K14.1

EB-2007-0905

Energy Probe Cross-examination

Document Brief for Examination in Chief

of

Dr. Lawrence P. Schwartz, PH.D

Cost of Capital

June 19, 2008

Energy Probe Research Foundation

Evidence for EB-2007-0905

ONTARIO POWER GENERATION INC.

Payment Amounts for Prescribed Facilities

EXHIBIT M TAB 6.1

Evidence Update

Authored by

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June 13, 2008

For

ENERGY PROBE RESEARCH FOUNDATION
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EB-2007-0905

Exhibit M Tab 6.1

Ontario Power Generation Inc.

Payment Amounts for Prescribed Facilities

Evidence of Energy Probe Research Foundation - Update

The following material is an update to the prefiled evidence of Dr. Schwartz on Cost of Capital appearing at Exhibit M Tab 6. This material has been prepared to clarify certain aspects of Dr. Schwartz' evidence relating to the cash flow analysis in his submission.

Tax-Adjusted WACC

[1] In my Report, I provided an estimate of the fair market value of the Prescribed Facilities based on a discounted cash flow analysis. That analysis used the ROE and capital structure recommended by Ms. McShane and the cost of debt indicated by OPG, and results in valuing the Prescribed Facilities at approximately $5.5 billion at the beginning of the test period. This value is 74% of the rate base for 2008 as measured by OPG.

[2] I performed the discounted cash flow calculations on the assumption that OPG's interest deductions were not financially beneficial in that they generated no interest tax shields. This assumption was reached from OPG's calculation of its "combined return" in which it used the pre-tax cost of debt together with the after-tax ROE, each weighted by their respective shares in the recommended deemed capital structure. It is now clear that OPG's combined return refers to the total cash payments to investors, and is not proposed as a discount rate in the valuation context. Accordingly, OPG calculates the combined return without regard to the distinction between pre-tax and after-tax returns.

[3] Moreover, the evidence of Mr. Staines is that the interest deduction does reduce regulatory taxable income and therefore generates interest tax shields that benefit the shareholder. This indicates to me that the after-tax cost of debt is lower than the pre-tax cost. As I noted in my Report (para. 44), using the lower after-tax cost of debt would result in a lower discount rate and a higher discounted present value of the cash flows generated by the Prescribed Facilities. I have recalculated the WACC using OPG's tax rate of 31.5% for 2008 [per Ex.F3-T2-S1, Table 7] and have used the resulting tax-adjusted WACC to discount the cash flow from assets. As a result, certain tables and calculations in my Report require updating.

[4] Table 6R below revises Table 6 in my Report. As shown, the tax-adjusted WACC is approximately 7.74% per annum (equivalent to approximately 14% for the test period) in nominal terms.

Table 6R: Cost of Capital (Nominal)

	Annual	Test Period
Tax rate	**31.50%**	31.50%
Cost of equity (nominal)	**10.50%**	19.092%
Equity share	**57.50%**	57.500%
Cost of debt (nominal)-pre-tax	**5.84%**	10.443%
Cost of debt (nominal)-after-tax	4.00%	7.105%
Debt share	42.50%	42.500%
WACC (nominal)	7.738%	13.998%

[5] Table 7R below revises Table 7 in my Report. As shown, the tax-adjusted WACC is approximately 5.63% per annum (equivalent to approximately 10.115% for the test period) in inflation-adjusted terms.

Table 7R: Cost of Capital (Inflation-adjusted)

	Annual	Test Period
Inflation rate	**2.00%**	3.53%
Tax rate	**31.50%**	31.50%
Cost of equity (real)	8.33%	15.036%
Equity share	57.50%	57.500%
Cost of debt (real)-pre-tax	3.76%	6.681%
Cost of debt (real)-after-tax	1.96%	3.457%
Debt share	42.50%	42.500%
WACC (real)	5.63%	10.1150%

[6] The cash flow from assets in the test period remains the same as presented in my Report: $649.4 million in nominal terms, equivalent to $627.28… in inflation-adjusted terms. This is because OPG projects that the Prescribed Facilities will generate no income tax liabilities in the test period; accordingly, the cash flow from assets does not change even though the WACC is tax-adjusted.

[7] Following the same procedures for discounted cash flow analysis discussed in my Report (para. 40) using the tax-adjusted WACC as the discount rate, the base-case present value of the Prescribed Facilities is approximately $6,201.5 billion, whether calculated in nominal or inflation-adjusted terms. This estimated fair market value is approximately 84% of the 2008 rate base estimated by OPG.

[8] In my Report, I recommended an ROE of 7.64% per annum and a capital structure consisting of 55% debt and 45% equity. At para.115, I indicate that the corresponding discounted present value of the Prescribed Facilities is approximately $7.7 billion, or 104% of the 2008 rate base estimated by OPG.

[9] I have performed this calculation again, discounting the cash flow from assets at the tax-adjusted WACC using my recommended ROE and capital structure. The resulting present value of the Prescribed Facilities is approximately $9,885 million. This estimated fair market value is approximately 134% of OPG's estimated rate base for 2008. Stated differently, the "market/book ratio" is 1.34 using my recommended ROE and capital structure.

[10] In Footnote 16 of my Report, I noted that the discounted present value of the Prescribed Facilities using a 3% inflation rate was approximately $6,425 million (87% of the 2008 book value) under Ms. McShane's recommended ROE and capital structure. Recalculating using the tax-adjusted WACC and a 3% inflation rate produces a discounted present value of approximately $7,473.8 million, which equals the 2008 book value of the rate base estimated by OPG.

[11] My Report did not calculate the discounted present value of the Prescribed Facilities using a 3% inflation rate and my recommended ROE and capital structure. Doing so together with the tax-adjusted WACC produces a value of approximately $13,556 million, roughly 183% of the 2008 book value of the rate base estimated by OPG.

[12] The higher discounted present values presented in Footnote 16 of my Report and reported here with a 3% inflation rate illustrate the sensitivity of the estimated valuation to the inflation rate. I believe that this sensitivity requires consideration but I do not regard a 3% rate of inflation for the indefinite future as realistic.

[13] On the basis of the above, certain numbers in my Report should be changed to reflect the calculations discussed in this update. However, the general conclusions and opinions that I reached in that Report are unchanged.

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Working Paper/Document de travail
2007-30

Term Structure Transmission of Monetary Policy

by Sharon Kozicki and P.A. Tinsley

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Bank of Canada Working Paper 2007-30

April 2007

Term Structure Transmission of Monetary Policy

by

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1. Introduction

> "Monetary policy works largely through indirect channels–in particular, by influencing private-sector expectations and thus long-term interest rates." Bernanke (2004)
>
> "Financial markets are the channel through which our policy affects the economy, and asset prices contain valuable information about investors' expectations for the course of policy, economic activity, and inflation, as well as the risks about those expectations." Kohn (2005)

Most studies of monetary policy focus on the policy interest rate, typically a very short-term rate, such as an overnight rate. However, as suggested by the above quotations, longer-term bond rates are essential conduits for the transmission of monetary policy. As bond rates contain bond trader expectations of future policy rates, not recent policy rates, monetary policy effectiveness depends on the policy perceptions of the bond market. The connection of these perceptions to announced or recently observed policy is not fully understood.

A large literature has developed to explain the historical behavior of the term structure of interest rates. The importance of accounting for asymmetric information on the part of the private sector and the central bank has been shown to be critical for understanding the relationship between short- and long-term interest rates—particularly in the 1980s (Kozicki and Tinsley 2001 a,b, 2005; Dewachter and Lyrio (2006c)). Other studies, including Shiller, Campbell, and Schoenholtz (1983), Duffee (2002), and Dai and Singleton (2002) emphasize the the key role of time-varying term premiums for capturing time variation in yields. Both of these areas of research form a part of a large literature exploring the connections between yields of different maturities. Other research, such as Ang and Piazzesi (2003), and Dewachter, Lyrio, and Maes (2006b) relate yields to macro factors.

Rudebusch and Wu (2004), Hördahl, Tristani and Vestin (2005), and Dewachter and Lyrio (2006a) use no-arbitrage term-structure models and structural macroeconomic models to relate bond yields to macroeconomic variables through policy responses of short-term interest rates. However, even in these papers, the focus remains largely one of explaining yield-curve behaviour given macroeconomic data, and explaining macroeconomic behaviour given policy rate responses. Although they comment on the lack of a structural link, Rudebusch, Sack, and Swanson (2006) establish an empirical link between term premiums and economic activity. Ang, Dong, and Piazzesi (2005) is the closest to our paper in that both papers present no-arbitrage models of the term structure based on Taylor-type rules that relate policy responses to economic outcomes. New contributions to the literature in this paper include an examination of the conditions for policy stability

Fundamentals of CORPORATE FINANCE

FIRST CANADIAN EDITION

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9

Finance in Action

The Fall of Barings Bank

The indexes of stock prices are used for more than just reporting on overall share price movements. As you will see in Chapters 13 and 25, there are a variety of financial instruments that firms and investors can use to take on or offload risk. Some of these instruments are based directly on stock market indexes. Contracts related to the Nikkei-225 stock market average caused many headlines in early 1995.

On February 23, 1995, officials at the Barings Bank found that Nick Leeson, a 28-year-old trader working in the Bank's Singapore branch, had, as part of a multi-billion dollar gamble, bought $7 billion worth of contracts tied to a future level of the Nikkei-225 stock market index. Leeson's buying and selling of futures contracts had apparently been profitable for the Bank in 1994, when Barings profits from futures trading were $12 million. But things went sour in early '95, when Leeson's trading — in the face of a 5 percent drop in the Tokyo stock market index — generated large losses for the Bank. Apparently Leeson then tried a "double or nothing" gamble, hoping that Tokyo's Nikkei would recover from its January plunge before the initial losses were discovered.

The Tokyo market did not improve, and Leeson's attempt to recoup the losses failed. By March 4th, Barings' losses on the Nikkei futures contracts reached $1 billion U.S. This huge loss exceeded the bank's equity, causing the spectacular collapse of the 233-year-old Barings.

by 23 percent, their largest one-day fall in history. However, Black Monday came after a prolonged rise in stock prices, so that over 1987 as a whole investors in common stocks earned a return of 5.2 percent. This was not a terrible return, but many investors who rode the 1987 roller coaster feel that it is not a year they would care to repeat.

SELF-TEST 9.2

Here are the average rates of return calculated for the postwar period 1949–1993:

Stocks	12.71%
Corporate bonds	7.59
Government bonds	6.38
Treasury bills	6.37

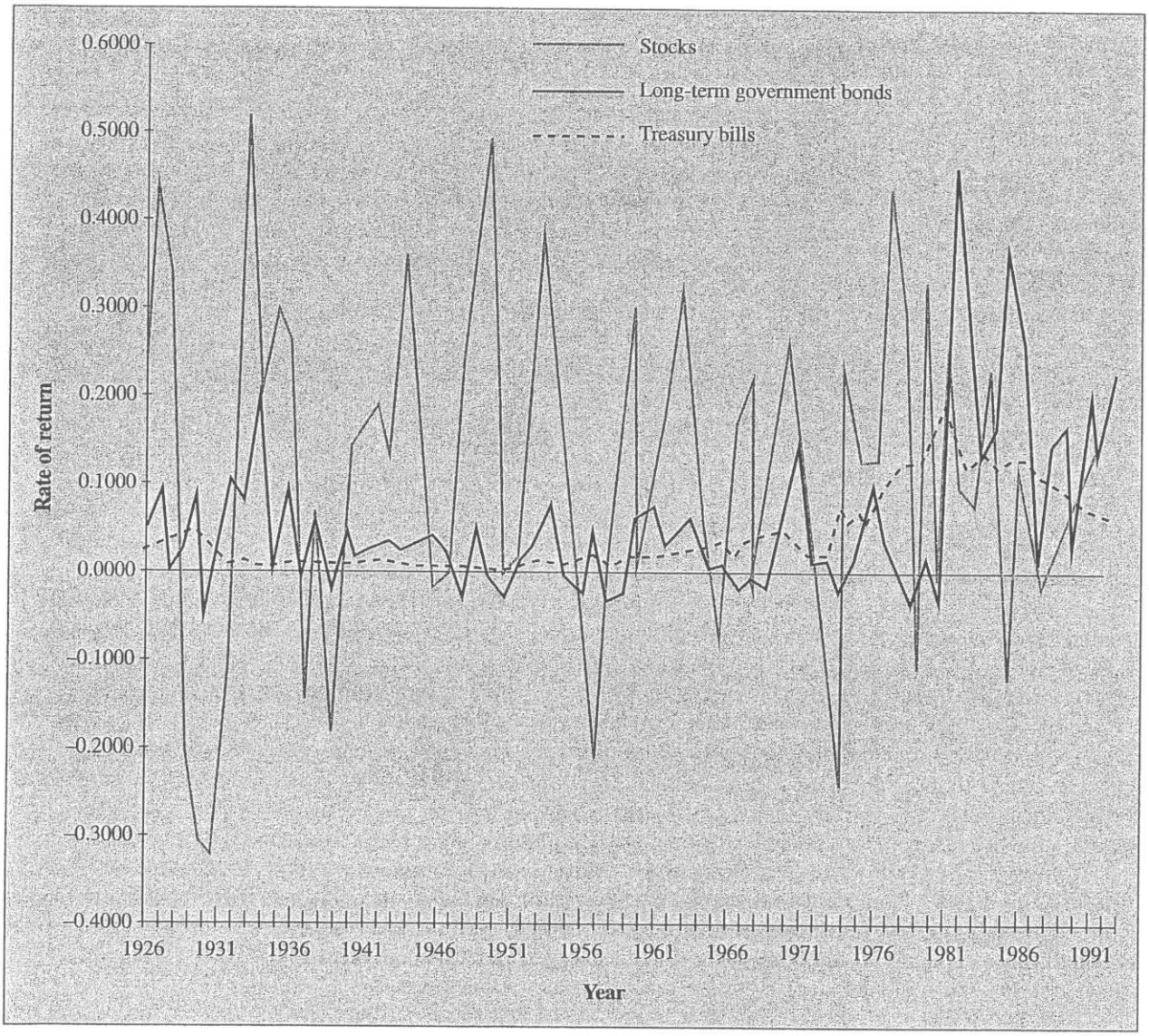
What were the risk premium on stocks and the maturity premium on government bonds for this period?

Using Historical Evidence to Estimate Today's Cost of Capital

We now have an idea of the average return an investor might expect to earn from an investment in a portfolio of common stocks. What does this have to do with the cost of capital? Suppose there is an investment project that you *know* — don't ask how — has the same risk as an investment in the portfolio of stocks in the TSE

(10)

FIGURE 9.2
Rates of return, 1926–1993.



Source: Calculated with data from P.P. Boyle, H.H. Panjer, and K.P. Sharp, "Report on Canadian Economic Statistics 1924–1990," Canadian Institute of Actuaries, Ottawa, 1991; and *ScotiaMcLeod's Handbook of Canadian Debt Market Indices*, 1947–1993.

300 Composite Index. We will say that it has the same degree of risk as the market portfolio of common stocks.[7]

Instead of investing in the project, your shareholders could invest directly in this market portfolio of common stocks. Therefore, the opportunity cost of capital for your project is the return that the shareholders could expect to earn on the market portfolio. This is what they are giving up by investing money in your project.

[7] This is speaking a bit loosely, because the TSE 300 does not include all stocks traded in Canada, much less in world markets.

The problem of estimating the project cost of capital boils down to that of estimating the currently expected rate of return on the market portfolio. One way to estimate the expected market return is to assume that the future will be like the past and that today's investors expect to receive the average rates of return shown in Table 9.1. In this case, you would judge that the expected market return today is 11.4 percent, the average of past market returns.

Unfortunately, this is *not* the way to do it. Investors are not likely to demand the same return each year of an investment in common stocks. For example, we know that the interest rate on safe Treasury bills varies over time. At their peak in 1981, Treasury bills offered a return of 18 percent, more than 13 percentage points above the 4.8 percent average return on bills shown in Table 9.1.

What if you were called upon to estimate the expected return on common stocks in 1981? Would you have said 11.4 percent? That doesn't make sense. Who would invest in the risky stock market for an expected return of 11.4 percent when you could get a safe 18 percent from Treasury bills?

A better procedure is to take the *current* interest rate on Treasury bills plus 7 percent, the average *risk premium* shown in Table 9.1. In 1981, when the rate on Treasury bills was 18 percent, that would have given

$$\begin{aligned}\text{Expected market return (1981)} &= \text{interest rate on Treasury bills (1981)} + \text{normal risk premium}\\ &= 18\% + 7\% = 25\%\end{aligned}$$

The first term on the right-hand side tells us the time value of money in 1981; the second term measures the compensation for risk. The sum of the two terms tells us the compensation for both waiting (time value) and worrying (risk).

This calculation assumes that there is a normal, stable risk premium on the market portfolio, so that the expected *future* risk premium can be measured by the average past risk premium. One could quarrel with this assumption, but it does yield estimates of the expected market return that are reasonable.

What about today? As we write this in July 1994, inflation has fallen from its 1981 figure of 12.2 percent to about 1.5 percent. As a result interest rates are also much lower and three month Treasury bills offer a return of only 5.9 percent. This suggests investors in common stocks are looking for a return of almost 13 percent:[8]

$$\begin{aligned}\text{Expected market return (1994)} &= \text{interest rate on Treasury bills (1994)} + \text{normal risk premium}\\ &= 5.9\% + 7\% = 12.9\%\end{aligned}$$

You now have a couple of benchmarks. You know that the opportunity cost of capital for safe projects must be the rate of return offered by safe Treasury bills and you know that the opportunity cost of capital for "average-risk" projects must be the expected rate of return on the market portfolio. But you don't know how to estimate the cost of capital for projects that do not fit these two simple cases. Before you can do this, you need to understand more about investment risk.

[8] In practice, things might be a bit more complicated. We've mentioned the term structure of interest rates, the relationship between bond maturity and yield. When firms consider investments in long-lived projects, they usually think about risk premiums relative to long-term bonds. In this case, the risk-free rate would be taken as the current long-term bond yield less the average maturity premium on such bonds.

period of the available U.S. data. These rates of return are calculated in the same way as was done for CanWest. In other words, they include (1) dividends or interest and (2) any capital gains or losses. The averages of the 67 annual rates of return are shown in Table 9.1.

TABLE 9.1
Average rates of return on Treasury bills, government bonds, corporate bonds, and common stocks, 1926–1992 (figures in percent per year)

	Average Annual Rate of Return (Nominal) (%)		Average Annual Rate of Return (Real) (%)		Average Risk Premium (Extra Return versus Treasury Bills) (%)	
Portfolio	**Canada**	**U.S.**	**Canada**	**U.S.**	**Canada**	**U.S.**
Treasury bills	4.8	3.8	1.4	0.6		
Government bonds	5.8	5.2	2.5	2.1	1.0	1.4
Corporate bonds	7.2	5.8	2.6	2.7	2.4	2.0
Common stocks	11.4	12.4	7.8	9.0	6.6	8.6

Source: Canadian results are calculated with data provided from P.P. Boyle, H.H. Panjer, and K.P. Sharp, "Report on Canadian Economic Statistics 1924–1990," Canadian Institute of Actuaries, Ottawa, 1991 and *ScotiaMcLeod's Handbook of Canadian Debt Market Indices*, 1947–1993. American results are from © *Stocks, Bonds, and Inflation 1993 Yearbook*™, Ibbotson Associates, Chicago (annual updates work by Roger G. Ibbotson and Rex A. Sinquefield). Used with permission. All rights reserved.

maturity premium: Extra average return from investing in long- versus short-term Treasury securities.

risk premium: Expected return in excess of risk-free return as compensation for risk.

The safest investment, Treasury bills, had the lowest rate of return — 4.8 percent a year in *nominal* terms and 1.4 percent in *real* terms. In other words, the average rate of inflation over this period was about 3.4 percent a year. Long-term government bonds gave slightly higher returns than Treasury bills. This difference is called the **maturity premium**. Corporate bonds gave still higher returns. Common stocks were in a class by themselves. Investors who accepted the risk of common stocks received on average an extra return of 6.6 percent a year over the return on Treasury bills. This compensation for taking on the risk of common stock ownership is known as the **risk premium**. A similar pattern of returns holds for U.S. securities.

You may ask why we look back over such a long period to measure average rates of return. The reason is that annual rates of return for common stocks fluctuate so much that averages taken over short periods are extremely unreliable. In some years investors in common stocks had a disagreeable shock and received a substantially lower return than they expected. In other years they had a pleasant surprise and received a higher return. Our only hope of gaining insights from historical rates of return is to look at a very long period. By averaging the returns across both the rough years and the smooth, we should get a fair idea of the typical return that investors might justifiably expect.

While common stocks have offered the highest average returns, they have also been riskier investments. Figure 9.2 shows the 68 annual rates of return for the four portfolios. The fluctuations in year-to-year stock returns are remarkably wide. There were two years (1933 and 1950) when investors earned a return of more than 50 percent. However, Figure 9.2 shows that you can also lose money by investing in the stock market. The most dramatic case was the stock market crash of 1929–1932. By July 1932 TSE listed common stocks had fallen four years in succession in a series of agonizing slides for a total decline of 88 percent.

Another major market crash, that of Monday, October 19, 1987, does not show up in Figure 9.2. On that day the TSE 300 fell by 11 percent and the S&P 500 fell

Corporate Finance

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(14)

S & P PROBLEMS

STANDARD &POOR'S

11.46 Go to the "Excel Analytics" link for Nexen Inc. (NXY) and Thomson Corp. (TOC) and download the monthly adjusted stock prices. Copy the monthly returns for each stock into a new spreadsheet. Calculate the covariance and correlation between the two stock returns. Would you expect a higher or lower correlation if you had chosen Petro-Canada (PCA) instead of Thomson Corp.? What is the standard deviation of a portfolio 75 percent invested in NXY and 25 percent in TOC? What about a portfolio equally invested in the two stocks? What about a portfolio 25 percent in NXY and 75 percent in TOC?

11.47 Go to the "Excel Analytics" link for Encana Corp (ECA) and download the monthly adjusted stock prices. Copy the monthly returns for ECA and the monthly S&P 500 returns in a new spreadsheet. Calculate the beta of ECA for the entire period of data available. Now download the monthly stock prices for Research In Motion Limited (RIM) and calculate the beta for this company. Are the betas similar? Would you have expected the beta for ECA to be higher or lower than the beta for RIM? Why?

Appendix 11A

Is Beta Dead?

The capital asset pricing model represents one of the most important advances in financial economics. It is clearly useful for investment purposes, since it shows how the expected return on an asset is related to its beta. In addition, we will show in Chapter 12 that it is useful in corporate finance, since the discount rate on a project is a function of the project's beta. However, one must never forget that, as with any other model, the CAPM is not revealed truth but, rather, a construct to be empirically tested.

The first empirical tests of the CAPM occurred over 20 years ago and were quite supportive. Using data from the 1930s to the 1960s, researchers showed that the average return on a portfolio of stocks was positively related to the beta of the portfolio,[22] a finding consistent with the CAPM. Though some evidence in these studies was less consistent with the CAPM,[23] financial economists were quick to embrace the CAPM following these empirical papers.

While a large body of empirical work developed in the following decades, often with varying results, the CAPM was not seriously called into question until recently. Two papers by Fama and French[24] (yes, the same Fama whose joint paper in 1973 with James MacBeth supported the CAPM) present evidence inconsistent with the model. Their work has received a great deal of attention, both in academic circles and in the popular press, with

[22] Perhaps the two most well-known papers were Fischer Black, Michael C. Jensen, and Myron S. Scholes, "The Capital Asset Pricing Model: Some Empirical Tests," in M. Jensen, ed. *Studies in the Theory of Capital Markets* (New York: Praeger, 1972); and Eugene F. Fama and James MacBeth, "Risk, Return and Equilibrium: Some Empirical Tests," *Journal of Political Economy* 8 (1973), pp. 607–36.

[23] For example, the studies suggest that the average return on a zero-beta portfolio is above the risk-free rate, a finding inconsistent with the CAPM. Two Canadian studies raising questions about the CAPM's accuracy are: J. D. Jobson and R. M. Korkie, "Some Tests of Linear Asset Pricing with Multivariate Normality," *Canadian Journal of Administrative Sciences* 2 (June 1985), and A. L. Calvet and J. Lefoll, "Risk and Return on Canadian Capital Markets," *Canadian Journal of Administrative Science* 5 (March 1988).

[24] Eugene F. Fama and Kenneth R. French, "The Cross-Section of Expected Stock Returns," *Journal of Finance* 47 (1992), pp. 427–66; and E. F. Fama and K. R. French, "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics* 17 (1993), pp. 3–56.

newspaper articles displaying headlines such as "Beta Is Dead!" These papers make two related points. First they conclude that the relationship between average return and beta is weak over the period from 1941 to 1990 and virtually nonexistent from 1963 to 1990. Second, they argue that the average return on a security is negatively related to both the firm's price-to-earnings (P/E) ratio and the firm's market value-to-book value (M/B) ratio. These contentions, if confirmed by other research, would be quite damaging to the CAPM. After all, the CAPM states that the expected returns on stocks should be related *only* to beta, and not to other factors such as P/E and M/B.

However, a number of researchers have criticized the Fama–French papers. While we avoid an in-depth discussion of the fine points of the debate, we mention a few issues. First, although Fama and French cannot reject the hypothesis that average returns are unrelated to beta, one can also not reject the hypothesis that average returns are related to beta exactly as specified by the CAPM. In other words, while 50 years of data seem like a lot, they may simply not be enough to test the CAPM properly. Second, the result with P/E and M/B may be due to a statistical fallacy called a hindsight bias.[25] Third, P/E and M/B are merely two of an infinite number of possible factors. Thus, the relationship between average return and both P/E and M/B may be spurious, being nothing more than the result of data dredging. Fourth, average returns are positively related to beta over the period from 1927 to 1990. There appears to be no compelling reason for emphasizing a shorter period than this one. Fifth, average returns are actually positively related to beta over shorter periods when annual data, rather than monthly data, are used to estimate beta.[26] There appears to be no compelling reason for preferring either monthly data over annual data or vice versa. Thus, we believe that, while the results of Fama and French are quite intriguing, they cannot be viewed as the final word.

[25]For example, see William J. Breen and Robert A. Korajczyk, "On Selection Biases in Book-to-Market Based Tests of Asset Pricing Models," unpublished paper, Northwestern University, November 1993; and S. P.

Fundamentals of CORPORATE FINANCE

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