slopes downward.

Tobin's q is also gaining popularity as a tool to investigate the monitoring activities provided by security analysts. A constant preoccupation exists for modern corporations with respect to agency problems that arise due to the separation of control and ownership. Chung and Jo (1996) examine the impact of security analyst monitoring and their marketing functions on firms' market value. They find that monitoring by analysts helps to keep managers on track, thereby reducing the agency costs associated with the separation of control and ownership.

Tobin's q is used to assess the impact of other intangibles, such as research and development (R&D) investment, and advertising expenditures. Hall (1993) uses R&D investment in the US during the 1980's, and Megna and Klock (1993) use R&D investment in the semiconductor industry to analyze the impact of R&D expenditures on market value as proxied by q. Chauvin and Hirschey (1993) find that both advertising and R&D expenditures have positive and consistent influences on the market value of companies with over $100 million in market capitalization over the period 1988-1990.

3. Methodology

In this thesis, we calculate and compare various estimators of Tobin's q for a sample of Canadian firms over the ten-year period, 1987-1996. The five estimators[5] considered are: a simple q ratio which principally uses book value data; a benchmark ratio that utilizes our estimated market values; a modified Lindenberg-Ross (LR) q; an estimator based on Hall's approach and an adjusted Hall q estimator. The respective methodology for each of these estimators now are described in more detail.

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[5] We also attempted unsuccessfully to compute the q ratio using techniques developed by Lewellen and Badrinath (1997). Except for a small number of companies, our historical data were not extensive enough to obtain the required asset vintage estimates using the backward summation of plant and equipment as per the LB procedure. In fact, a rough estimate of the total gross fixed assets of all companies in our sample shows that this asset category more than doubled over the past ten years. This made it difficult to perform a backward summation to compute asset vintage.

Also, the Lindenberg and Ross (LR) (1981) estimator in its original form is not estimated herein for two reasons. First, it is based on two replacement cost values reported by the firms themselves. These are not available for Canadian firms, except for a few large firms that are listed on the US exchanges. Second, the original LR method uses bond yields to calculate the bond prices in the numerator of q due to the absence of bond prices. Fortunately, since prices are reported more frequently for Canadian firms, an estimation approach to calculate bond prices as per the original LR technique was unnecessary. Hence, the calculation of q using the original LR procedure is not included herein.

3.1 Simple q Estimator

The simple q ratio, q_S, is given by:

$$q_S = \frac{MVCE + PREFBK + STDEBT + DS}{RCS} \quad (1)$$

where

MVCE	=	Year-end market value of the firm's common stock
PREFBK	=	Year-end book value of the firm's preferred stock
STDEBT	=	Year-end book value of the firm's short-term debt
DS	=	Year-end book value of the firm's long-term debt
RCS	=	Year-end book value of the firm's total assets

Consistent with the numerator in other q estimators, the numerator in the simple q estimator consists of the sum of common equity, preferred equity, short- and long-term debt. The alternative estimators differ in the choice of the proxies used to represent the components in the numerator and denominator of the q ratio. In the simple q, market values are used for only common equity. The market values are obtained as the product of share price and the number of outstanding shares, both taken at fiscal year-end. All of the other components in the numerator are book values.

In the denominator, the replacement cost is simply represented by the book value of total assets at year-end.

3.2 Benchmark q Estimator

The benchmark q ratio, q_B, is given by:

$$q_B = \frac{MVCE + PREFMV + STDEBT + DB}{RCS} \quad (2)$$

where PREFMV = Year-end market value of the firm's preferred stock

DB = Year-end market value of the firm's long-term debt

and All the other terms are as defined previously.

In the benchmark q estimator, all components in the numerator are market valued. Typically, to obtain an approximation of the market value of preferred stock, preferred dividends are capitalized at the preferred dividend yield of a particular Index. While a preferred yield is available for US indices, no preferred dividend yield series is available for the TSE 300 Index. In this thesis, we first calculate the individual preferred dividend yields of each firm, and then compute the market value by capitalizing the preferred cash dividends by the imputed preferred stock yield. For firms whose individual yields cannot be obtained, an average yield for the sample is used (see Appendix A for more details). The market values of long-term debt are calculated using year-end bond prices for those firms with publicly traded bonds. For the remaining firms, we use their Canadian bond ratings to assign the bond prices to them that reflect their bond ratings. If a firm has multiple bonds, the average price is recorded. Whenever the firm does not have any publicly traded bonds or if their bond ratings are not accessible, we attempt to assess the firm's long term debt using a Z score (see Appendix B for more explanations), and then assign the corresponding bond prices based on our inferred bond rating. Since no firm-reported replacement cost values are available for Canadian firms, we use the book values of total assets to represent their replacement cost values as is the case for the simple q estimator.

3.3 Modified Lindenberg and Ross (LR) q Estimator

The modified Lindenberg and Ross q ratio, q_{LR}, is given by:

$$q_{LR} = \frac{MVCE + PREFMV + STDEBT + DLR}{LRRC} \qquad (3)$$

where DLR = Year-end market value of the firm's long-term debt using the modified LR estimation technique

LRRC = Year-end replacement cost of the firm's assets using the modified LR estimation technique

and All the other terms are as defined previously.

The only component in the numerator of q_{LR} that differs from the previously discussed q estimators is the calculation of the market value of long-term debt. As in

Lindenberg and Ross (1981), all new debts are assumed to be issued for n years (n=10 herein). New debt is taken as the difference between the current long-term debt (DL) and the long term debt in the previous period, after adding the current portion of long-term debt due in one year. If N_t is the new debt[6] issued at t, it follows that:

$$N_t = DL_t - DL_{t-1} + N_{t-n+1} \quad \text{if } DL_t > DL_{t-1}$$

$$N_t = 0 \quad \text{if } DL_t \leq DL_{t-1}$$

Then, a maturity distribution, $f_{t,t-j}$, for the long-term debt is estimated. This smoothing exercise dampens potential errors arising from the estimation of the newly issued debt. Specifically:

$$f_{t,t-j} = N_{t-j} / \Sigma_{k=0}^{n-2} N_{t-k}$$

where j = 0, ..., n-2, and all the terms are as defined previously

According to the Lindenberg and Ross (1981) model, the current yield to maturity of the firm's debt at time t depends upon the firm's bond rating Z, and is denoted by ρ^z_t. A drawback of this approach is that it is time consuming since the bond rating, z, is firm-specific. The modified LR estimator alleviates this problem by simply assuming that the debt of all firms issued in year t (DLR_t) is priced to yield the

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6 For the companies where DL_{t-1} is not available in 1987, N_t is obtained by subtracting the sum of the previous N_t for the previous nine years from DL_t.

average interest rate on a A-rated debt for that year, ρ^{A}_{t-j}. Given these assumptions, the market value of the firm's debt at t is calculated using:

$$DLR_t = DBK_t \, \Sigma^{n-2}_{j=0} f_{t,t-j} \{ (\rho^{A}_{t-j} / \rho^{A}_{t})[I - (1 + \rho^{A}_{t})^{-(n-j)}] + (1 + \rho^{A}_{t})^{-(n-j)} \}$$

where all the terms are as previously defined.

The replacement cost value in the modified LR procedure depends upon the adjusted values of the two largest components of total assets - namely net plant[7] and inventory. The underlying relationship is as follows:

$$LRRC_t = TA_t + RNP_t - HNP_t + RINV_t - HINV_t$$

where TA_t = Book value of total assets in year t;

RNP_t = Replacement cost of net plant in year t;

HNP_t = Historical book value of net plant in year t;

$RINV_t$ = Replacement cost of inventories in year t;

$HINV_t$ = Historical book value of inventories in year t

[7] Net plant is represented herein by net plant, property and equipment (PPE). While these items may be separately reported in Compustat, their depreciation expense and accumulated depreciation are not always given separately. In such cases, the depreciation rate cannot be calculated. Hence, we calculate the replacement cost value on the net PPE.

According to Lindenberg-Ross (1981), replacement cost is influenced primarily by price level changes, real economic depreciation, technological changes and investment in plant. The relation between these variables can be described as:[8,9]

$$RNP_t = RNP_{t-1}[(1+\phi_t)/(1+\delta_t)(1+\theta_t)] + (HGP_t - HGP_{t-1}) \text{ for } t > 0$$

where HGP_t = Historical book value of gross fixed assets in year t

$RNP_0 = HNP_{1986}$

ϕ_t = Growth rate of capital good prices in year t (measured by the Gross National Product deflator for nonresidential fixed investment in year t)

δ_t = Real economic depreciation rate in year t, as measured by DEP_t/HNP_{t-1}

θ_t = Cost-reducing rate of technological progress for the firm in year t

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8 If the 1986 figure for HNP is not available, we use 1987 as the base year. Further, since the gross PPE for the previous period would also not be available for that period of time, we use the new investments, I_t, incurred by the firm instead of the change in the gross fixed assets ($HGP_t - HGP_{t-1}$).

9 Whenever, the previous net PPE is not available or zero and both the current depreciation expense and net PPE are nonzero, the depreciation rate is divided by the current net PPE rather than the PPE for the previous period to calculate δ_t.

The rate of cost-reducing technological progress, θ_t, is assumed to be zero due to its unavailability. Hence, the replacement cost of net plant and equipment is restated as:

$$RNP_t = RNP_{t-1}[(1+\phi_t)/(1+\delta_t)] + (HGP_t - HGP_{t-1}) \quad \text{for } t > t_0$$

$$RNP_{t0} = HNP_{t0} \quad \text{for } t = t_0$$

where all the other terms are as defined previously.

The replacement value of inventory $RINV_t$ depends on the accounting inventory method used by each firm. If FIFO is the reporting method, inventory is left at book value. For other methods, book values are adjusted by using appropriate price indices. Specifically:

$$RINV_t = INV_t \quad \text{if FIFO is used by the firm}$$

$$RINV_t = RINV_{t-1}(P_t / P_{t-1}) + (INV_t - INV_{t-1})\,[0.5(P_t + P_{t-1}) / P_{t-1}], \text{ and}$$

$$RINV_{t0} = INV_{t0=1986 \text{ or } 1987} \quad \text{if LIFO is used by the firm}$$

$$RINV_t = INV_t\,[\,2P_t / (P_t + P_{t-1})] \quad \text{if average cost method is used by the firm}$$

$$RINV_t = HINV_t\,[\,P_t / R_t] \quad \text{if retail cost method is used by the firm}$$

where P_t is the wholesale price index, and R_t is the retail price index.[10]

[10] The wholesale price index is proxied by the industrial producer price index (base year = 1986) which is readily available from Statistics Canada Catalogue no. 11-010-XPB (Canadian Economic Observer).

3.4 Hall's q Estimator

The Hall ratio, q_H, is given by:

$$q_H = \frac{MVCE + PREFL + STDEBT + DH - ADJ}{HRC} \qquad (4)$$

where DH = Year-end market value of long-term debt using Hall's estimation method

ADJ = Year-end market value of the sum of net short-term assets, as measured by (Current Assets + STDEBT) - (Inventories + Current Liabilities)

HRC = Year-end replacement cost of the firm's assets using Hall's estimation method

and All the other terms are as defined previously.

The calculation of the q ratio using Hall's (1990) recursive method tries, as much as possible, to use data available from databases like *Compustat.* The liquidating value of the firm's preferred stock at year t, $PREFL_t$, is chosen as the fair market value. The adjustment, ADJ, which is subtracted from the numerator, represents the value of net short-term assets. It is obtained by taking current assets plus short-term debt minus inventories minus current liabilities. The other two components in the numerator (namely, the market value of common equity and book

However, the retail price index and inventory price index are constructed using raw data. See Appendix C for more details.

value of short-term debt), are like those components used in the estimators discussed earlier.

In Hall's procedure, the market value of the long-term debt is calculated using its age structure as follows. Based on the assumptions that all debts issued are financed by a 12-year bond, the age structure is constructed by estimating the proportion of the debt issued over each of the previous twelve years. The current prices based on *ScotiaMcLeod*'s BBB-rated Canadian bond index for each of the previously issued bonds is then inferred.[11] Current prices are adjusted annually to incorporate newly issued long-term debt. Using these estimates, the market value of the firm's long-term debt is given by:

$$DH_t = \Sigma^{t-1}_{s=t-12} DBK_s . P_{st}$$

where DBK_s is the estimated book value of debt issued in year s, and P_{st} is the current price of a 12-year bond issued in year s.

The replacement cost calculation differs somewhat from the other q estimators discussed above. Replacement cost is not inferred by adjusting the value of the total

[11] The age of the long-term bond index constructed by ScotiaMcLeod is assumed to be 12 years.

assets of the firm, but as the sum of three items; namely, net value of plant,[12] the adjusted value of inventories, and an adjustment to the value of intangibles for unconsolidated subsidiaries and other investments. Specifically:

$$HRC_t = NPLANT_t + ADJINV_t + INTAN_t$$

where	NPLANT	=	Book value of plant * Inflation Adjustment Factor
	Infl. Adj. Factor	=	GNP $Deflator_t$ / GNP Deflator at SAA_t
	SAA_t	=	Ratio of the estimated average age of fixed assets and the length-of life estimates for the current year t to the smoothed length-of-life of fixed assets
	$INTAN_t$	=	Intangibles at year t

The net book value of plant is adjusted using an inflation factor which represents the ratio of investment growth (denoted by the GNP deflator for non-residential fixed assets) at time t to that of the smoothed average age of fixed assets as of year-end t. The smoothing process is designed to moderate the effects of potentially wide variations in the year-to-year estimates. The smoothed average is obtained from the following steps:

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[12] As for the LR estimator, we use net plant, property and equipment (PPE) for net plant herein.

$$AA_t = AD_t / D_t$$

$$LL_t = GF_t / D_t$$

$$SAA_t = (AA_t)*(LL_t / SLL_t)$$

where AD_t = Accumulated depreciation at time t

D_t = Depreciation expense at time t

GF_t = Gross fixed assets at time t

LL_t = Ratio of gross fixed assets to depreciation expense at time t

The adjustment of inventory for Hall's q estimates also differs from the other estimators discussed previously. Inventory, except for LIFO, is at book value. Formally:

$$ADJINV_t = BV_t \qquad \text{if reporting is not LIFO}$$

If LIFO is used, inventory is given by:

$$ADJINV_{t0} = BV_{t0}$$

$$ADJINV_t = [ADJINV_{t-1} * (IPI_t / IPT_{t-1})] + (BV_t - Bv_{t-1}) \quad \text{if } BV_t > BV_{t-1}$$

$$ADJINV_t = [BV_{t-1} * (IPI_t / IPT_{t-1})] * (BV_t / BV_{t-1}) \quad \text{if } BV_t < BV_{t-1}$$

where IPI_t = Inventory price level index

The last component in Hall's replacement cost estimate is the intangible value for unconsolidated subsidiaries. This figure is obtained as the sum of three readily available Compustat items;[13] namely, intangibles, other investments, and investments and advances - equity. This sum is then adjusted for inflation as was described above for inventory.

3.5 Adjusted Hall q Estimator

The adjusted Hall ratio, q_{ADJH}, is given by:

$$q_{ADJH} = \frac{MVCE + PREFL + STDEBT + \dot{D}H - ADJ}{HARC}, \text{ and} \qquad (5)$$

$$HARC_t = TA_t + RNP_t - HNP_t + RINV_t - HINV_t + INTAN_t - RINTAN_t$$

where $RINTAN_t$ = Replacement cost of intangibles at year t

and All other terms are as defined previously.

The adjusted Hall estimator is calculated for comparison purposes. As noted earlier, the original Hall estimator only includes three components of total assets in the estimation of its replacement cost value, while other estimators use adjusted total asset values. Thus, if everything else remains constant, the replacement cost in Hall's q estimator will be lower, and the resulting effect is to upwardly bias the q estimate.

[13] In Hall (1990), these are from older versions of Compustat. Herein, they represent Compustat items #30, #31 and #32.

Hence, to allow for a fair comparison of the different q estimates based on their estimation technique, we attempt to remove this upward bias by using an adjusted total asset value as the denominator instead of only three (adjusted) components of total assets. The numerator is left unchanged, and is equal to that for q_H.

4. Sample Selection and Data Source

Our sample consists of 139 firms listed on the Toronto Stock Exchange, more than one hundred of which are part of the TSE 300 Index in 1996. The ten-year period of investigation runs from 1987 to 1996. A major criterion used to select firms was the availability of annual financial statements for the complete ten-year period. Almost all firms have a December 31 fiscal year-end. Others have a fiscal year-end ending in January, February, October and November. These principally include the banks whose fiscal year-end is at the end of October. If the fiscal year-end changed over the ten-year period or if the company's market value in 1996 was less than 50 million Canadian dollars, it was eliminated from the sample. Firms missing either market values or gross fixed assets (except for financial firms) are removed from the initial sample.

Extreme q estimates are removed by deleting 1% of the observations on the upper and lower end of the q_H estimator. This reduces our sample to 1,332 observations for each q estimators over the period 1987-1996.

The main source of data is the 1996 Compustat PC Plus version which provides annual financial statements and market values of firms. Bond prices are manually obtained from the *Canadian Bond Prices*. Bond ratings are obtained from the *Corporate Bond Record*. The generic bond price for each specific bond rating category is obtained from the *ScotiaMcLeod Bond Index* publication. Year-end prices and annual dividends for preferred shares are obtained from the *Ten Year Price Range* publication for the period prior to 1993, and from the *Eight Year Price Range* publication for the years after 1993. All of these publications, except for the Bond Index, are from the Financial Post Datagroup. Indices and any raw data to calculate our indices are obtained from Statistics Canada publications, including the *Canadian Economic Observer*, the monthly *Gross National Product by Industry*, the *National Economic and Financial Accounts*, and *National Income and Expenditure Account* (see Appendix C for more details).

5. An Analysis of the Tobin's q Ratio Estimates

5.1 Tests of Mean, Median and Variance Equality

In this section, we test for the equality of the means, medians and variances of the Tobin's q estimates across estimator, and on the main components of both the numerator and denominator of the q estimates. Our null and alternate hypotheses for these tests are:

$$H_0: \quad x_1 = x_2$$

$$H_1: \quad x_1 \neq x_2$$

where x is, in turn, the mean, median and variance of the two estimates being tested

If the p-value exceeds 0.05, then we cannot reject the null hypothesis of equality between the two estimates under consideration.

We measure the degree of association between the different q estimators using Pearson correlation coefficient. Values closer to unity indicate a higher degree of correlation. Since q estimators with high correlations do not necessarily lead to the same ordering of the firms in the sample, we also test for the concordance amongst the q estimates. This is particularly important for empirical studies that use q as a ranking variable [e.g. Lang, Ofek, and Stulz (1996), Lang and Stulz (1994), Denis, Denis and Sarin (1994), and Berger and Ofek (1995)]. We assess the degree of correspondence in firm ordering from alternative q estimators by ranking the firms according to the q's derived from the various estimators, and then computing Kendall[14] correlation coefficients across the rankings. A coefficient estimate of one denotes perfect agreement between the rankings.

5.1.1 Market Value of Common Equity

Table 1 reports descriptive statistics for the common equity of the firms in our sample. Market value of common equity is significantly different from its book value, being about two times the latter. The standard deviation is high, given the large range of values from a minimum market value of 0.72 to a maximum value of 22,141. The distribution of market values is skewed to the right, with a mean approximately three times the median for both periods.[15] Hence, not surprisingly, tests of the equality of the means, medians and variances of the market values and book values (not reported herein) are significantly different at the 5% level.

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[14] Lewellen and Badrinath (1997) point out that Kendall's correlation coefficients are empirically more relevant than Spearman rank correlation coefficients because the former examines the number of inversions in the rank which occur for all pairs of observations within a sample when objects are ranked by different methods whereas the latter simply treats ranks as scores.

[15] Throughout this section, we report results for the ten-year and the recent three-year periods to demonstrate potential differences between long- and short-term q values. Due to the small sample size of the one-year period, we use the three-year period to represent the short-term.

5.1.2 Market Value of Preferred Equity

Examination of Table 2 indicates that the smallest means and medians for both periods are for our estimated market values of preferred shares. This is also the case for the standard deviation, except for the period 1987-1996, where the variance of the estimated market values is almost equal to that of the two other estimates. No significant difference exists between the variances based on the large p-values in Panel B. Liquidating value has the highest mean and median for both periods in our sample and is closely followed by the book value. The mean book value of $150.37 million for 1987-1996 is approximately equal to its mean liquidating value of $151.73 million. The null hypothesis that the two estimates are equal cannot be rejected at the 5% level. In fact, based on Panel B (of Table 2), none of the pair-wise null hypotheses can be rejected. These findings suggest that the book and liquidating values available from Compustat are not significantly different from our estimated market values for preferred shares. One possible reason as to why our estimated market values are lower than the reported book and liquidating values is that the average preferred yield used by us to proxy for market yield is too high. In turn, this biases the market values downwards.

5.1.3 Market Value of Long-Term Debt

The values for long-term debt for the various q estimators are provided in Panels A and B of Table 3. For both periods, the book value (D_S) results in the lowest mean and median market values of long-term debt, respectively. The mean and median estimates of market value of long-term debt under the Hall method (D_H) are the highest, and only the estimates for this estimator are significantly different from those for the other three estimators based on tests of the equality of their means, medians and variances.

Our results are consistent with those reported in Perfect and Wiles (1994). The Hall estimates of long-term debt are much larger in magnitude and more volatile than those generated by the other estimators. This is probably due to the use of the rescaling process in Hall's estimator which tends to shorten the maturity structure of the debt.

5.1.4 Total Market Value (Numerator)

The different estimates of the numerator are reported in Table 4. For both periods, MV_S and MV_H calculations result in the lowest and highest mean and median, respectively. Based on the results reported in Panel B, no significant difference is observed between the different means and medians. The largest standard deviation is given by MV_H in all cases. Results for the equality tests of the variances reveal significant differences only between MV_H and the other estimates at the 5% level. Thus, the different estimates of the numerator are reasonably robust to different estimation approaches. This implies that any differences in q ratios occur mostly from differences in the replacement cost estimates.

5.1.5 Replacement Cost of Fixed Assets

The replacement cost estimates for the fixed assets (plant, property and equipment) are presented in Table 5. For both periods, PPE_ LR provides the lowest mean and median replacement cost estimates. The highest mean and median for the ten-year period are given by PPE_H, and those for the three-year period by PPE_BK. Based on the results reported in Panel B, no significant differences are observed between the different means and medians, respectively. However, significant differences in variances are observed between PPE_LR and the two other estimates over the two periods. There is also significant difference in the variance between the estimates of PPE_BK and PPE_H over the ten-year period.

5.1.6 Replacement Cost of Inventory

Inventory values are presented in Panels A and B of Table 6. Our examination indicates that the estimates for inventory are approximately the same. For both periods, INV_BK and INV_LR provide the lowest and highest means, medians and variances, respectively. However, the differences between the estimates are small. Results for equality tests for means, medians and variances also indicate no statistically significant differences between the estimators.

5.1.7 Total Replacement Cost (Denominator)

Table 7 presents the different replacement cost estimates for assets. The only consistent result is that RC_H has the lowest mean and median values for both periods. Results for the equality tests also show that the mean and median of RC_H are significantly different than those for the others, respectively. Analysis of variances across q estimators for the replacement cost of assets shows that only the pair RC_S and RC_ADJH are not significantly different. All the other pairs display significant differences.

5.1.8 Comparison of the q Estimates for the Five Estimators

Table 8 reports the ordering of means and medians of the q estimates. Over the ten-year period, the ranking in descending order is Q_H, Q_LR, Q_ADJH, Q_B and Q_S. For the shorter period, Q_ADJH and Q_LR change position in the ranking. The descending ordering of standard deviation for both periods begins with Q_H, followed by Q_ADJH, Q_LR, Q_B and Q_S. Results from Panel B of Table 8 show statistically significant differences in the mean and median between Q_H and each of the other estimates for both periods, respectively. Over the three-year period, the mean and median of Q_ADJH are significantly different from those of Q_S and Q_B, respectively. Additionally, the medians of Q_S and Q_LR are significantly different from each other for both periods. In short, the only pairs which consistently show no significantly difference in means and medians are Q_S and Q_B, and Q_LR and Q_B.

Results for equality of variances show that Q_H is significantly different from all but Q_B at the 5% level. For the ten-year period, there are two more significant differences. First, Q_ADJH is significantly different with all but Q_LR. Second, the pair Q_LR and Q_S differ. Our findings are consistent with Perfect and Wiles (1994) which find that Hall's method produce the highest means, medians and volatilities.

5.1.9 Pair-wise Pearson and Kendall Correlation Coefficients

Pair-wise Pearson and Kendall correlation coefficient estimates between the different q's are reported in Table 9. The highest Pearson coefficients (with values above 0.9) are observed for the pairs involving Q_S, Q_B and Q_LR. The lowest correlations, (with values that are greater than 0.6) are between Q_H and each of the other estimators. For both periods, the highest Kendall coefficients which are greater than 0.9 are between Q_B and Q_S. The lowest Kendall values which range between 0.46 and 0.56 are between Q_H and each of the others (except Q_ADJH). In general, Kendall coefficients, which measure the degree of concordance amongst the q estimates, are lower than their corresponding Pearson values.

5.1.10 Comparison of q Estimates by Industry[16]

Tobin's q estimates by industry are reported in Table 10. The highest q ratios are given by the chemical, financial and mining sectors. The lowest q's are found in the primary metals. The highest volatilities are associated with the highest q's in the chemical and financial sectors, whereas the lowest q's are from the pulp and paper sector. Industry effects are further investigated using regression models in a subsequent section of this thesis.

5.2 Comparison of Regression Results

We now run regressions with the alternative q estimates acting as the dependent variable and several firm attributes acting as independent variables. Two models are investigated. The first regression model draws on the work of Morck, Shleifer and Vishny (1988). The independent variables include the firm's annual advertising expense normalized by the market value of equity, the firm's annual research and development (R&D) expense normalized by the market value of equity, the book value of the firm's debt normalized by the market value of equity, the estimated market value of the firm's common equity (all in natural logarithms to

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[16] We group firms according to their first SIC digit. Each industry reported herein has at least six companies.

An adjustment is made to the replacement cost estimates for financial firms. We subtract the spontaneous, non-interest-bearing liabilities such as payables, accruals, deferred tax credits and deferred income taxes. This adjustment allows a more effective measure of the firm's funded investment in fixed assets plus working capital for financial firms. The book value of inventory is assumed to represent market value for this sector.

control for heteroskedasticity), and dummy variables to account for different industry effects. Perfect and Wiles (1994) find that Tobin's q is positively associated with the firm's profitability, R&D, and advertising expenditures, and negatively associated with the level of debt. The second model follows Chung and Jo (1996) and investigates the firm's determinants proxied by the firm's return to capital, R&D and advertising expenditure ratios, the firm's size, and dummy variables to control for differences between different industries. Their results also reveal a positive relation between the q ratio and the first three variables, and a negative association with the firm's size. The two models are:

Model 1: $$q = a_0 + a_1\ln(\text{Advertising/Market Value}) + a_2\ln(\text{R\&D/Market Value}) + a_3\ln(\text{Long-term Debt/Market Value}) + a_4\ln(\text{Market Value}) + a_5(\text{Industry Dummies}) \quad (5)$$

Model 2: $$q = b_0 + b_1(\text{Return to Capital}) + b_2(\text{Advertising/Net Sales}) + b_3(\text{R\&D/Net Sales}) + b_4\ln(\text{Book Value}) + b_5(\text{Industry Dummies}) \quad (6)$$

where a_0, b_0 = Intercepts

a_i, b_i = Regression coefficients

and i = 1,2,3.....5.

Table 11 summarizes the results of our regressions. Inclusion of dummy variables for industry effects considerably improves the explanatory power (adjusted R^2) for both models. We also find noticeable differences between the explanatory powers of q_H and q_{ADJH} and the other estimators in both instances. In the first model, as shown by equation (2) in panel A, the estimated coefficients for all independent variables are significant with q_S. With the exception of ln_ADV, the benchmark q yields similar results. With q_{LR} as dependent variable, all the estimated coefficients, except for ln_RD and ln_MV, are significantly different from zero. For q_H, the exceptions are ln_ADV and ln_RD, and for q_{ADJH} only the coefficient estimate for ln_MV is significant. All industry coefficient estimates, except PUBLIS for q_H and q_{ADJH}, are significant at the 5% level for all q estimators. In general, the signs of the coefficient estimates are consistent across q estimators, and also with previous studies, except for the negative value for ln_MV with q_H, and the positive values for ln_DEBT with q_H and q_{AJDH}.

Results for the second regression model as represented by equation (4) are given in panel A. All independent variables are significant with either q_H, q_S or q_B as the dependent variable. The only insignificant variable is PRIMMET industry. For q_{LR} and q_{ADJH} estimators, only the coefficient estimates for R&D, book value and the industry dummy variables are significant at the 5% level. Regardless of the q estimator used, the sign of the coefficient estimates remain unchanged and they are consistent with previous research. The magnitudes of coefficient estimates exhibit their highest values for q_H.

Panel B reports the results from the tests for the equality of the coefficient estimates for the firm's attributes in both models. Several inferences can be made. Except for ln_ADV in equation (2), no significant differences are observed between the q_S and q_B estimators. The coefficient estimates for q_{LR} are also not significantly different from the two previous estimators, with the exception of ln_ADV in equation (2) and ln_BK in equation (4). Coefficient estimates for q_H are significantly different from those of the other estimators.[17] Based on the analysis of inputs comprising the q estimators in the preceding section, we attribute the principal difference between q_H and the other estimators to the differences in the construction of the replacement cost estimates under Hall.

[17] The only exception is the return to capital variable which is significant for q_H

6. Summary and Concluding Remarks

In this thesis, we empirically evaluate five alternative estimators of Tobin's q. We report the empirical evidence on the comparisons of inputs comprising the q estimators, attributes of the actual q ratio estimates, correlations among the computed ratios, and results from sorting and regression analyses. We find that q_H produces the highest mean and variance estimates among the five estimators. Hall's estimates also exhibit the lowest correlations with the other estimators, and their regression coefficients are also significantly different from the others. We find that these differences stem largely from the construction of the replacement cost values under the Hall method. The benchmark q ratio does not yield results that are significantly different from the simple q ratio. This indicates that the use of market values for debt and preferred shares in the numerator does not affect the q estimates significantly. The q ratios based on the Lindenberg and Ross (LR) techniques have high correlations with the simple and benchmark q's, and their regression coefficients often are not significantly different from those using these two estimators. In order words, even though the q_{LR} is theoretically superior than the simple q, it does not provide significantly different results.

Our results, by no means, indicate which estimator most closely approximates the true value of the firm's q. However, this thesis shows the extent to which alternative constructions of q affect conclusions drawn from empirical analyses. The choice of the appropriate q ratio primarily depends upon a trade-off between theoretically superior procedures and those that are more comprehensive in terms of computation and probably subject to greater measurement errors. With these perspectives in mind, we find that the Hall estimates are theoretically better, and the simple q which provide good estimates of the LR q's are satisfactory given the simplicity of their measurements. Our work also provides the primary groundwork for the computation of the q ratios for Canadian firms using different estimation methods. We believe that there is potential for future research in this area. For instance, other empirical estimations of q, especially using the Lewellen and Badrinath (1997) procedure, can be performed for longer periods of time to investigate the robustness of our results. Another interesting area is the application of the q for Canadian firms in the examination of takeovers, and the monitoring of the functions of analysts.

We also find that the determinants of the firm [as used in Morck, Shleifer and Vishny (1988) and Chung and Jo (1996)] generally influence the q values for our sample of Canadian firms. Research and development (R&D) and advertising expenses have a positive effect on Tobin's q, and the greater use of debt has a negative effect. The inclusion of dummy variables to control for industry differences considerably improves explanatory power.

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Table 1- Descriptive Statistics for Common Equity

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	MVCE	1,297	424	0.72	22,141	2,391
1,332 Obs.	CS	768	282	-868.21	11,078	1,419
1994-1996	MVCE	1,781	634	5.91	22,141	3,060
408 Obs.	CS	962	359	-110.43	10,522	1,507

Notes: (1)Values are in millions of Canadian dollars; (2) MVCE is the estimated market value of common equity and CS is the book value of common equity; (3) Tests of significance for equality of means, medians and variances are measured at the 5% level.

Table 2, Panel A - Descriptive Statistics for Preferred Stock

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	PREFBK	150.37	62.48	0.03	1,450	222.12
566 Obs.	PREFVAL	140.86	53.29	0.15	1,488	223.87
	PREFLQD	151.73	62.63	0.03	1,450	223.20
1994-1996	PREFBK	172.18	70.10	0.07	1,450	252.03
131 Obs.	PREFVAL	143.74	53.99	0.21	1,356	238.89
	PREFLQD	174.18	70.10	0.07	1,450	254.19

Note: Values are in millions of Canadian dollars

Table 2, Panel B - Results for the Equality Tests for the Means, Medians and Variances of Preferred Stock

		T-values Means		Z- values Medians		F-values Variances	
Period	Variable	PREFVAL	PRELQD	PREFVAL	PRELQD	PREFVAL	PRELQD
1987-1996	**PREFBK**	0.718	-0.103	1.188	0.000	1.020	1.010
		(0.473)	(0.918)	(0.235)	(1.000)	(0.851)	(0.908)
	PREFVAL		-0.818		-1.188		1.010
			(0.413)		(0.235)		(0.943)
1994-1996	**PREFBK**	0.938	-0.064	-0.867	0.000	1.110	1.020
		(0.349)	(0.949)	(0.862)	(1.000)	(0.542)	(0.923)
	PREFVAL		-0.999		0.867		1.130
			(0.319)		(0.386)		(0.480)

Notes: (1) The F-statistics for variances, t-statistics for means, and z-values for medians are provided for the equality tests between the estimates for preferred shares. The corresponding p-values are reported in the brackets; (2) The approximate t-statistics are provided depending upon the equality of variances. Differences in t-values for equal or unequal variances are very minor in all cases; (3) A z-value of zero implies that the two medians being tested are equal, and a large z-value (irrespective of its sign) means that they are significantly different from each other; (4) PREFBK is the book value of preferred shares, PREFVAL is the estimated market value of preferred shares, and PREFLQD is the liquidation value of the preferred shares; (5) On average, approximately 44 firms in our sample of 139 non-financial firms have preferred shares in their capital structure.

Table 3, Panel A - Descriptive Statistics for Long-Term Debt

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	D_S	617.37	200.98	0	13,136	1,293
1,332 Obs.	D_B	637.02	219.87	0	15,227	1,348
	D_LR	646.32	211.51	0	13,770	1,361
	D_H	846.24	296.48	0	33,158	2,298
1994-1996	D_S	730.52	244.42	0	11,880	1,401
408 Obs.	D_B	807.07	286.31	0	15,227	1,562
	D_LR	772.80	258.01	0	13,081	1,497
	D_H	1,184.00	470.97	0	33,158	2,948

Note: Values are in millions of Canadian dollars

Table 3, Panel B - Results for the Equality Tests for the Means, Medians and Variances of the Long-Term Debt

	T-values Means			Z values Medians			F-values Variances		
Variable	D_B	D_LR	D_H	D_B	D_LR	D_H	D_B	D_LR	D_H
D_S	-0.384	-0.563	-3.168	-0.542	-0.310	-3.797	1.090	1.110	3.160
	(0.701)	(0.573)	(0.002)	(0.588)	(0.757)	(0.000)	(0.126)	(0.061)	(0.000)
D_B		-0.177	-2.866		0.387	-3.409		1.020	2.910
		(0.859)	(0.004)		(0.698)	(0.001)		(0.730)	(0.000)
D_LR			-2.732			-3.409			2.850
			(0.006)			(0.001)			(0.000)
D_S	-0.737	-0.417	-2.804	-0.980	-0.420	-3.219	1.240	1.140	4.430
	(0.461)	(0.677)	(0.005)	(0.327)	(0.675)	(0.001)	(0.029)	(0.179)	(0.000)
D_B		0.320	-2.280		0.840	-2.659		1.090	3.560
		(0.749)	(0.023)		(0.401)	(0.008)		(0.397)	(0.000)
D_LR			-2.510			-2.939			3.880
			(0.012)			(0.003)			(0.000)

Notes: (1) The F-statistics for variances, t-statistics for means, and z-values for medians are provided for the equality tests between the estimates of long-term debt. The corresponding p-values are in brackets; (2) The approximate t-statistics are provided depending upon the equality of variances. Differences in t-values for equal or unequal variances are very minor in all cases; (3) A z-value of zero implies that the two medians in question are equal, and a large z-value (irrespective of the sign) means that they differ significantly from each other; (4) D_S is the book value of long-term debt, D_B is the estimated market value for the benchmark q, D_LR is the market value of long-term debt under the Lindenberg and Ross (LR) estimation technique, and D_H is the long-term debt estimate under the Hall method.

Table 4, Panel A - Descriptive Statistics for the Numerator

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	MV_S	2,103	787	3.31	36,939	3,821
1,332 Obs.	MV_B	2,118	792	3.29	39,053	3,870
	MV_LR	2,127	792	3.29	37,748	3,884
	MV_H	2,298	839	3.02	56,542	4,839
1994-1996	MV_S	2,671	1,014	6.24	35,816	4,383
408 Obs.	MV_B	2,738	1,067	6.11	39,053	4,456
	MV_LR	2,704	1,028	6.11	36,907	4,456
	MV_H	3,054	1,169	4.54	56,048	5,633

Note: Values are in millions of Canadian dollars

Table 4, Panel B - Results for the Equality Tests for the Means, Medians and Variances of the Numerator

		T-values Means			Z values Medians			F-values Variances		
Period	Variable	MV_B	MV_LR	MV_H	MV_B	MV_LR	MV_H	MV_B	MV_LR	MV_H
1987-1996	MV-S	-0.100	-0.162	-1.154	0.000	-0.077	-1.007	1.030	1.030	1.600
		(0.921)	(0.872)	(0.249)	(1.000)	(0.938)	(0.314)	(0.644)	(0.553)	(0.000)
	MV_B		-0.0619	-1.060		-0.077	-0.930		1.010	1.560
			(0.951)	(0.289)		(0.938)	(0.353)		(0.896)	(0.000)
	MV_LR			-1.005			-0.930			1.550
				(0.315)			(0.353)			(0.000)
1994-1996	MV-S	-0.215	-0.106	-1.084	-0.420	-0.140	-1.259	1.050	1.030	1.650
		(0.830)	(0.916)	(0.279)	(0.675)	(0.889)	(0.208)	(0.612)	(0.737)	(0.000)
	MV_B		0.109	-0.886		0.280	-0.700		1.020	1.570
			(0.913)	(0.376)		(0.780)	(0.484)		(0.864)	(0.000)
	MV_LR			-0.985			-1.259			1.600
				(0.325)			(0.208)			(0.000)

Notes: (1) The F-statistics for variances, t-statistics for means, and z-values for medians are provided for the equality tests between the estimates for the numerator. The corresponding p-values are reported in the brackets; (2) The appropriate t-statistics are provided depending upon the equality of variances. Differences in t-values for equal or unequal variances are very minor in all cases; (3) A z-value of zero implies that the two medians being tested are equal, and a large z-value (irrespective of its sign) means that they are significantly different from each other; (4) MV_S is the market value of the numerator for the simple q, MV_B is the estimated numerator for the benchmark q, MV_LR is the estimated market value of numerator under the LR estimation technique, and MV_H is the numerator under the Hall method.

Table 5, Panel A - Descriptive Statistics for Net Plant, Property and Equipment (PPE)

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	PPE_BK	1,285	394	0.15	22,597	2,554
1,332 Obs.	PPE_LR	1,226	381	0.11	17,000	2,307
	PPE_H	1,406	434	0.18	22,183	2,781
1994-1996	PPE_BK	1,520	599	0.23	22,597	2,731
408 Obs.	PPE_LR	1,356	522	0.11	16,744	2,246
	PPE_H	1,514	590	0.25	21,443	2,684

Note: Values are in millions of Canadian dollars

Table 5, Panel B - Results for the Equality Tests for the Means, Medians and Variances of Net Plant, Property and Equipment (PPE)

		T-values Means		Z values Medians		F-values Variances	
Period	Variable	PPE_LR	PPE_H	PPE_LR	PPE_H	PPE_LR	PPE_H
1987-1996	PPE_BK	0.624	-1.176	-0.310	1.162	1.230	1.190
		(0.533)	(0.240)	(0.757)	(0.245)	(0.000)	(0.002)
	PPE_LR		-0.182		1.705		1.450
			(0.068)		(0.088)		(0.000)
1994-1996	PPE_BK	0.935	0.032	0.560	0.280	1.480	1.030
		(0.350)	(0.974)	(0.576)	(0.780)	(0.000)	(0.730)
	PPE_LR		-0.909		-0.560		1.430
			(0.364)		(0.576)		(0.000)

Notes: (1) The F-statistics for variances, t-statistics for means, and z-values for medians are provided for the equality tests between the replacement cost values for PPE. The corresponding p-values are reported in the brackets; (2) The appropriate t-statistics are provided depending upon the equality of variances. Differences in t-values for equal or unequal variances are very minor in all cases; (3) A z-value of zero implies that the two medians being tested are equal, and a large z-value (irrespective of its sign) means that they are significantly different from each other; (4) PPE_BK is the book value of the replacement cost, PPE_LR is the replacement cost using the LR technique, and PPE_H is the replacement cost estimate under the Hall method.

Table 6, Panel A - Descriptive Statistics for Inventory

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	INV_BK	205.42	59.56	0	3,455	368.44
1,332 Obs	INV_LR	207.42	59.56	0	3,455	370.66
	INV_H	205.56	59.56	0	3,455	368.45
1994-1996	INV_BK	234.25	84.99	0	3,455	431.77
408 Obs.	INV_LR	238.73	86.27	0	3,455	435.39
	INV_H	234.72	84.99	0	3,455	431.93

Note: Values are in millions of Canadian dollars

Table 6, Panel B - Results for the Equality Tests for the Means, Medians and Variances of Inventory

		T-values Means		Z values Medians		F-values Variances	
Period	Variable	INV_LR	INV_H	INV_LR	INV_H	INV_LR	INV_H
1987-1996	INV_BK	-0.140	-0.010	0.000	0.000	1.010	1.000
		(0.889)	(0.992)	(1.000)	(1.000)	(0.826)	(0.999)
	INV_LR		0.130		0.000		1.010
			(0.897)		(1.000)		(0.827)
1994-1996	INV_BK	-0.148	-0.016	0.070	0.000	1.020	1.000
		(0.883)	(0.988)	(0.944)	(1.000)	(0.864)	(0.994)
	INV_LR		0.132		-0.701		1.020
			(0.895)		(0.944)		(0.872)

Notes: (1) The F-statistics for variances, t-statistics for means, and z-values for medians are provided for the equality tests between the replacement cost estimates for inventory.. The corresponding p-values are reported in the brackets; (2) The appropriate t-statistics are provided depending upon the equality of variances. Differences in t-values for equal or unequal variances are very minor in all cases; (3) A z-value of zero implies that the two medians being tested are equal, and a large z-value (irrespective of its sign) means that they are significantly different from each other; (4) INV_BK is the book value of inventory, INV_LR is the replacement cost estimate using the LR technique, and INV_H is the replacement cost estimate under the Hall method.

Table 7, Panel A - Descriptive Statistics for the Denominator

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	RC_S	2,210	825	2.76	48,312	4,365
1,332 Obs	RC_LR	2,154	826	2.78	43,836	4,075
	RC_H	1,838	667	0.72	31,834	3,543
	RC_ADJH	2,337	846	2.81	49,088	4,579
1994-1996	RC_S	2,565	1,009	10.22	41,261	4,507
408 Obs.	RC_LR	2,406	1,019	10.53	34,442	3,980
	RC_H	1,975	815	4.48	29,297	3,448
	RC_ADJH	2,558	991	10.30	40,022	4,448

Note: Values are in millions of Canadian dollars

Table 7, Panel B - Results for the Equality Tests of the Means, Medians and Variances of the Denominator

		T-values Means			Z values Medians			F-values Variances		
Period	Variable	RC_LR	RC_H	RC_ADJH	RC_LR	RC_H	RC_ADJH	RC_LR	RC_H	RC_ADJH
1987-1996	RC_S	0.347	2.419	-0.731	-0.077	2.712	-0.465	1.150	1.520	1.100
		(0.729)	(0.016)	(0.465)	(0.938)	(0.007)	(0.642)	(0.012)	(0.000)	(0.081)
	RC_LR		2.134	-1.093		2.712	-0.465		1.320	1.260
			(0.033)	(0.275)		(0.007)	(0.642)		(0.000)	(0.000)
	RC_H			-3.148			-3.099			1.670
				(0.002)			(0.002)			(0.000)
1994-1996	RC_S	0.535	2.100	0.024	0.000	2.099	0.000	1.280	1.710	1.030
		(0.593)	(0.036)	(0.981)	(1.000)	(0.036)	(1.000)	(0.012)	(0.000)	(0.792)
	RC_LR		1.653	-0.513		1.819	0.140		1.330	1.250
			(0.099)	(0.608)		(0.069)	(0.889)		(0.004)	(0.025)
	RC_H			-2.091			-1.679			1.660
				(0.037)			(0.093)			(0.000)

Notes: (1) The F-statistics for variances, t-statistics for means, and z-values for medians are provided for the equality tests between the replacement cost estimates for the denominator. The corresponding p-values are reported in the brackets; (2) The appropriate t-statistics are provided depending upon the equality of variances. Differences in t-values for equal or unequal variances are very minor in all cases; (3) A z-value of zero implies that the two medians being tested are equal, and a large z-value (irrespective of its sign) means that they are significantly different from each other; (4) RC_S is the replacement cost of the simple q, RC_LR is the replacement cost using the LR technique, RC_H is the replacement cost estimate under the Hall method, and RC_ADJH is the adjusted replacement cost estimate under the Hall method.

Table 8, Panel A - Descriptive Statistics for q

Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
1987-1996	Q_S	1.093	0.924	0.217	11.806	0.668
1332 Obs.	Q_B	1.099	0.929	0.204	11.809	0.680
	Q_LR	1.123	0.954	0.222	11.454	0.704
	Q_H	1.625	1.231	0.416	16.535	1.577
	Q_ADJH	1.110	0.938	0.207	11.677	0.722
1994-1996	Q_S	1.152	0.965	0.326	11.806	0.791
408 Obs.	Q_B	1.181	1.001	0.360	11.803	0.791
	Q_LR	1.218	1.037	0.325	11.454	0.803
	Q_H	1.910	1.440	0.471	16.535	1.647
	Q_ADJH	1.309	1.104	0.296	11.677	0.808

Table 8, Panel B - Results for the Equality Tests for the Means, Medians and Variances of q

		T-values Means				Z-values Medians				F-values Variances			
Period	Variable	Q_B	Q_LR	Q_H	Q_ADJH	Q_B	Q_LR	Q_H	Q_ADJH	Q_B	Q_LR	Q_H	Q_ADJH
1987-1996	Q_S	-0.209	-1.136	-11.345	-0.642	-0.542	-2.288	-15.530	-0.833	1.040	1.110	5.580	1.170
		(0.834)	(0.256)	(0.000)	(0.521)	(0.588)	(0.022)	(0.000)	(0.405)	(0.500)	(0.054)	(0.000)	(0.005)
	Q_B		-0.922	-11.196	-0.435		-1.835	-14.954	-0.646		1.070	5.380	1.130
			(0.357)	(0.000)	(0.664)		(0.067)	(0.000)	(0.518)		(0.210)	(0.000)	(0.031)
	Q_LR			-10.611	0.468			-13.676	1.179			5.020	1.050
				(0.000)	(0.640)			(0.000)	(0.239)			(0.000)	(0.366)
	Q_H				10.839				13.870				4.780
					(0.000)				(0.000)				(0.000)
	Q_S	-0.520	-1.180	-8.381	-2.813	-1.261	-2.032	-13.661	-4.898	1.000	1.030	4.340	1.040
		(0.603)	(0.238)	(0.000)	(0.005)	(0.207)	(0.042)	(0.000)	(0.000)	(0.999)	(0.765)	(0.000)	(0.663)
1994-1996	Q_B		-0.664	-8.064	-2.299		-1.539	-12.891	-3.551		1.030	4.340	1.050
			(0.507)	(0.000)	(0.022)		(0.124)	(0.000)	(0.000)		(0.756)	(0.000)	(0.655)
	Q_LR			-7.632	-1.625			-10.636	-2.799			4.210	1.010
				(0.000)	(0.105)			(0.000)	(0.005)			(0.000)	(0.892)
	Q_H				6.613				7.557				4.150
					(0.000)				(0.000)				(0.000)

Notes: (1) The F-statistics for variances, t-statistics for means, and z-values for medians are provided for the equality tests between the estimates of q. The corresponding p-values are reported in the brackets; (2) The appropriate t-statistics are provided depending upon the equality of variances. Differences in t-values for equal or unequal variances are very minor in all cases; (3) A z-value of zero implies that the two medians being tested are equal, and a large z-value (irrespective of its sign) means that they are significantly different from each other; (4) Q_S is the simple q, Q_B is the benchmark ratio, Q_LR is the estimate obtained using the LR technique, Q_H is the estimate under Hall's method, and Q_ADJH is the adjusted Hall estimate.

Table 9 - Pair-wise Pearson and Kendall Correlation Coefficients

	Pearson Correlation Coefficients				Kendall Correlation Coefficients			
Period 1987 - 1996								
	Q_B	Q_LR	Q_H	Q_ADJH	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	0.991	0.950	0.688	0.873	0.918	0.769	0.539	0.634
Q_B		0.948	0.675	0.871		0.768	0.557	0.650
Q_LR			0.643	0.846			0.530	0.602
Q_H				0.735				0.679
Period 1994 - 1996								
	Q_B	Q_LR	Q_H	Q_ADJH	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	0.998	0.975	0.742	0.908	0.907	0.750	0.498	0.593
Q_B		0.976	0.741	0.911		0.747	0.510	0.620
Q_LR			0.717	0.891			0.463	0.529
Q_H				0.748				0.673

Note: The p-values for all these correlations are equal or lower than 0.0001

Table 10 - Descriptive Statistics of q Estimates by Industry

Category	Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
Mining	1987-1996	Q_S	1.797	1.574	0.421	5.161	0.980
	102 Obs.	Q_B	1.801	1.571	0.408	5.189	0.981
		Q_LR	2.004	1.643	0.260	6.407	1.246
		Q_H	2.279	1.947	0.422	7.166	1.367
		Q_ADJH	1.694	1.445	0.365	5.342	0.983
	1994-1996	Q_S	1.879	1.911	0.635	5.001	0.944
	33 Obs.	Q_B	1.901	1.919	0.651	5.008	0.938
		Q_LR	1.973	2.048	0.688	5.601	1.070
		Q_H	2.560	2.848	0.959	6.393	1.208
		Q_ADJH	1.903	1.870	0.583	4.883	0.938
Oil & Gas	1987-1996	Q_S	1.268	1.080	0.088	11.806	0.928
	189 Obs.	Q_B	1.275	1.089	0.088	11.803	0.933
		Q_LR	1.184	0.998	0.081	11.454	0.939
		Q_H	1.721	1.273	0.011	23.892	2.291
		Q_ADJH	1.285	1.071	0.010	11.677	0.976
	1994-1996	Q_S	1.506	1.233	0.608	11.806	1.453
	62 Obs.	Q_B	1.531	1.531	0.640	11.803	1.452
		Q_LR	1.479	1.479	0.581	11.454	1.436
		Q_H	2.415	2.415	0.841	23.892	3.454
		Q_ADJH	1.706	1.706	0.761	11.677	1.436
Pulp& Paper	1987-1996	Q_S	0.861	0.818	0.604	1.349	0.185
	60 Obs.	Q_B	0.873	0.810	0.576	1.345	0.197
		Q_LR	0.821	0.799	0.331	1.356	0.234
		Q_H	1.101	1.069	0.548	2.629	0.394
		Q_ADJH	0.896	0.900	0.496	1.930	0.293
	1994-1996	Q_S	0.912	0.883	0.665	1.196	0.153
	18 Obs.	Q_B	0.973	0.948	0.744	1.265	0.151
		Q_LR	0.913	0.885	0.653	1.295	0.182
		Q_H	1.436	1.324	1.068	2.183	0.287
		Q_ADJH	1.142	1.048	0.896	1.610	0.221

Table 10 - Descriptive Statistics of q Estimates by Industry (Continued)

Category	Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
Lumber	1987-1996	Q_S	0.979	0.898	0.533	2.032	0.264
	70 Obs.	Q_B	0.983	0.893	0.526	2.055	0.273
		Q_LR	0.987	0.946	0.364	2.122	0.307
		Q_H	1.188	1.157	0.591	2.776	0.404
		Q_ADJH	0.984	0.945	0.531	2.081	0.305
	1994-1996	Q_S	0.950	0.900	0.774	1.180	0.116
	21 Obs.	Q_B	1.003	0.993	0.826	1.245	0.124
		Q_LR	0.992	0.982	0.823	1.214	0.116
		Q_H	1.333	1.281	1.095	1.695	0.166
		Q_ADJH	1.091	1.084	0.858	1.343	0.121
Publishing	1987-1996	Q_S	1.137	1.123	0.505	1.729	0.298
	60 Obs.	Q_B	1.148	1.130	0.479	1.798	0.302
		Q_LR	1.211	1.197	0.486	2.137	0.373
		Q_H	1.602	1.519	0.758	3.035	0.510
		Q_ADJH	1.157	1.117	0.555	2.226	0.381
	1994-1996	Q_S	1.071	1.054	0.659	1.689	0.316
	18 Obs.	Q_B	1.109	1.059	0.674	1.798	0.322
		Q_LR	1.178	1.128	0.635	2.137	0.456
		Q_H	1.770	1.730	0.919	3.035	0.625
		Q_ADJH	1.252	1.162	0.737	2.226	0.478
Communication	1987-1996	Q_S	0.926	0.912	0.629	1.399	0.122
	80 Obs.	Q_B	0.935	0.872	0.597	1.427	0.143
		Q_LR	1.100	0.954	0.587	1.699	0.238
		Q_H	1.158	0.949	0.779	2.358	0.317
		Q_ADJH	0.979	0.850	0.679	1.619	0.206
	1994-1996	Q_S	0.989	0.983	0.755	1.399	0.139
	24 Obs.	Q_B	1.026	0.997	0.737	1.427	0.155
		Q_LR	1.293	1.284	0.892	1.699	0.219
		Q_H	1.406	1.341	1.011	2.358	0.319
		Q_ADJH	1.166	1.131	0.896	1.619	0.189

Table 10 - Descriptive Statistics of q Estimates by Industry (Continued)

Category	Period	Variable	Mean	Median	Minimum	Maximum	Std. Dev.
Chemical	1987-1996	Q_S	2.067	1.415	0.549	9.227	1.721
	70 Obs.	Q_B	2.067	1.391	0.545	9.227	1.721
		Q_LR	2.079	1.441	0.671	9.273	1.697
		Q_H	6.606	1.958	0.895	71.859	11.144
		Q_ADJH	1.848	1.215	0.548	8.523	1.602
	1994-1996	Q_S	2.251	1.743	0.701	9.227	1.856
	21 Obs.	Q_B	2.266	1.752	0.709	9.227	1.846
		Q_LR	2.257	1.735	0.720	9.273	1.840
		Q_H	10.031	2.547	0.987	71.859	16.559
		Q_ADJH	1.983	1.623	0.716	8.523	1.648
Primary Metals	1987-1996	Q_S	0.807	0.760	0.481	1.737	0.223
	100 Obs.	Q_B	0.801	0.757	0.378	1.737	0.233
		Q_LR	0.827	0.815	0.411	1.431	0.181
		Q_H	1.049	0.959	0.573	2.761	0.431
		Q_ADJH	0.798	0.741	0.428	2.073	0.295
	1994-1996	Q_S	0.885	0.836	0.522	1.737	0.300
	32 Obs.	Q_B	0.896	0.835	0.469	1.737	0.301
		Q_LR	0.858	0.902	0.411	1.089	0.171
		Q_H	1.291	1.158	0.756	2.761	0.504
		Q_ADJH	0.975	0.869	0.543	2.073	0.399
Financial (RC Adjusted)	1987-1996	Q_S	2.572	1.040	0.040	19.962	3.859
	164 Obs.	Q_B	2.543	1.004	0.040	19.707	3.826
		Q_LR	2.586	1.027	0.040	21.147	3.924
		Q_H	2.556	0.750	0.016	30.574	4.286
		Q_ADJH	2.552	0.997	0.032	18.609	3.770
	1994-1996	Q_S	2.470	1.101	0.060	19.386	3.959
	50 Obs.	Q_B	2.459	1.079	0.060	19.707	4.014
		Q_LR	2.516	1.107	0.063	21.147	4.146
		Q_H	2.729	0.710	0.063	30.574	5.558
		Q_ADJH	2.861	1.163	0.064	18.609	4.485

Table 11, Panel A - Regression Results Using the Firm's Determinants

	Equation (1) Dependent Variables					Equation (2) Dependent Variables				
	Q_S	Q_B	Q_LR	Q_H	Q_ADJH	Q_S	Q_B	Q_LR	Q_H	Q_ADJH
Intercept	1.352	1.339	1.264	4.063	1.445	1.231	1.218	1.137	3.700	1.049
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
ln_ADV	0.002	0.002	0.000	0.029	-0.002	0.005	0.004	0.003	0.027	0.000
	(0.349)	(0.507)	(0.936)	**(0.000)**	(0.346)	**(0.030)**	(0.064)	(0.277)	**(0.000)**	(0.882)
ln_R&D	0.014	0.013	0.012	0.052	0.009	0.015	0.014	0.013	0.051	0.010
	(0.028)	**(0.039)**	(0.060)	**(0.003)**	(0.181)	**(0.008)**	**(0.012)**	**(0.028)**	**(0.000)**	(0.110)
ln_DEBT	-0.041	-0.043	-0.034	-0.015	-0.003	-0.021	-0.023	-0.015	0.012	0.015
	(0.000)	**(0.000)**	**(0.000)**	(0.470)	(0.745)	**(0.009)**	**(0.005)**	(0.084)	(0.558)	(0.106)
ln_MV	0.033	0.032	0.040	(0.064)	0.030	0.042	0.042	0.049	-0.050	0.039
	(0.021)	**(0.027)**	**(0.008)**	(0.057)	(0.057)	**(0.001)**	**(0.002)**	**(0.001)**	(0.127)	**(0.009)**
CHEM						0.679	0.674	0.681	1.681	0.524
						(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
MIN						0.8695	0.860	0.940	0.962	0.716
						(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
O&G						0.3618	0.355	0.221	0.284	0.317
						(0.000)	**(0.000)**	**(0.000)**	**(0.020)**	**(0.000)**
PRIMMET						-0.1566	-0.173	-0.190	-0.397	-0.226
						(0.015)	**(0.009)**	**(0.006)**	**(0.013)**	**(0.002)**
PUBLIS						0.1686	0.166	0.182	0.314	0.140
						(0.039)	**(0.046)**	**(0.035)**	(0.117)	(0.131)
F-value	9.108	9.116	6.485	16.677	1.079	36.701	35.022	33.185	21.260	18.312
Adj. R^2	0.024	0.024	0.016	0.045	0.000	0.195	0.187	0.179	0.121	0.105

	Equation (3)					Equation (4)				
	Q_S	Q_B	Q_LR	Q_H	Q_ADJH	Q_S	Q_B	Q_LR	Q_H	Q_ADJH
Intercept	1.314	1.316	1.291	2.311	1.314	1.114	1.114	1.103	2.145	1.144
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
ROC	0.048	0.048	0.035	0.071	-0.003	0.073	0.073	0.059	0.089	0.018
	(0.163)	(0.169)	(0.341)	(0.314)	(0.939)	**(0.020)**	**(0.022)**	(0.081)	(0.199)	(0.609)
R&D	0.252	0.253	0.237	1.567	0.149	0.193	0.193	0.180	1.473	0.109
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**
ADV.	5.479	5.133	4.640	38.614	2.072	6.851	6.503	5.774	38.193	3.329
	(0.074)	(0.095)	(0.157)	**(0.000)**	(0.524)	**(0.014)**	**(0.021)**	(0.056)	**(0.000)**	(0.281)
ln_BK	-0.046	-0.045	-0.037	-0.145	-0.043	-0.034	-0.033	-0.024	-0.131	-0.031
	(0.000)	**(0.000)**	**(0.001)**	**(0.000)**	**(0.005)**	**(0.001)**	**(0.001)**	**(0.024)**	**(0.000)**	**(0.005)**
CHEM						0.602	0.600	0.564	0.819	0.434
						(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
MIN						0.735	0.735	0.816	0.732	0.598
						(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
O&G						0.328	0.327	0.190	0.028	0.271
						(0.000)	**(0.000)**	**(0.000)**	**(0.762)**	**(0.000)**
PRIMMET						-0.088	-0.103	-0.123	-0.214	-0.141
						(0.104)	(0.060)	**(0.034)**	(0.071)	**(0.018)**
PUBLIS						0.236	0.240	0.258	0.305	0.211
						(0.000)	**(0.000)**	**(0.000)**	**(0.039)**	**(0.004)**
F-value	26.145	25.253	18.471	195.727	10.797	45.959	45.021	38.207	99.152	22.948
Adj. R^2	0.072	0.0697	0.051	0.376	0.029	0.238	0.234	0.206	0.406	0.132

Notes:(1) Coefficients that are significant at the 5% level have their p-values in bold; (2) For equations (1) and (2), ln_ADV is the ratio of advertising to the market value of common equity in natural logarithm; ln_R&D is the ratio of research and development (R&D) to market value of common equity in natural logarithm; ln_DEBT is the ratio of long-term debt to the market value of common equity in natural logarithm; and ln_MV is the common equity in natural logarithm. For equations (3) and (4), ROC is the firm's return to capital; R&D is the ratio of research and development (R&D) to net sales; ADV is the advertising expenditure to net sales ratio; and ln_BK is the market value of common equity. The dummy variables for industry effects include CHEM for the chemical sector, MIN for the mining sector, O&G for the oil and gas sector, PRIMMET for the primary metals sector, and PUBLISH for the publishing sector; (3) Our criterion for including a dummy variable to account for an industry (at least a single digit SIC code) is a minimum of 60 observations. Other sectors, namely, communication, lumber, and pulp and paper, are not significant, and are not shown in the table to conserve space.

Table 11, Panel B - Tests for Equality of the Regression Coefficients

Independent Variables from Equation (2)

ln_ADV

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	4.454	8.689	24.112	12.289
	(0.035)	(0.003)	(0.000)	(0.001)
Q_B		4.157	25.743	9.263
		(0.042)	(0.000)	(0.002)
Q_LR			28.750	2.449
			(0.000)	(0.118)
Q_H				41.859
				(0.000)

ln_R&D

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	0.784	0.969	10.922	2.266
	(0.376)	(0.325)	(0.001)	(0.133)
Q_B		0.378	11.412	1.721
		(0.539)	(0.008)	(0.190)
Q_LR			11.787	0.682
			(0.001)	(0.409)
Q_H				16.649
				(0.000)

ln_DEBT

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	4.373	5.267	4.408	60.935
	(0.037)	(0.022)	(0.036)	(0.000)
Q_B		8.700	5.066	69.884
		(0.003)	(0.025)	(0.000)
Q_LR			2.783	33.873
			(0.096)	(0.000)
Q_H				0.049
				(0.825)

ln_MV

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	0.078	2.176	12.877	0.152
	(0.780)	(0.140)	(0.000)	(0.697)
Q_B		2.272	12.839	0.108
		(0.132)	(0.000)	(0.743)
Q_LR			14.433	1.347
			(0.000)	(0.246)
Q_H				14.292
				(0.000)

Independent Variables from Equation (4)

ROC

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	0.004	1.206	0.096	11.678
	(0.953)	(0.272)	(0.756)	(0.001)
Q_B		1.198	0.099	12.407
		(0.274)	(0.753)	(0.000)
Q_LR			0.321	4.831
			(0.571)	(0.028)
Q_H				2.203
				(0.138)

R&D

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	0.051	1.042	694.847	29.603
	(0.821)	(0.308)	(0.000)	(0.000)
Q_B		1.148	702.608	32.003
		(0.284)	(0.000)	(0.000)
Q_LR			675.622	15.861
			(0.000)	(0.000)
Q_H				896.308
				(0.000)

ADV

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	2.667	0.939	47.891	6.036
	(0.103)	(0.333)	(0.000)	(0.014)
Q_B		0.437	49.547	5.235
		(0.509)	(0.000)	(0.022)
Q_LR			48.888	2.134
			(0.000)	(0.144)
Q_H				67.353
				(0.000)

ln_BK

	Q_B	Q_LR	Q_H	Q_ADJH
Q_S	3.306	6.650	37.491	0.426
	(0.069)	(0.011)	(0.000)	(0.514)
Q_B		4.912	39.008	0.156
		(0.003)	(0.000)	(0.693)
Q_LR			43.455	1.286
			(0.000)	(0.257)
Q_H				45.535
				(0.000)

Note: F-values (p-values) are reported.

APPENDIX A

Computation of the Market Value of Preferred Shares

The market values of preferred shares for Canadian firms are generally not readily available. The prices of preferred shares sold in private placements are not reported regularly. For this reason, we cannot use the common equity procedure to compute the market value of preferred shares. Researchers usually circumvent this problem by dividing the preferred dividend by the preferred dividend yield in the market. Unfortunately, the preferred dividend yield for the TSE is not computed by the exchange.

Thus, we first compute the average preferred dividend yield of each company by dividing its preferred cash dividend (available on Compustat) by the preferred stock price. If a firm reports cumulative dividends, we use the annual dividend calculated by taking the difference between the current and reported dividend of the previous year. The cash dividend then is divided by the imputed individual preferred dividend yield to obtain the market value of a preferred share. This method gives an estimate of the market value of all preferred stock that are publicly traded.

For preferred shares not publicly traded, we first create an equally weighted portfolio of preferred shares for our sample, and then calculate the average preferred yield for each year for that portfolio. For our sample period of ten years, the average sample size of the portfolio is 44 non-financial firms and the average annual portfolio yield is 8.9%. The market value of preferreds for nonpublicly traded firms is then calculated using this average portfolio yield.

For firms that report no cash preferred dividend payments, we use the book value as the proxy for the market value of the preferred.

APPENDIX B

Bond Rating Assignment Procedure for Long-Term Bonds

We use a Z-type score to assess the bond rating of firms with no publicly traded bonds or publicly traded bond prices. The four criteria used are the pretax fixed charge coverage, the ratio of cash flow to total long-term debt, the pretax return on capital, and the ratio of the long term debt to capitalization.

$$\text{Pretax Fixed Charge Coverage} = \frac{\text{Pretax Income + Interest}}{\text{Gross Interest Expense}}$$

$$\text{Cash Flow/Total Long Term Debt} = \frac{\text{Net Income + Depreciation + Deferred Taxes}}{\text{Total Long Term Debt}}$$

$$\text{Pretax Return to Capital} = \frac{\text{Pretax Income + Interest}}{\text{(Long Term Debt + Minority Interest + Deferred Taxes + Shareholders' Equity)}}$$

$$\text{Long Term Debt / Capitalization} = \frac{\text{Long Term Debt}}{\text{(Long Term Debt + Minority Interest + Shareholders' Equity)}}$$

The Z-score is an equally weighted mean of the three-year moving average of these four components.[1]

[1] For the first two years, the moving averages differ because of the lack of data. Namely, the moving average consists of two years (including current) for 1998, and only a single year for 1987.

$$Z = 0.25(\text{Fixed Coverage}) + 0.25(\text{Cash Flow/Long Term Debt}) + 0.25/100(\text{ROC}) + 0.25(1 - \text{LONG TERM Debt/Capital})$$

Given each firm's Z-score, the bond rating is assigned according to the following schedule:[2]

Bond Rating	**Score (Z)**
AAA	2.93
AA	1.66
A	1.54
BBB	1.15
CC	0.40
CCC	Below 0.4

For computational purposes, we assign arbitrary values in the following circumstances. If long term debt is zero, the ratio of cash flow to long term debt is assigned a value of 10.[3] If both interest expense and long term debt are nil, the coverage is assigned a value of 10. If only the interest expense is zero, the coverage ratio is ignored and the Z score is based on an average of the three remaining variables. Return to capital is set to zero if the numerator is negative.

[2] We use information from the *Standard & Poors Ratings Guide (1979)*, pp. 27-45 as a guide in allocating the score to corresponding bond rating categories,
[3] Otherwise, if the denominator is zero, then the value is infinity.

The year-end bond prices from the *ScotiaMcLeod Bond Index* are used to price the firm's debt using our inferred bond rating. Long-term debt due in one year is valued separately based on its respective bond rating at the price of short-term bonds. All bonds rated at BBB or below are priced at BBB-rated bond prices.

APPENDIX C

Construction of Retail, Finance and Inventory Indices

We construct retail, finance and inventory indices in constant dollars, with 1986 as the base year.[4] The appropriate indices are computed using:

$$I_t = \frac{X_t * 100}{X_{t=1986}}$$

where X_t = Constant dollars of the particular variable during year t, where X represents retail trade, finance or inventory

$X_{t=1986}$ = Constant dollars of the particular variable in 1986

The three imputed indices over the period 1987-1996, with 1986 as the base year, are as follows:

[4] These indices are not available directly from Statistics Canada. In the case of the retail and finance indices, current publications do not have up-to-date figures. The inventory price index is simply not calculated by Statistics Canada.

	Retail Price Index	Finance Index	Inventory Price Index
1996	115.10	128.29	113.19
1995	114.34	124.08	112.84
1994	113.30	122.10	106.87
1993	107.78	119.23	102.68
1992	104.86	116.23	102.62
1991	103.62	115.04	105.48
1990	109.29	112.22	108.50
1989	111.83	111.11	111.87
1988	109.15	108.24	108.66
1987	105.87	104.20	104.03
1986	100.00	100.00	100.00

All of these raw data are from Statistics Canada publications. Retail trade and finance dollars are from the monthly Gross National Product by Industry (Catalogue 15-001-XPB, Table 1). Values for outstanding amount of inventory are taken from the National Economic and Financial Accounts (Statistic Canada Catalogue 13-001-XPB, Table 3, Cansim Matrix No. 6829) for current data, and from the National Income and Expenditure Accounts (Statistics Canada Catalogue 13-201-XPB, Table 2, Cansim Matrix No. 6628) for historical values.