CHAPTER 4

RISK MEASUREMENT AND HURDLE RATES IN PRACTICE

In the last chapter, we presented the argument that the expected return on an equity investment should be a function of the market or non-diversifiable risk embedded in that investment. Here we turn our attention to how best to estimate the parameters of market risk in each of the models described in the previous chapter—the capital asset pricing model, the arbitrage pricing model, and the multifactor model. We will present three alternative approaches for measuring the market risk in an investment; the first is to use historical data on market prices for the firm considering the project, the second is to use the market risk parameters estimated for other firms that are in the same business as the project being analyzed, and the third is to use accounting earnings or revenues to estimate the parameters.

In addition to estimating market risk, we will also discuss how best to estimate a riskless rate and a risk premium (in the CAPM) or risk premiums (in the APM and multifactor models) to convert the risk measures into expected returns. We will present a similar argument for bringing default risk into a cost of debt and then bring the discussion to fruition by combining both the cost of equity and debt to estimate a cost of capital, which will become the minimum acceptable hurdle rate for an investment.

Cost of Equity

The *cost of equity* is the rate of return that investors require to invest in the equity of a firm. All of the risk and return models described in the previous chapter need a risk-free rate and a risk premium (in the CAPM) or premiums (in the APM and multifactor models). We begin by discussing those common inputs before turning attention to the estimation of risk parameters.

I. Risk-Free Rate

Most risk and return models in finance start off with an asset that is defined as risk-free and use the expected return on that asset as the risk-free rate. The expected returns

on risky investments are then measured relative to the risk-free rate, with the risk creating an expected risk premium that is added on to the risk-free rate.

Requirements for an Asset to be Risk-Free

We defined a risk-free asset as one for which the investor knows the expected returns with certainty. Consequently, for an investment to be risk-free, that is, to have an actual return be equal to the expected return, two conditions have to be met:

- There has to be *no default risk*, which generally implies that the security has to be issued by a government. Note, though, that not all governments are default-free, and the presence of government or sovereign default risk can make it very difficult to estimate risk-free rates in some currencies.
- There can be *no uncertainty about reinvestment rates*, which implies that there are no intermediate cash flows. To illustrate this point, assume that you are trying to estimate the expected return over a five-year period and that you want a risk-free rate. A six-month Treasury bill rate, although default-free, will not be risk-free, because there is the reinvestment risk of not knowing what the bill rate will be in six months. Even a five-year Treasury bond is not risk-free, because the coupons on the bond will be reinvested at rates that cannot be predicted today. The risk-free rate for a five-year time horizon has to be the expected return on a default-free (government) five-year zero coupon bond.

This clearly has painful implications for anyone doing corporate financial analysis, where expected returns often have to be estimated for periods ranging over multiple years. A purist's view of risk-free rates would then require different risk-free rates for each period and different expected returns. As a practical compromise, however, it is worth noting that the present value effect of using risk-free rates that vary from year to year tends to be small for most well-behaved term structures.[1] In these cases, we could use a duration matching strategy, where the duration of the default-free security used as the risk-free asset is matched up to the duration of the cash flows in the analysis.[2] If, however, there

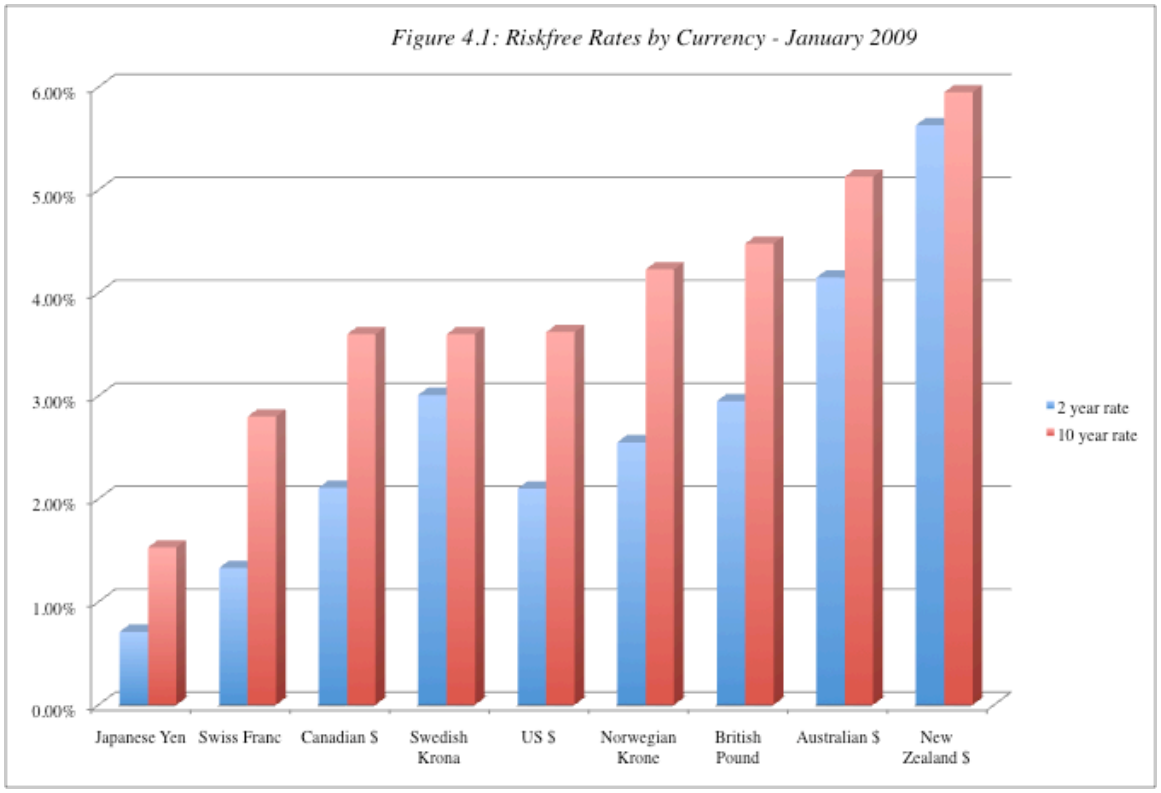
[1]By "well-behaved term structures", I would include a normal upwardly sloping yield curve, where long term rates are at most 2–3 percent higher than short-term rates.

[2]In investment analysis, where we look at projects, these durations are usually between three and ten years. In valuation, the durations tend to be much longer, because firms are assumed to have infinite lives. The

are very large differences in either direction between short-term and long-term rates, it does pay to use year-specific risk-free rates in computing expected returns.

Cash Flows and Risk-Free Rates: The Consistency Principle

The risk-free rate used to come up with expected returns should be measured consistently with how the cash flows are measured. If the cash flows are nominal, the risk-free rate should be in the same currency in which the cash flows are estimated. This also implies that it is not where a project or firm is located that determines the choice of a risk-free rate, but the currency in which the cash flows on the project or firm are estimated. Thus, Disney can analyze a proposed project in Mexico in dollars, using a dollar discount rate, or in pesos, using a peso discount rate. For the former, it would use the U.S. Treasury bond rate as the risk-free rate, but the latter would need a peso risk-free rate. Figure 4.1 compares risk free rates in different currencies in early 2009:



Note that if these are truly default free rates, the key factor determining the differences across currencies is expected inflation. The riskfree rate in Australian dollars is higher

duration in these cases is often well in excess of ten years and increases with the expected growth potential of the firm.

than the riskfre rate in Swiss Francs, because expected inflation is higher in Australia than in Switzerland.

Under conditions of high and unstable inflation, valuation is often done in real terms. Effectively, this means that cash flows are estimated using real growth rates and without allowing for the growth that comes from price inflation. To be consistent, the discount rates used in these cases have to be real discount rates. To get a real expected rate of return, we need to start with a real risk-free rate. Although government bills and bonds offer returns that are risk-free in nominal terms, they are not risk-free in real terms, because inflation can be volatile. The standard approach of subtracting an expected inflation rate from the nominal interest rate to arrive at a real risk-free rate provides at best only an estimate of the real risk-free rate. Until recently, there were few traded default-free securities that could be used to estimate real risk-free rates; but the introduction of inflation-indexed Treasuries (called TIPs) has filled this void. An inflation-indexed Treasury security does not offer a guaranteed nominal return to buyers, but instead provides a guaranteed real return. In early 2008, for example, the inflation indexed U.S. ten-year Treasury bond rate was only 1.4 percent, much lower than the nominal ten-year bond rate of 3 percent.

4.1. **What Is the Right Risk-Free Rate?**

The correct risk-free rate to use in the CAPM

a. is the short term government security rate.

b. is the long term government security rate.

c. can be either, depending on whether the prediction is short-term or long-term.

In Practice: What If There Is No Default-Free Rate?

Our discussion to this point has been predicated on the assumption that governments do not default, at least on local borrowing. There are many emerging market economies where this assumption might not be viewed as reasonable. Governments in these markets are perceived as capable of defaulting even on local borrowing. When this is coupled with the fact that many governments do not borrow long-term in the local currency, there are scenarios in which obtaining a risk-free rate in that currency, especially for the long

term, becomes difficult. In these cases, there are compromises that give us reasonable estimates of the risk-free rate.

- If the government does issue long-term bonds in the local currency, you could adjust the government bond rate by the estimated default spread on the bond to arrive at a riskless local currency rate. The default spread on the government bond can be estimated using the local currency ratings that are available for many countries.[3] In May 2009, for instance, the ten-year rupee denominated Indian government bond rate was 7%. However, the local currency sovereign rating assigned to the Indian government in January 2009 by Moody's was Ba2, indicating that they (Moody's) perceive default risk in Indian government rupee bonds. If the default spread for Ba2 rated government bonds is 3%, the rupee risk free is 4%.[4]

  Rupee Riskfree Rate = Indian government bond rate – Default spread for India

  = 7% - 4% = 3%

- If there are long-term dollar-denominated forward contracts on the currency, you can use interest rate parity and the Treasury bond rate (or riskless rate in any other base currency) to arrive at an estimate of the local borrowing rate. For instance, if the current spot rate is 38.10 Thai baht per U.S. dollar, the ten-year forward rate is 61.36 baht per dollar and the current ten-year U.S. Treasury bond rate is 5 percent, the ten-year Thai risk-free rate (in nominal baht) can be estimated as follows:

$$61.36 = (38.1)\left(\frac{1+\text{Interest Rate}_{\text{Thai Baht}}}{1+0.05}\right)^{10}$$

  Solving for the Thai interest rate yields a ten-year risk free rate of 10.12%.

If every attempt at estimating a riskfree rate in the local currency falls short, the fall back position is to do your entire analysis in a different currency, where estimation poses fewer challenges. Thus, we can analyze a Russian company in Euros or a Brazilian company in U.S. dollars. If we do so, though, we have to be consistent and estimate all of

[3]Ratings agencies generally assign different ratings for local currency borrowings and dollar borrowings, with higher ratings for the former and lower ratings for the latter.

[4] The default spread for a sovereign rating is computed by comparing dollar or euro denominated sovereign bonds issued by emerging markets to the default free US rate (treasury) or Euro rate (the German 10-year bond).

our cash flows in those currencies, which will require forecasting future exchange rates. We will come back to the question of how best to do this in the next chapter.

Illustration 4.1: Estimating Riskfree Rates

The companies that we are analyzing in this book include two US companies, (Disney and Bookscape), a Brazilian company (Aracruz), an Indian company (Tata Chemicals) and a German bank (Deutsche Bank). We estimated riskfree rates in four currencies, on May 23, 2009, and will use these riskfree rates for the rest of the book:

a. In US dollars: The ten-year US treasury bond rate was 3.5%. While concerns about the credit worthiness of the US government have increased in the aftermath of the billions in financial commitments made after the banking crisis, we will use 3.5% as the riskfree rate in any dollar based computation.

b. In Euros: For a Euro riskfree rate, we looked at ten-year Euro denominated government bonds and noted that at least 12 different European governments have such bonds outstanding, with wide differences in rates.[5] Since the only reason for differences in these government bond rates has to be default risk (since they are denominated in the same currency), we used the lowest of these rates, resulting in the German ten-year bond rate of 3.60% being used as the riskfree rate for Euro based computations.

c. In Rupees: On May 23, 2009, the ten-year rupee-denominated bond, issued by the Indian government, traded to yield 7%. Subtracting out the default spread of 3% estimated for India, based upon its sovereign rating of Ba2, yields a riskfree rate of 4% for rupee-based computations:

   Riskfree rate in Rupees = Ten-year Rupee bond rate – Default spread

   = 7% -3% = 4%

d. In Brazilian Reals: On May 23, 2009, the ten-year Brazilian Real ($R) denominated government rate was 11%. Subtracting out the default spread of 2.5% estimated for Brazil, based upon its sovereign rate of Ba1, yields a riskfree rate of 8.5% for $R-based computation.

[5] On May 23, 2009, the German ten year Euro bond rate was 3.60%, the Italian ten-year Euro bond was yielding 4.46% and the Greek ten-year Euro bond rate was 5.26%

e. In real terms: For any computations done in real terms, we need a real riskfree rate. We will use the ten-year inflation-indexed treasury bond (TIPS) rate of 1.6% (from May 23, 2009) as the riskfree rate for any computations done in real terms.

II. Risk Premium

The risk premium(s) is clearly a significant input in all of the asset pricing models. In the following section, we will begin by examining the fundamental determinants of risk premiums and then look at practical approaches to estimating these premiums.

What Is the Risk Premium Supposed to Measure?

The risk premium in the CAPM measures the extra return that would be demanded by investors for shifting their money from a riskless investment to the market portfolio or risky investments, on average. It should be a function of two variables:

1. ***Risk Aversion of Investors***: As investors become more risk-averse, they should demand a larger premium for shifting from the riskless asset. Although some of this risk aversion may be inherent, some of it is also a function of economic prosperity (when the economy is doing well, investors tend to be much more willing to take risk) and recent experiences in the market (risk premiums tend to surge after large market drops).
2. ***Riskiness of the Average Risk Investment***: As the riskiness of the average risk investment increases, so should the premium. This will depend on what firms are actually traded in the market, their economic fundamentals, and how involved they are in managing risk.

Because each investor in a market is likely to have a different assessment of an acceptable equity risk premium, the premium will be a weighted average of these individual premiums, where the weights will be based on the wealth the investor brings to the market. Put more directly, what Warren Buffett, with his substantial wealth, thinks is an acceptable premium will be weighted in far more into market prices than what you or I might think about the same measure.

In the APM and the multifactor models, the risk premiums used for individual factors are similar wealth-weighted averages of the premiums that individual investors would demand for each factor separately.

4.2 What Is Your Risk Premium?

Assume that stocks are the only risky assets and that you are offered two investment options:

- A riskless investment (say, a government security), on which you can make 4 percent
- A mutual fund of all stocks, on which the returns are uncertain

How much of an expected return would you demand to shift your money from the riskless asset to the mutual fund?

a. Less than 4 percent
b. Between 4 and 6 percent
c. Between 6 and 8 percent
d. Between 8 and10 percent
e. Between 10 and 12 percent
f. More than 12 percent

Your answer to this question should provide you with a measure of your risk premium. (For instance, if your answer is 6 percent, your premium is 2 percent.)

Estimating Risk Premiums

There are three ways of estimating the risk premium in the CAPM: Large investors can be surveyed about their expectations for the future, the actual premiums earned over a past period can be obtained from historical data, and the implied premium can be extracted from current market data. The premium can be estimated only from historical data in the APM and the multi-factor models.

1. Survey Premiums

Because the premium is a weighted average of the premiums demanded by individual investors, one approach to estimating this premium is to survey investors about their expectations for the future. It is clearly impractical to survey all investors; therefore, most surveys focus on portfolio managers or Chief Financial Officers (CFOs), who carry

the most weight in the process. Table 4.1 summarizes the results of some of these surveys, along with the groups surveyed:

Table 4.1: Equity Risk Premiums from Surveys

Group Surveyed	*Survey done by*	*Results (Year)*
Individual Investors	Securities Industry Association	8.3% (December 2004)
Institutional Investors	Merrill Lynch	3.8% (July 2008)
CFOs	Campbell and Harvey	4.2% (March 2008)
Finance academics	Fernandez	6.2% (2008)

Although numbers do emerge from these surveys, very few practitioners actually use these survey premiums. There are three reasons for this reticence:

- There are no constraints on reasonability; individual money managers could provide expected returns that are lower than the risk-free rate, for instance.
- Survey premiums are extremely volatile; the survey premiums can change dramatically, largely as a function of recent market movements.
- Survey premiums tend to be short-term; even the longest surveys do not go beyond one year.

4.3 Do Risk Premiums Change?

In the previous question, you were asked how much of a premium you would demand for investing in a portfolio of stocks as opposed to a riskless asset. Assume that the market dropped by 20 percent last week, and you were asked the same question today. Would your premium be

a. higher?
b. lower?
c. unchanged?

2. Historical Premiums

The most common approach to estimating the risk premium(s) used in financial asset pricing models is to base it on historical data. In the APM and multifactor models, the premiums are based on historical data on asset prices over very long time periods which are used to extract factor-specific risk premiums. In the CAPM, the premium is defined as the difference between average returns on stocks and average returns on risk-free securities over an extended period of history.

Basics

In most cases, this approach is composed of the following steps. It begins by defining a time period for the estimation, which can range to as far back as 1871 for U.S. data. It then requires the calculation of the average returns on a stock index and average returns on a riskless security over the period. Finally, the difference between the average returns on stocks and the riskless return it is defined as the risk premium looking forward. In doing this, we implicitly assume that

1. The risk aversion of investors has not changed in a systematic way across time. (The risk aversion may change from year to year, but it reverts back to historical averages.)
2. The average riskiness of the "risky" portfolio (stock index) has not changed in a systematic way across time.

Estimation Issues

Users of risk and return models may have developed a consensus that the historical premium is in fact the best estimate of the risk premium looking forward, but there are surprisingly large differences in the actual premiums used in practice. For instance, the risk premium estimated in the U.S. markets by different investment banks, consultants, and corporations range from 4 percent at the lower end to 12 percent at the upper end. Given that they almost all use the same database of historical returns, provided by Ibbotson Associates,[6] summarizing data from 1926, these differences may seem surprising. There are, however, three reasons for the divergence in risk premiums.

- *Time Period Used*: Although there are some who use all of the Ibbotson which goes back to 1926, there are many using data over shorter time periods, such as fifty, twenty, or even ten years to come up with historical risk premiums. The rationale presented by those who use shorter periods is that the risk aversion of the average investor is likely to change over time and using a shorter and more recent time period provides a more updated estimate. This has to be offset against a cost associated with using shorter time periods, which is the greater estimation error in the risk premium

estimate. In fact, given the annual standard deviation in stock prices between 1928 and 2008 of 20 percent,[7] the standard error associated with the risk premium estimate can be estimated as follows for different estimation periods in Table 4.2.[8]

Table 4.2 Standard Errors in Risk Premium Estimates

Estimation Period	Standard Error of Risk Premium Estimate
5 years	$20/\sqrt{5} = 8.94\%$
10 years	$20/\sqrt{10} = 6.32\%$
25 years	$20/\sqrt{25} = 4.00\%$
50 years	$20/\sqrt{50} = 2.83\%$

Note that to get reasonable standard errors, we need very long time periods of historical returns. Conversely, the standard errors from ten- and twenty-year estimates are likely to be almost as large or larger than the actual risk premiums estimated. This cost of using shorter time periods seems, in our view, to overwhelm any advantages associated with getting a more updated premium.

- *Choice of Risk-Free Security*: The Ibbotson database reports returns on both Treasury bills and bonds and the risk premium for stocks can be estimated relative to each. Given that short term rates have been lower than long term rates in the United States for most of the past seven decades, the risk premium is larger when estimated relative to shorter-term government securities (such as Treasury bills). The risk-free rate chosen in computing the premium has to be consistent with the risk-free rate used to compute expected returns. For the most part, in corporate finance and valuation, the risk-free rate will be a long-term government bond rate and not a short term rate. Thus the risk premium used should be the premium earned by stocks over Treasury bonds.

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[6]See "Stocks, Bonds, Bills and Inflation," an annual publication that reports on the annual returns on stocks, Treasury bonds and bills, and inflation rates from 1926 to the present. Available online at www.ibbotson.com.

[7]For the historical data on stock returns, bond returns, and bill returns, check under Updated Data at www.damodaran.com..

[8]These estimates of the standard error are probably understated because they are based on the assumption that annual returns are uncorrelated over time. There is substantial empirical evidence that returns are correlated over time, which would make this standard error estimate much larger.

- *Arithmetic and Geometric Averages*: The final sticking point when it comes to estimating historical premiums relates to how the average returns on stocks and Treasury bonds and bills are computed. The arithmetic average return measures the simple mean of the series of annual returns, whereas the geometric average looks at the compounded return.[9] Conventional wisdom argues for the use of the arithmetic average. In fact, if annual returns are uncorrelated over time and our objective was to estimate the risk premium for the next year, the arithmetic average is the best unbiased estimate of the premium. In reality, however, there are strong arguments that can be made for the use of geometric averages. First, empirical studies seem to indicate that returns on stocks are negatively correlated over time.[10] Consequently, the arithmetic average return is likely to overstate the premium. Second, although asset pricing models may be single-period models, the use of these models to get expected returns over long periods (such as five or ten years) suggests that the analysis is more likely to be over multiple years than for just the next year. In this context, the argument for geometric average premiums becomes even stronger.

In summary, the risk premium estimates vary across users because of differences in time periods used, the choice of Treasury bills or bonds as the risk-free rate, and the use of arithmetic as opposed to geometric averages. The effect of these choices is summarized in Table 4.3, which uses returns from 1928 to 2008.[11]

Table 4.3 Historical Risk Premiums (%) for the United States, 1928- 2008

	Stocks – Treasury Bills		*Stocks – Treasury Bonds*	
	Arithmetic	*Geometric*	*Arithmetic*	*Geometric*
1928–2008	7.30%	5.65%	5.32%	3.88%

[9]The compounded return is computed by taking the value of the investment at the start of the period ($Value_0$) and the value at the end ($Value_N$) and then computing the following:

$$\text{Geometric Average} = \left(\frac{\text{Value}_N}{\text{Value}_0}\right)^{1/N} - 1$$

[10]In other words, good years are more likely to be followed by poor years and vice versa. The evidence on negative serial correlation in stock returns over time is extensive and can be found in Fama, E.F. and K.R. French, 1988, *Permanent and Temporary Components of Stock Prices*, Journal of Political Economy, v96, 246-273. Although they find that the one-year correlations are low, the five-year serial correlations are strongly negative for all size classes.

[11]The raw data on Treasury bill rates, Treasury bond rates, and stock returns was obtained from the Federal Reserve data archives maintained by the Fed in St. Louis.

1959–2008	5.14%	3.33%	3.77%	2.29%
1999–2008	-2.53%	-6.26%	-4.53%	-7.96%

Note that the premiums range from negative values (for the ten-year premiums) to values as high as 7.30% (which is the arithmetic average of the premium over treasury bills), If we follow the propositions about picking a long-term geometric average premium over the long-term Treasury bond rate, the historical risk premium that makes the most sense is 3.88 percent.

Historical Premiums in Other Markets

Although historical data on stock returns is easily available and accessible in the United States, it is much more difficult to get for foreign markets. The most detailed look at these returns estimated the returns you would have earned on fourteen equity markets between 1900 and 2005 and compared these returns with those you would have earned investing in bonds.[12] Table 4.4 presents the risk premiums—that is, the additional returns—earned by investing in equity over short term and long term government bonds over that period in each of the fourteen markets.

Table 4.4 Equity Risk Premiums by Country

	Stocks minus Short term Governments				*Stocks minus Long term Governments*			
Country	*Geometric Mean*	*Arithmetic Mean*	*Standard Error*	*Standard Deviation*	*Geometric Mean*	*Arithmetic Mean*	*Standard Error*	*Standard Deviation*
Australia	7.08	8.49	1.65	17.00	6.22	7.81	1.83	18.80
Belgium	2.80	4.99	2.24	23.06	2.57	4.37	1.95	20.10
Canada	4.54	5.88	1.62	16.71	4.15	5.67	1.74	17.95
Denmark	2.87	4.51	1.93	19.85	2.07	3.27	1.57	16.18
France	6.79	9.27	2.35	24.19	3.86	6.03	2.16	22.29
Germany*	3.83	9.07	3.28	33.49	5.28	8.35	2.69	27.41
Ireland	4.09	5.98	1.97	20.33	3.62	5.18	1.78	18.37
Italy	6.55	10.46	3.12	32.09	4.30	7.68	2.89	29.73
Japan	6.67	9.84	2.70	27.82	5.91	9.98	3.21	33.06
Netherlands	4.55	6.61	2.17	22.36	3.86	5.95	2.10	21.63
Norway	3.07	5.70	2.52	25.90	2.55	5.26	2.66	27.43
South Africa	6.20	8.25	2.15	22.09	5.35	7.03	1.88	19.32
Spain	3.40	5.46	2.08	21.45	2.32	4.21	1.96	20.20

[12]Dimson, E.,, P Marsh and M Staunton, 2002, *Triumph of the Optimists: 101 Years of Global Investment Returns,* Princeton University Press, NJ and *Global Investment Returns Yearbook,* 2006, ABN AMRO/London Business School.

Sweden	5.73	7.98	2.15	22.09	5.21	7.51	2.17	22.34
Switzerland	3.63	5.29	1.82	18.79	1.80	3.28	1.70	17.52
U.K.	4.43	6.14	1.93	19.84	4.06	5.29	1.61	16.60
U.S.	5.51	7.41	1.91	19.64	4.52	6.49	1.96	20.16
World-ex U.S.	4.23	5.93	1.88	19.33	4.10	5.18	1.48	15.19
World	4.74	6.07	1.62	16.65	4.04	5.15	1.45	14.96

The differences in compounded annual returns between stocks and short-term governments/long-term governments is reported for each country..

Although equity returns were higher than what you would have earned investing in government bonds or bills in each of the countries examined, there are wide differences across countries. If you had invested in Spain, for instance, you would have earned only 3 percent over government bills and 2.3 percent over government bonds on an annual basis by investing in equities. In France, in contrast, the corresponding numbers would have been 6.8 percent and 3.9 percent. When looking at forty or fifty-year periods, therefore, it is entirely possible that equity returns can lag bond or bill returns, at least in some equity markets. In other words, the notion that stocks always win in the long run is not only dangerous but does not make sense. If stocks always beat riskless investments in the long run, they should be riskless to an investor with a long time horizon.

 histretSP.xls: This data set has yearly data on Treasury bill rates, Treasury bond rates, and returns and stock returns going back to 1928.

A Modified Historical Risk Premium

In many emerging markets, there is very little historical data, and what does exist is too volatile to yield a meaningful estimate of the risk premium. To estimate the risk premium in these countries, let us start with the basic proposition that the risk premium in any equity market can be written as

Equity Risk Premium = Base Premium for Mature Equity Market + Country Premium

The country premium could reflect the extra risk in a specific market. This boils down our estimation to answering two questions:

- What should the base premium for a mature equity market be?
- How do we estimate the additional risk premium for individual countries?

To answer the first question, we will make the argument that the U.S. equity market is mature and that there is sufficient historical data to make a reasonable estimate of the risk

premium. In fact, reverting back to our discussion of historical premiums in the U.S. market, we will use the geometric average premium earned by stocks over Treasury bonds of 3.88 percent between 1928 and 2008. We chose the long time period to reduce the standard error in our estimate, the Treasury bond to be consistent with our choice of a risk-free rate, and geometric averages to reflect our desire for a risk premium that we can use for longer-term expected returns. There are three approaches that we can use to estimate the country risk premium.

1. ***Country Bond Default Spreads***: There are several measures of country risk, and one of the simplest and most easily accessible is the rating assigned to a country's debt by a ratings agency (S&P, Moody's, and IBCA all rate countries). These sovereign ratings measure default risk (rather than equity risk), but they are affected by many of the factors that drive equity risk—the stability of a country's currency, its budget and trade balances, and its political stability, for instance.[13] The other advantage of ratings is that they come with default spreads over the U.S. Treasury bond. To illustrate, in May 2009, Moody's assigned ratings of Ba1 to Brazil and Ba2 to India; the typical default spread at the time was 2.5% for a Ba1 rated sovereign bond and 3% for a Ba2 rated sovereign bond.[14]

   Analysts who use default spreads as measures of country risk typically add them on to both the cost of equity and debt of every company traded in that country. For instance, the cost of equity for a Brazilian company, estimated in U.S. dollars, will be 2.5 percent higher than the cost of equity of an otherwise similar U.S. company. If we assume that the risk premium for the United States and other mature equity markets is 3.88 percent, the cost of equity for a Brazilian company with a beta of 1.2 can be estimated as follows (with a U.S. Treasury bond rate of 3.5 percent).

   Cost of equity = Risk-free rate + Beta * (U.S. Risk premium) + Country Bond Default Spread

   = 3.5% + 1.2(3.88%) + 2.50% = 10.65%

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[13]The process by which country ratings are obtained is explained on the S&P Web site at www.ratings.standardpoor.com/criteria/index.htm.

[14] We estimated these spreads by looking at dollar or euro denominated bonds issued by governments with these ratings and comparing the rates on these bonds to the US treasury (for dollar bonds) and the German Euro bond (for Euro bonds).

In some cases, analysts add the default spread to the U.S. risk premium and multiply it by the beta. This increases the cost of equity for high-beta companies and lowers them for low-beta firms.

2. ***Relative Standard Deviation***: There are some analysts who believe that the equity risk premiums of markets should reflect the differences in equity risk, as measured by the volatilities of these markets. A conventional measure of equity risk is the standard deviation in stock prices; higher standard deviations are generally associated with more risk. If you scale the standard deviation of one market against another, you obtain a measure of relative risk.

$$\text{Relative Standard Deviation}_{\text{Country X}} = \frac{\text{Standard Deviation}_{\text{Country X}}}{\text{Standard Deviation}_{\text{US}}}$$

This relative standard deviation when multiplied by the premium used for U.S. stocks should yield a measure of the total risk premium for any market.

$$\text{Equity risk premium}_{\text{Country X}} = \text{Risk Premium}_{\text{U.S.}} * \text{Relative Standard deviation}_{\text{Country X}}$$

Assume for the moment that you are using a mature market premium for the United States of 3.88 percent and the annual standard deviation of U.S. stocks is 20 percent. The annualized standard deviation in the Brazilian equity index is 34 percent,[15] yielding a total risk premium for Brazil:

$$\text{Equity Risk Premium}_{\text{Brazil}} = 3.88\% * \frac{34\%}{20\%} = 6.60\%$$

The country risk premium can be isolated as follows:

$$\text{Country Risk Premium}_{\text{Brazil}} = 6.60\% - 3.88\% = 2.72\%$$

Using the 32% standard deviation in the Sensex (the Indian equity index) yields the equity risk premium for India:

$$\text{Equity Risk Premium}_{\text{India}} = 3.88\% * \frac{32\%}{20\%} = 6.21\%$$

$$\text{Country Risk Premium}_{\text{India}} = 6.21\% - 3.88\% = 2.33\%$$

[15]Both the U.S. and Brazilian standard deviations were computed using weekly returns for two years from the beginning of 2002 to the end of 2003. You could use daily standard deviations to make the same judgments, but they tend to have much more estimation error in them.

Although this approach has intuitive appeal, there are problems with using standard deviations computed in markets with widely different market structures and liquidity. There are very risky emerging markets that have low standard deviations for their equity markets because the markets are illiquid. This approach will understate the equity risk premiums in those markets.

3. ***Default Spreads + Relative Standard Deviations***: The country default spreads that come with country ratings provide an important first step, but still only measure the premium for default risk. Intuitively, we would expect the country equity risk premium to be larger than the country default risk spread since equities are riskier than bonds. To address the issue of how much higher, we look at the volatility of the equity market in a country relative to the volatility of the country bond used to estimate the default spread. This yields the following estimate for the country equity risk premium.

$$\text{Country Risk Premium} = \text{Country Default Spread} * \left(\frac{\sigma_{\text{Equity}}}{\sigma_{\text{Country Bond}}} \right)$$

To illustrate, consider the case of Brazil. As noted earlier, the dollar-denominated bonds issued by the Brazilian government trade with a default spread of 3 percent over the U.S. Treasury bond rate. The annualized standard deviation in the Brazilian equity index over the previous year is 34.0 percent, whereas the annualized standard deviation in the Brazilian C-bond is 21.5 percent.[16] The resulting additional country equity risk premium for Brazil is as follows:

$$\text{Brazil's Country Risk Premium} = 2.50\% \left(\frac{34.0\%}{21.5\%} \right) = 3.95\%$$

Note that this country risk premium will increase if the country default spread widens or if the relative volatility of the equity market increases. It is also <u>in addition</u> to the equity risk premium for a mature market. Thus the total equity risk premium for a Brazilian company using the approach and a 3.88 percent premium for the United

[16]The standard deviation in C-bond returns was computed using weekly returns over two years as well. Because these returns are in dollars and the returns on the Brazilian equity index are in real, there is an inconsistency here. We did estimate the standard deviation on the Brazilian equity index in dollars, but it

States would be 7.63 percent. Using the same approach for India, where the Indian government bond had a standard deviation of 21.3% yield the country risk premium for India:

$$\text{India's Country Risk Premium} = 3.00\%\left(\frac{32.0\%}{21.3\%}\right) = 4.51\%$$

$$\text{Total Equity Risk Premium}_{\text{India}} = 3.88\% + 4.51\% = 8.39\%$$

Why should equity risk premiums have any relationship to country bond default spreads? A simple explanation is that an investor who can make 6 percent on a dollar-denominated Brazilian government bond would not settle for an expected return of 5.5 percent (in dollar terms) on Brazilian equity. This approach and the previous one both use the standard deviation in equity of a market to make a judgment about country risk premium, but they measure it relative to different bases. This approach uses the country bond as a base, whereas the previous one uses the standard deviation in the U.S. market. This approach assumes that investors are more likely to choose between Brazilian government bonds and Brazilian equity, whereas the previous approach assumes that the choice is across equity markets.

The three approaches to estimating country risk premiums will generally give different estimates, with the bond default spread and relative equity standard deviation approaches yielding lower country risk premiums than the melded approach that uses both the country bond default spread and the equity and bond market standard deviations. Table 4.5 summarizes these estimates:

Table 4.5: Country Risk Premiums Estimates for India and Brazil – March 2009

	Sovereign Rating	Default Spread	Relative Equity Market volatility	Composite Country risk premium
Brazil	Ba1	2.50%	$\frac{34\%}{20\%}(3.88\%) - 3.88\% = 2.72\%$	$\frac{34\%}{21.5\%}(2.5\%) = 3.95\%$
India	Ba2	3.00%	$\frac{32\%}{20\%}(3.88\%) - 3.88\% = 2.33\%$	$\frac{32\%}{21.3\%}(3\%) = 4.51\%$

We believe that the larger country risk premiums that emerge from the last approach are the most realistic for the immediate future, but country risk premiums may

made little difference to the overall calculation because the dollar standard deviation was close to 36 percent.

decline over time. Just as companies mature and become less risky over time, countries can mature and become less risky as well.

In Practice: Should There Be a Country Risk Premium?

Is there more risk in investing in a Malaysian or Brazilian stock than there is in investing in the United States? The answer, to most, seems to be obviously affirmative. That, however, does not answer the question of whether there should be an additional risk premium charged when investing in those markets. Note that the only risk relevant for the purpose of estimating a cost of equity is market risk or risk that cannot be diversified away. The key question then becomes whether the risk in an emerging market is diversifiable or non-diversifiable risk. If, in fact, the additional risk of investing in Malaysia or Brazil can be diversified away, then there should be no additional risk premium charged. If it cannot, then it makes sense to think about estimating a country risk premium.

For purposes of analyzing country risk, we look at the marginal investor—the investor most likely to be trading on the equity. If that marginal investor is globally diversified, there is at least the potential for global diversification. If the marginal investor does not have a global portfolio, the likelihood of diversifying away country risk declines substantially. Even if the marginal investor is globally diversified, there is a second test that has to be met for country risk to not matter. All or much of country risk should be country-specific. In other words, there should be low correlation across markets. Only then will the risk be diversifiable in a globally diversified portfolio. If, on the other hand, stock markets across countries move together, country risk has a market risk component, is not diversifiable, and should command a premium. Whether returns across countries are positively correlated is an empirical question. Studies from the 1970s and 1980s suggested that the correlation was low, and this was an impetus for global diversification. Partly because of the success of that sales pitch and partly because economies around the world have become increasingly intertwined over the past decade or so, more recent studies indicate that the correlation across markets has risen. This is borne out by the speed at which troubles in one market, say, Russia, can spread to a market with which it has little or no obvious relationship, say, Brazil.

So where do we stand? We believe that although the barriers to trading across markets have dropped, investors still have a home bias in their portfolios and that markets remain partially segmented. Globally diversified investors are playing an increasing role in the pricing of equities around the world, but the resulting increase in correlation across markets has resulted in a portion of country risk becoming non-diversifiable or market risk.

 ctryprem.xls: There is a data set online that contains the updated ratings for countries and the risk premiums associated with each.

3. Implied Equity Premiums

There is an alternative to estimating risk premiums that does not require historical data or adjustments for country risk but does assume that the overall stock market is correctly priced. Consider, for instance, a very simple valuation model for stocks

$$\text{Value} = \frac{\text{Expected Dividends Next Period}}{(\text{Required Return on Equity} - \text{Expected Growth Rate in Dividends})}$$

This is essentially the present value of dividends growing at a constant rate. Three of the four variables in this model can be obtained easily—the current level of the market (i.e., value), the expected dividends next period, and the expected growth rate in earnings and dividends in the long term. The only unknown is then the required return on equity; when we solve for it, we get an implied expected return on stocks. Subtracting out the risk-free rate will yield an implied equity risk premium.

To illustrate, assume that the current level of the S&P 500 Index is 900, the expected dividend yield on the index for the next period is 2 percent, and the expected growth rate in earnings and dividends in the long run is 7 percent. Solving for the required return on equity yields the following:

$$900 = \frac{900(0.02)}{r - 0.07}$$

Solving for r,

$$r - 0.07 = 0.02$$

$$r = 0.09 = 9\%$$

If the current risk-free rate is 6 percent, this will yield a premium of 3 percent.

This approach can be generalized to allow for high growth for a period and extended to cover cash flow–based rather than dividend–based, models. To illustrate this, consider the S&P 500 Index on January 1, 2009. On December 31, 2008, the S&P 500 Index closed at 903.25, and the dividend yield on the index was roughly 3.12%. In addition, the consensus estimate of growth in earnings for companies in the index was approximately 4% for the next 5 years.[17] Since the companies in the index have bought back substantial amounts of their own stock over the last few years, we considered buybacks as part of the cash flows to equity investors. Table 4.6 summarizes dividends and stock buybacks on the index, going back to 2001.

Table 4.6: Dividends and Stock Buybacks on S&P 500 Index: 2001-2008

Year	Market value of index	Dividends	Buybacks	Cash to equity	Dividend yield	Buyback yield	Total yield
2001	1148.09	15.74	14.34	30.08	1.37%	1.25%	2.62%
2002	879.82	15.96	13.87	29.83	1.81%	1.58%	3.39%
2003	1111.91	17.88	13.70	31.58	1.61%	1.23%	2.84%
2004	1211.92	19.01	21.59	40.60	1.57%	1.78%	3.35%
2005	1248.29	22.34	38.82	61.17	1.79%	3.11%	4.90%
2006	1418.30	25.04	48.12	73.16	1.77%	3.39%	5.16%
2007	1468.36	28.14	67.22	95.36	1.92%	4.58%	6.49%
2008	903.25	28.47	40.25	68.72	3.15%	4.61%	7.77%
Normalized	903.25	28.47	24.11	52.584	3.15%	2.67%	5.82%

In 2008, for instance, firms collectively returned 7.77% of the index in the form of dividends (3.15%) and stock buybacks (4.61%). Buybacks are volatile, and dropped about 40% in the last quarter of 2008, relative to the last quarter of 2007, in the face of a market crisis and a slowing economy. Since this slowdown is likely to continue into 2009, we reduced the buybacks in 2008 by 40% to compute a normalized cash yield of 5.82% for the year (resulting in a total cash to equity of 52.584 for the year). In table 4.7, we estimate the cash flows to investors in the S&P 500 index from 2009-2014 by growing the normalized cash flow at 4% a year for the first five years and 2.21% (set equal to the riskfree rate) thereafter.

[17] We used the average of the analyst estimates for individual firms (bottom-up). Alternatively, we could have used the top-down estimate for the S&P 500 earnings.

Table 4.7: Cashflows on S&P 500 Index

Year	*Expected growth rate*	*Dividends+ Buybacks on Index*
2008		52.584
2009	4.00%	54.69
2010	4.00%	56.87
2011	4.00%	59.15
2012	4.00%	61.52
2013	4.00%	63.98
2014	2.21%	65.39

Using these cash flows to compute the expected return on stocks, we derive the following:

$$903.25 = \frac{54.69}{(1+r)} + \frac{56.87}{(1+r)^2} + \frac{59.15}{(1+r)^3} + \frac{61.52}{(1+r)^4} + \frac{63.98}{(1+r)^5} + \frac{65.39}{(r-.0221)(1+r)^5}$$

Solving for the required return and the implied premium with the higher cash flows:

Required Return on Equity = 8.64%

Implied Equity Risk Premium = Required Return on Equity - Riskfree Rate

= 8.64% - 2.21% = 6.43%

We believe that this estimate of risk premium (6.43%) is a more realistic value for January 1, 2009 than the historical risk premium of 3.88%. The advantage of this approach is that it is market-driven and forward-looking and does not require any historical data. In addition, it will change in response to changes in market conditions. Note that the S&P 500 a year prior was trading at 1468.36 and the implied equity risk premium on January 1, 2008 was 4.37%. The unusual shift is best seen by graphing out implied premiums from the S& P 500 from 1960 in Figure 4.2:

Figure 4.2: Implied Equity Premium for US Equity Market:1960-2008

In terms of mechanics, we used analyst estimates of growth rates in earnings and dividends as our projected growth rates and a two-stage dividend discount model (similar to the one that we used to compute the implied premium in the last paragraph). Looking at these numbers, we would draw the following conclusions.

- Implied versus Historical Risk Premiums: For much of the last thirty years, the implied equity premium has been lower than the historical risk premium, reflecting the long term upward movement in stock prices between 1981 and 2007. At the peak of dot-com boom at the end of1999, the implied equity risk premium was 2% while the historical risk premium was about 6.5%. It is only in the last quarter of 2008 that implied premiums surged well above historical risk premiums.
- Effects of inflation: The implied equity premium did increase during the 1970s as inflation increased. This does have interesting implications for risk premium estimation. Instead of assuming that the risk premium is a constant and is unaffected by the level of inflation and interest rates, which is what we do with historical risk premiums, it may be more realistic to increase the risk premium as expected inflation and interest rates increase.

- Mean Reversion: While implied equity risk premiums have moved significantly over time, with a low of 2% in 1999 and a high of 6.43% at the end of 2008, there is evidence that they revert back to a historic norm of between 4% and 4.5%. That reversal, however, occurs over long time periods.

 histimpl.xls: This data set online shows the inputs used to calculate the premium in each year for the U.S. market.

 implprem.xls: This spreadsheet allows you to estimate the implied equity premium in a market.

Choosing an Equity Risk Premium

We have looked at three different approaches to estimating risk premiums, the survey approach, where the answer seems to depend on who you ask and what you ask them, the historical premium approach, with wildly different results depending on how you slice and dice historical data and the implied premium approach, where the final number is a function of the model you use and the assumptions you make about the future. There are several reasons why the approaches yield different answers much of time and why they converge sometimes.

1. When stock prices enter an extended phase of upward (downward) movement, the historical risk premium will climb (drop) to reflect past returns. Implied premiums will tend to move in the opposite direction, since higher (lower) stock prices generally translate into lower (higher) premiums.
2. Survey premiums reflect historical data more than expectations. When stocks are going up, investors tend to become more optimistic about future returns and survey premiums reflect this optimism. In fact, the evidence that human beings overweight recent history (when making judgments) and overreact to information can lead to survey premiums overshooting historical premiums in both good and bad times. In good times, survey premiums are even higher than historical premiums, which, in turn, are higher than implied premiums; in bad times, the reverse occurs.
3. When the fundamentals of a market change, either because the economy becomes more volatile or investors get more risk averse, historical risk premiums will not

change but implied premiums will. Shocks to the market are likely to cause the two numbers to deviate. After the terrorist attack in September 2001, for instance, implied equity risk premiums jumped almost 0.50% but historical premiums were unchanged.

In summary, we should not be surprised to see large differences in equity risk premiums as we move from one approach to another, and even within an approach, as we change estimation parameters.

If the approaches yield different numbers for the equity risk premium, and we have to choose one of these numbers, how do we decide which one is the "best" estimate? The answer to this question will depend upon several factors:

a. Predictive Power: In corporate finance and valuation, what we ultimately care about is the equity risk premium for the future. Consequently, the approach that has the best predictive power, i.e. yields forecasts of the risk premium that are closer to realized premiums, should be given more weight. So, which of the approaches does best on this count? To answer this question, we used the implied equity risk premiums from 1960 to 2007 and considered four predictors of this premium – the historical risk premium through the end of the prior year, the implied equity risk premium at the end of the prior year and the average implied equity risk premium over the previous five years. Since the survey data does not go back very far, we could not test the efficacy of the survey premium. Our results are summarized in table 4.8:

Table 4.8: Predictive Power of different estimates

Predictor	*Correlation with implied premium next year*	*Correlation with actual risk premium – next 10 years*
Current implied premium	0.758	0.376
Average implied premium: Last 5 years	0.515	0.183
Historical Premium	-0.288	-0.596

Over this period, the implied equity risk premium at the end of the prior period was the best predictor of the implied equity risk premium in the next period, whereas historical risk premiums did worst. The results, though, may be specific to one-year ahead forecasts and are skewed towards the implied premium forecasts. If we extend our analysis to make forecasts of the actual return premium earned by stocks over

bonds for the next 10 years, the current implied equity risk premium still yields the best forecast for the future. Historical risk premiums perform even worse as forecasts of actual risk premiums over the next 10 years.

b. Beliefs about markets: Implicit in the use of each approach are assumptions about market efficiency or lack thereof. If you believe that markets are efficient in the aggregate, or at least that you cannot forecast the direction of overall market movements, the current implied equity premium is the most logical choice, since it is estimated from the current level of the index. If you believe that markets, in the aggregate, can be significantly overvalued or undervalued, the historical risk premium or the average implied equity risk premium over long periods becomes a better choice. If you have absolutely no faith in markets, survey premiums will be the choice.

c. Purpose of the analysis: Notwithstanding your beliefs about market efficiency, the task for which you are using equity risk premiums may determine the right risk premium to use. In acquisition valuations and equity research, for instance, you are asked to assess the value of an individual company and not take a view on the level of the overall market. This will require you to use the current implied equity risk premium, since using any other number will bring your market views into the valuation. In corporate finance, where the equity risk premium is used to come up with a cost of capital, which in turn determines the long-term investments of the company, it may be more prudent to build in a long-term average (historical or implied) premium.

In conclusion, there is no one approach to estimating equity risk premiums that will work for all analyses. If predictive power is critical or if market neutrality is a pre-requisite, the current implied equity risk premium is the best choice. For those more skeptical about markets, the choices are broader, with the average implied equity risk premium over a long time period having the strongest predictive power. Historical risk premiums are very poor predictors of both short-term movements in implied premiums or long-term returns on stocks.

4.4 Implied and Historical Premiums

Assume that the implied premium in the market is 3 percent and that you are using a historical premium of 7.5 percent. If you valued stocks using this historical premium, you are likely to find

a. more undervalued stocks than overvalued ones.
b. more overvalued stocks than undervalued ones.
c. about as many undervalued as overvalued stocks.

How would your answer change if the implied premium is 7% and the historical premium is 3%?

Illustration 4.2: Estimating Equity Risk Premiums

In May 2009, the implied equity risk premium for the S&P 500 stood at 6.5%, well above the historical risk premium of 3.88%, computed from 1928 to 2008. Using the latter will generate hurdle rates that will be too low, given current market conditions. While we are mindful of the tendency of equity risk premiums to revert back to historic norms, we believe that memories of this crisis will linger for an extended period. Consequently, we will use an equity risk premium of 6% not only for the United States but also for other mature markets; for simplicity, we will assume that all countries with sovereign ratings of Aaa are mature. As a consequence, we will use the 6% equity risk premium for much of the European Union, the Scandinavian countries, Canada and Australia.

For countries rated below Aaa, we will use the composite country risk premium approach, described in the earlier section. The country risk premium that we estimated using this approach was 3.95% for Brazil and 4.51% for India. Adding these premiums on to the mature market premium of 6% yields the total risk premiums for the two countries:

Total Equity Risk Premium$_{Brazil}$ = 6% + 3.95% = 9.95%

Total Equity Risk Premium$_{India}$ = 6% + 4.51% = 10.51%

We will use this approach for computing equity risk premiums for any other risky markets that we encounter during the course of the book.

Normal and Actual Values- A Behavioral Perspective

Riskfree rates and equity risk premiums vary over time and managers often are confronted with numbers that they believe are "not normal". This was the case in early 2009, when managers saw the US ten-year treasury bond rate at 2.3% and equity risk premiums at close to 7%. Faced with these unusual numbers, many analysts and corporate treasurers decided to override them and go with what they believed were more normal values.

While this push towards normalization has an empirical basis, there is also a behavioral spin that we can put on it. As we noted in chapter 3, there is significant evidence that individuals anchor their estimates to arbitrary starting values. In the case of CFOs, those starting values may very well be the risk free rates and equity risk premiums that they were familiar with over their working lifetime, leading to very different definitions of what comprises normal. In addition, firms that have been using the same equity risk premiums for long periods find it abandon these estimates, even in the face of substantial evidence to the contrary.

III. Risk Parameters

The final set of inputs we need to put risk and return models into practice are the risk parameters for individual assets and projects. In the CAPM, the beta of the asset has to be estimated relative to the market portfolio. In the APM and multifactor model, the betas of the asset relative to each factor have to be measured. There are three approaches available for estimating these parameters; one is to use historical data on market prices for individual assets; the second is to estimate the betas from fundamentals; and the third is to use accounting data. We use all three approaches in this section.

A. Historical Market Betas

This is the conventional approach for estimating betas used by most services and analysts. For firms that have been publicly traded for a length of time, it is relatively straightforward to estimate returns that an investor would have made investing in its equity in intervals (such as a week or a month) over that period. These returns can then be related to returns on a equity market index to get a beta in the CAPM, to multiple macroeconomic factors to get betas in the multifactor models, or put through a factor analysis to yield betas for the APM.

Standard Procedures for Estimating CAPM Parameters, Betas and Alphas

To set up the standard process for estimating the beta in the CAPM, let us revisit the equation it provides for the expected return on an investment (R_j) as a function of the beta of the investment (βj) riskfree rate (R_f) and the expected return on the market portfolio (R_m):

$$R_j = R_f + \beta_j (R_m - R_f)$$

This equation can be rewritten in one of two ways:

In terms of excess returns: $R_j - R_f = \beta_j (R_m - R_f)$

In terms of raw returns: $R_j = R_f (1- \beta_j) + \beta_j R_m$

These equations provide the templates for the two standard procedures for estimating the beta of an investment, using past returns. In the first, we compute the returns earned by an investment and a specified market index over past time periods, in excess of the riskfree rates in each of the time periods, and regress the excess returns on the investment against the excess returns on the market:

$$(R_j - R_f) = \alpha + \beta_j (R_m - R_f)$$

In the second, we compute the raw returns (not adjusted for the riskfree rate) earned by an investment and the market index over past time period and regress the raw returns on the investment against the raw returns on the market:

$$R_j = \alpha + \beta_j R_m$$

Jensen's Alpha: This is the difference between the actual return on an asset and the return you would have expected it to make during a past period, given what the market did, and the asset's beta.

In both regressions, the sl*ope* of the regression measures the beta of the stock and measures the riskiness of the stock. The intercept is a simple measure of stock price performance, relative to CAPM expectations, in each regression, but with slightly different interpretations. In the excess return regression, the intercept should be zero if the stock did exactly as predicted by the CAPM, and a positive (negative) intercept can be viewed as a measure that the stock did better (worse) than expected, at least during the period of the regression. In the raw return regression, the intercept has to be compared to the predicted intercept, $R_f (1- \beta_j)$, in the CAPM equation:

If $\alpha > R_f (1 - \beta)$ Stock did better than expected during regression period

$\alpha = R_f (1 - \beta)$ Stock did as well as expected during regression period

$\alpha < R_f (1 - \beta)$ Stock did worse than expected during regression period

This measure of stock price performance (α in excess return regression, and $\alpha - R_f(1 - \beta)$ in the raw return regression) is called *Jensen's alpha* and provides a measure of whether the asset in question under- or outperformed the market, after adjusting for risk, during the period of the regression.

> ***R Squared*** **(R^2):** The *R* squared measures the proportion of the variability of a dependent variable that is explained by an independent variable or variables in a regression.

The third statistic that emerges from the regression is the *R squared* (R^2) of the regression. Although the statistical explanation of the R^2 is that it provides a measure of the goodness of fit of the regression, the financial rationale for the R^2 is that it provides an estimate of the proportion of the risk (variance) of a firm that can be attributed to market risk; the balance ($1 - R^2$) can then be attributed to firm-specific risk.

The final statistic worth noting is the *standard error of the beta estimate*. The slope of the regression, like any statistical estimate, is estimated with error, and the standard error reveals just how noisy the estimate is. The standard error can also be used to arrive at confidence intervals for the "true" beta value from the slope estimate.

The two approaches should yield very similar estimates for all of the variables, but the excess return approach is slightly more precise, because it allows for the variation in riskfree rates from period to period. The raw return approach is easier to put into practice, precisely because we need only the average risk free rate over the regression period.[18]

Estimation Issues

There are three decisions the analyst must make in setting up the regression described. The first concerns the *length of the estimation period*. The trade-off is simple: A longer estimation period provides more data, but the firm itself might have changed in its risk characteristics over the time period. Disney and Deutsche Bank have changed substantially in terms of both business mix and financial leverage over the past few years, and any regression that we run using historical data will be affected by these changes.

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[18] With weekly or daily return regressions, the riskfree rate (weekly or daily) is close to zero. Consequently, many services estimate betas using raw returns rather than excess returns.

The second estimation issue relates to the *return interval*. Returns on stocks are available on annual, monthly, weekly, daily, and even intraday bases. Using daily or intraday returns will increase the number of observations in the regression, but it exposes the estimation process to a significant bias in beta estimates related to non-trading.[19] For instance, the betas estimated for small firms, which are more likely to suffer from non-trading, are biased downward when daily returns are used. Using weekly or monthly returns can reduce the non-trading bias significantly.[20]

The third estimation issue relates to the choice of a *market index* to be used in the regression. Since we are estimating the betas for the capital asset pricing model, the index that we are using, at least in theory, should be the market portfolio, which includes all traded assets in the market, held in proportion to their market values. While such a market portfolio may not exist in practice, the closer the chosen index comes to this ideal, the more meaningful the beta estimate should be. Thus, we should steer away from narrow indices (Dow 30, Sector indices or the NASDAQ) and towards broader indices and away from equally weighted indices to value weighted indices. It should be no surprise that the most widely used market index by beta estimation services in the United States is the S&P 500. It may include only 500 stocks, but since they represent the largest market capitalization companies in the market, held in proportion to their market value, it does represent a significant portion of the market portfolio, but only if we define it narrowly as US equities. As asset classes proliferate and global markets expand, we have to consider how best to broaden the index we use to reflect these excluded risky assets.

Illustration 4.3: Estimating CAPM Risk Parameters for Disney

To evaluate how Disney performed as an investment between 2004 and 2008 and how risky it is, we regressed monthly raw returns on Disney against returns on the S&P 500 between January 2004 and December 2008. The returns on Disney and the S&P 500 index are computed as follows:

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[19]The nontrading bias arises because the returns in nontrading periods is zero (even though the market may have moved up or down significantly in those periods). Using these nontrading period returns in the regression will reduce the correlation between stock returns and market returns and the beta of the stock.
[20]The bias can also be reduced using statistical techniques.

1. The returns to a stockholder in Disney are computed month by month from January 2004 to December 2008. These returns include both dividends and price appreciation and are defined as follows:

$$\text{Return}_{\text{Disney},j} = (\text{Price}_{\text{Disney},j} - \text{Price}_{\text{Disney},j-1} + \text{Dividends}_{\text{Disney},j})/\text{Price}_{\text{Disney},j-1}$$

where $\text{Price}_{\text{Disney},j}$ is the price of Disney stock at the end of month j; and $\text{Dividends}_{\text{Disney},j}$ are dividends on Disney stock in month j. Note that Disney pays dividends only once a year and that dividends are added to the returns of the month in which the stock went ex-dividend.[21]

2. The returns on the S&P 500 are computed for each month of the same time period, using the level of the index at the end of each month, and the monthly dividend yield on stocks in the index.

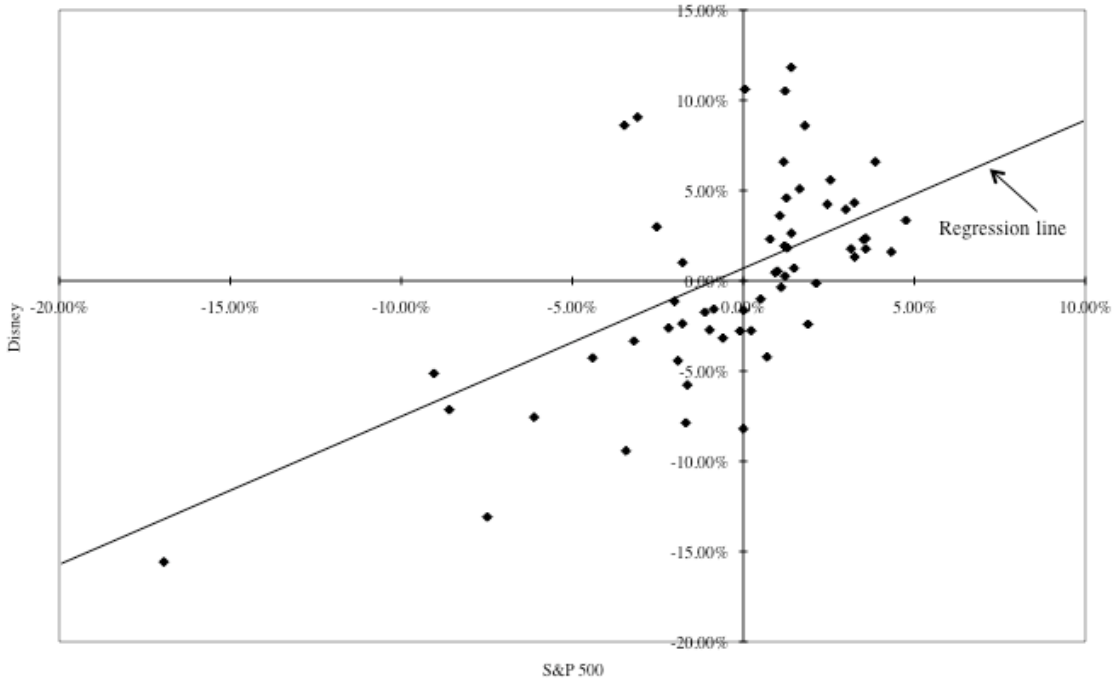
$$\text{Market Return}_{\text{S\&P 500},j} = (\text{Index}_j - \text{Index}_{j-1} + \text{Dividends}_t)/\text{Index}_{j-1}$$

where Index_j is the level of the index at the end of month j and Dividend_j is the dividends paid on stocks in the index in month j. Although the S&P 500 is the most widely used index for U.S. stocks, they are at best imperfect proxies for the market portfolio in the CAPM, which is supposed to include all traded assets.

Figure 4.3 graphs monthly returns on Disney against returns on the S&P 500 index from January 2004 to December 2008.

Figure 4.3 Disney versus S&P 500: 2004-2008

Figure 4.3: Disney versus S&P 500: 2004-2008



The regression statistics for Disney are as follows:[22]

a. Slope of the Regression = 0.95. This is Disney's beta, based on returns from 2004 to 2008. Using a different time period for the regression or different return intervals (weekly or daily) for the same period can result in a different beta.

b. Intercept of the Regression = 0.47 percent. This is a measure of Disney's performance, but only when it is compared with $R_f\ (1 - \beta)$.[23] Since we are looking at an investment made in the past, the monthly risk-free rate (because the returns used in the regression are monthly returns) between 2004 and 2008 averaged 0.272 percent, resulting in the following estimate for the performance:

$$R_f\ (1 - \beta) = 0.272\%\ (1 - 0.95) = 0.01\%$$

$$\text{Intercept} - R_f\ (1 - \beta) = 0.47\% - 0.01\% = 0.46\%$$

This analysis suggests that Disney's stock performed 0.46 percent better than expected, when expectations are based on the CAPM, on a monthly basis between January 2004 and December 2008. This results in an annualized excess return of approximately 5.62 percent.

$$\text{Annualized Excess Return} = (1 + \text{Monthly Excess Return})^{12} - 1$$

$$= (1 + 0.0046)^{12} - 1 = 0.0562 \text{ or } 5.62\%$$

By this measure of performance, Disney did slightly better than expected during the period of the regression, given its beta and the market's performance over the period.

Note, however, that this does not imply that Disney would be a good investment looking forward. It also does not provide a breakdown of how much of this excess return can be attributed to industry-wide effects and how much is specific to the firm. To make that breakdown, the excess returns would have to be computed over the same period for other firms in the entertainment industry and compared with Disney's excess return. The difference would be then attributable to firm-specific actions. In this case, for instance, the average annualized excess return on other entertainment firms between 2004 and

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[22]The regression statistics are computed in the conventional way. Appendix 1 explains the process in more detail.

[23]In practice, the intercept of the regression is often called the alpha and compared to zero. Thus a positive intercept is viewed as a sign that the stock did better than expected and a negative intercept as a sign that the stock did worse than expected. In truth, this can be done only if the regression is run in terms of excess returns, that is, returns over and above the risk-free rate in each month for both the stock and the market index.

2008 was -13.04 percent. This would imply that Disney stock outperformed its peer group by 18.66 percent between 2004 and 2008, after adjusting for risk. (Firm-specific Jensen's alpha = 5.62% – (-13.04%) = 18.66%)

c. R squared of the regression = 39 percent. This statistic suggests that 39 percent of the risk (variance) in Disney comes from market sources (interest rate risk, inflation risk etc.) and that the balance of 61 percent of the risk comes from firm-specific components. The latter risk should be diversifiable, and is therefore unrewarded. Disney's R^2 is slightly higher than the median R^2 of US companies against the S&P 500, which was approximately 24 percent in 2008.

d. Standard Error of Beta Estimate = 0.15. This statistic implies that the true beta for Disney could range from 0.80 to 1.10 (subtracting or adding one standard error to the beta estimate of 0.95) with 67 percent confidence and from 0.65 to 1.25 (subtracting or adding two standard errors to the beta estimate of 0.95) with 95 percent confidence. These ranges may seem large, but they are not unusual for most U.S. companies. This suggests that we should consider regression estimates of betas from regressions with caution.

 indreg.xls: This data set online shows the average betas, Jensen's alphas and R-squared, classified by industry for the United States.

4.5 The Relevance of R^2 to an Investor

Assume that, having done the regression analysis, both Disney and Amgen, a biotechnology company, have betas of 0.95. Disney, however, has an R^2 of approximately 40 percent, while Amgen has an R^2 of only 20 percent. If you had to pick between these investments, which one would you choose?

a. Disney, because it's higher R^2 suggests that it is less risky

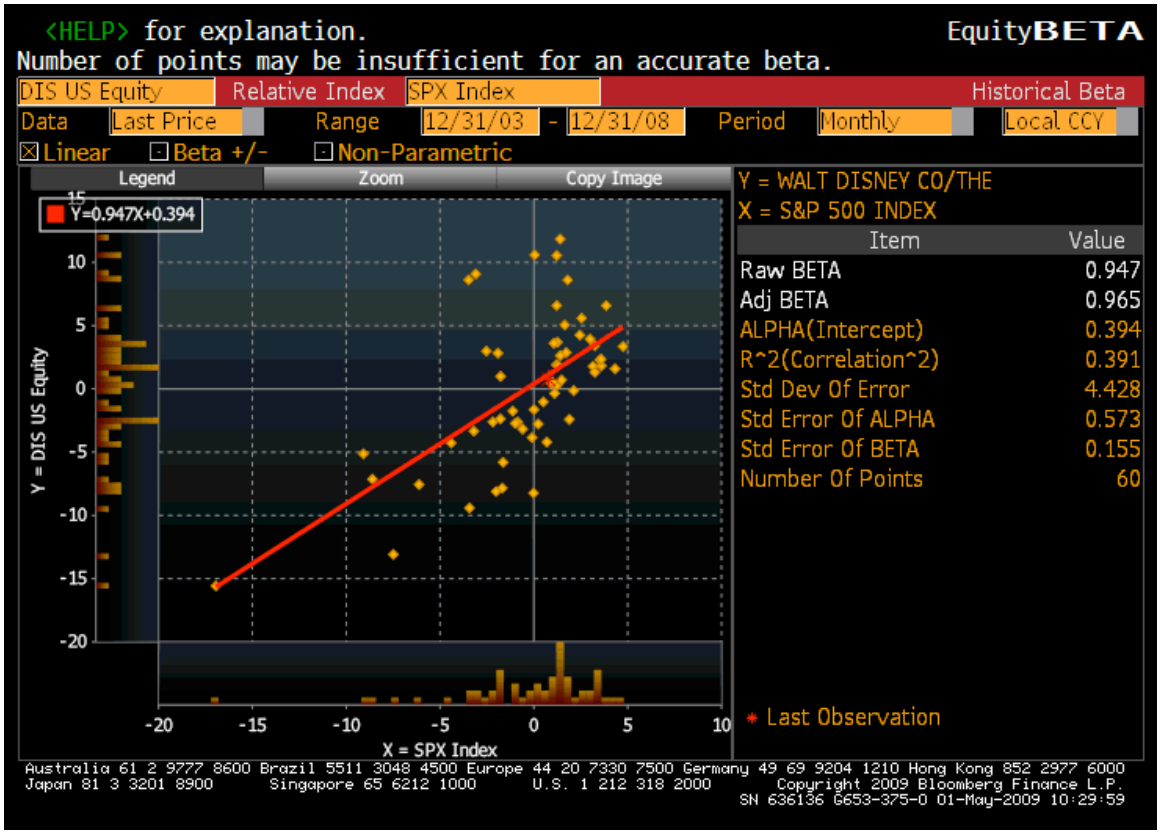
b. Amgen, because it's lower R^2 suggests a greater potential for high returns

c. I would be indifferent, because they both have the same beta

Would your answer be any different if you were running a well-diversified fund?

In Practice: Using a Service Beta

Most analysts who use betas obtain them from an estimation service; Merrill Lynch, Barra, Value Line, S&P, Morningstar, and Bloomberg are some of the well-known services. All begin with regression betas and make what they feel are necessary changes to make them better estimates for the future. Although most of these services do not reveal the internal details of this estimation, Bloomberg is an honorable exception. The following is the beta calculation page from Bloomberg for Disney, using the same period as our regression (January 2004 to December 2008).



The regression is a raw return, rather than an excess return regression, and should thus be directly comparable to the regression in Figure 4.3. Although the time period used in the two regressions are identical, there are subtle differences. First, Bloomberg uses price appreciation in the stock and the market index in estimating betas and ignores dividends.[24] This does not make much of a difference for a Disney, but it could make a difference for a company that either pays no dividends or pays significantly higher

[24]This is why the intercept in the Bloomberg graph (0.39%) is slightly different from the intercept estimated earlier in the chapter (0.47%). The beta and R^2 are identical.

dividends than the market. Second, Bloomberg also computes what they call an adjusted beta, which is estimated as follows:

Adjusted Beta = Raw Beta (0.67) + 1(0.33)

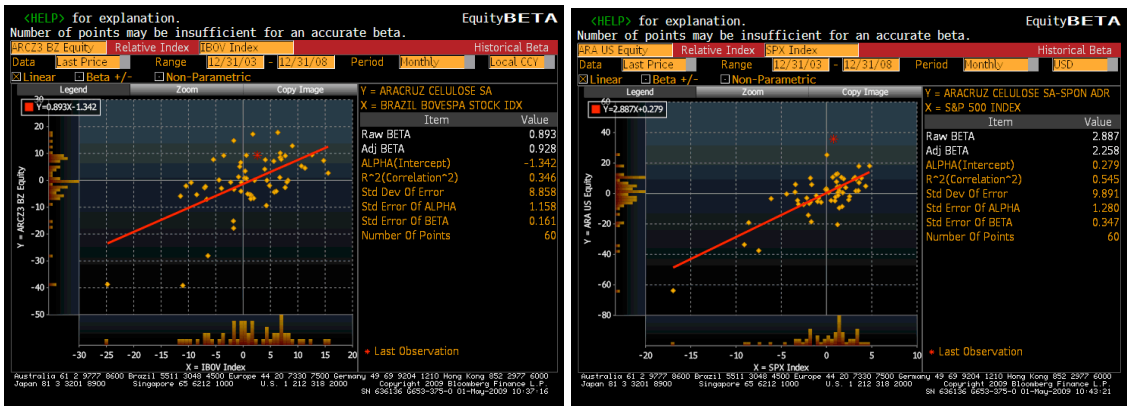
These weights do not vary across stocks, and this process pushes all estimated betas toward one. Most services employ similar procedures to adjust betas toward one. In doing so, they are drawing on empirical evidence that suggests that the betas for most companies over time tend to move toward the average beta, which is one. This may be explained by the fact that firms get more diversified in their product mix and client base as they get larger.

Generally, betas reported by different services for the same firm can be very different because they use different time periods (some use two years and others five years), different return intervals (daily, weekly, or monthly), different market indices, and different post-regression adjustments. Although these beta differences may be troubling, the beta estimates delivered by each of these services comes with a standard error, and it is very likely that all of the betas reported for a firm fall within the range of the standard errors from the regressions.

Illustration 4.4: Estimating Historical Betas for Aracruz, Tata Chemicals and Deutsche Bank

Aracruz is a Brazilian company, and we can regress returns on the stock against a Brazilian index, the Bovespa, to obtain risk parameters. The stock also had an ADR listed on the U.S. exchanges, and we can regress returns on the ADR against a U.S. index to obtain parameters. Figure 4.4 presents both graphs for the January 2004- December 2008 time period:

Figure 4.4 Estimating Aracruz's Beta: Choice of Indices



Source: Bloomberg

How different are the risk parameters that emerge from the two regressions? Aracruz has a beta of 2.89 when the ADR is regressed against the S&P 500, and a beta of only 0.89 when the local listing is regressed against the Bovespa.[25] Each regression has its own problems. The Bovespa is a narrow index dominated by a few liquid stocks and does not represent the broad spectrum of Brazilian equities. Although the S&P 500 is a broader index, the returns on the ADR have little relevance to a large number of non-U.S. investors who bought the local listing. While it may seem intuitive that an emerging market stock should have a higher beta to reflect its risk, the results are often unpredictable, with many emerging market ADRs having much lower betas than their domestic listings.

Deutsche Bank does not have an ADR listed in the United States, but we can regress returns against a multitude of indices. Table 4.9 presents comparisons of the results of the regressions of returns on Deutsche Bank against three indices—a German equity index (DAX), an index of large European companies (FTSE Euro 300), and a global equity index (Morgan Stanley Capital Index, MSCI).

Table 4.9 Deutsche Bank Risk Parameters: Index Effect

	DAX	*FTSE Euro 300*	*MSCI*
Intercept	-1.63%	-1.05%	-0.48%

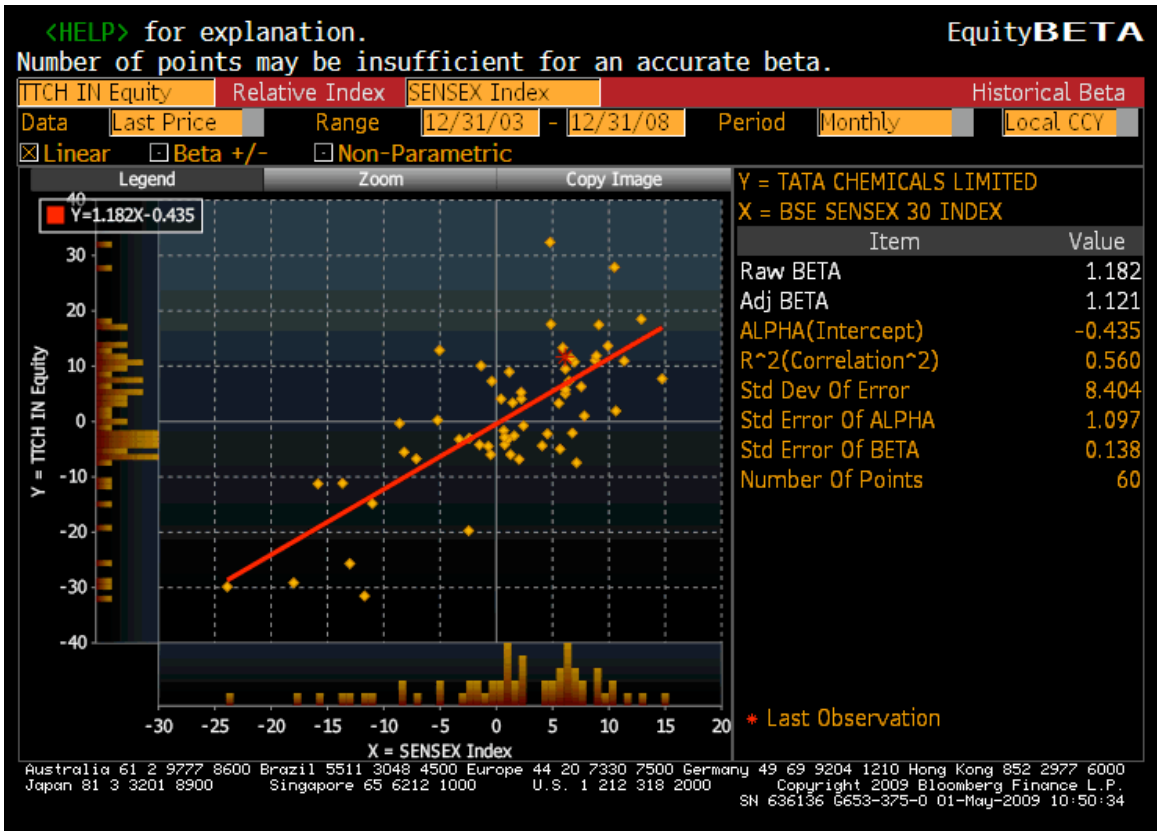
[25]The biggest source of the difference is one month (January 1999). In that month, Aracruz had a return of 133 percent in the São Paulo exchange whereas the ADR dropped by 9.67 percent in the same month. The disparity in returns can be attributed to a steep devaluation in the Brazilian real in that month.

Beta	1.40	1.52	1.99
Std Error of beta	0.14	0.19	0.21
R^2	62%	54%	50%

Here again, the risk parameters estimated for Deutsche Bank are a function of the index used in the regression. The standard error is lowest (and the R^2 is highest) for the regression against the DAX; this is not surprising because Deutsche Bank is a large component of the DAX. The standard error gets larger and the R^2 gets lower as the index is broadened to initially include other European stocks and then expanded to global stocks.

For Tata Chemicals, we regressed returns on the stock against returns on the Sensex, the most widely referenced Indian market index, using monthly returns from January 2004 to December 2008. Figure 4.5 contains the regression output:

Figure 4.5: Regression Output: Tata Chemicals versus Sensex



As with the regression of Deutsche Bank against the DAX, the high R-squared is more indicative of the narrowness of the index rather than the quality of the regression.

Deconstructing the regression output for each of these companies, just as we did for Disney, does however does provide us with some information on the riskiness and performance of the stocks, at least relative to the indices used. Table 4.10 summarizes the estimates:

Table 4.10: Jensen's Alpha, Beta and R-Squared

	Beta (Std error)	Jensen's Alpha (Annualized)	R-Squared
Aracruz ADR	2.89 (0.35)	9.97%	55%
Aracruz	0.89 (0.16)	-15.51%	35%
Deutsche Bank	1.40 (0.14)	-16.89%	62%
Tata Chemicals	1.18 (0.14)	-4.29%	56%

All three companies underperformed their domestic indices, after adjusting for risk and market performance. While the Aracruz ADR had a positive Jensen's alpha against the S&P 500, much of that positive performance was dissipated in the last few months of 2008.

In Practice: Which Index Should We Use to Estimate Betas?

In most cases, analysts are faced with a mind-boggling array of choices among indices when it comes to estimating betas; there are more than 20 broad equity indices ranging from the Dow 30 to the Wilshire 5000 in the United States alone. One common practice is to use the index that is most appropriate for the investor who is looking at the stock. Thus, if the analysis is being done for a U.S. investor, the S&P 500 is used. This is generally not appropriate. By this rationale, an investor who owns only two stocks should use an index composed of only those stocks to estimate betas.

The right index to use in analysis should be determined by the holdings of the marginal investor in the company being analyzed. Consider Aracruz, Tata Chemicals and Deutsche Bank in the earlier illustration. If the marginal investors in these companies are investors who hold only domestic stocks—just Brazilian stocks in the case of Aracruz, Indian stocks in the case of Tata Chemicals or German stocks in the case of Deutsche—we can use the regressions against the local indices. If the marginal investors are global investors, a more relevant measure of risk will emerge by using the global index. Over time, you would expect global investors to displace local investors as the marginal investors, because they will perceive far less of the risk as market risk and thus pay a

higher price for the same security. Thus, one of the ironies of this notion of risk is that Aracruz will be less risky to an overseas investor who has a global portfolio than to a Brazilian investor with all of his or her wealth in Brazilian assets.

Standard Procedures for Estimating Risk Parameters in the APM and Multifactor Model

Like the CAPM, the APM defines risk to be nondiversifiable risk, but unlike the CAPM, the APM allows for multiple economic factors in measuring this risk. Although the process of estimation of risk parameters is different for the APM, many of the issues raised relating to the determinants of risk in the CAPM continue to have relevance for the APM.

The parameters of the APM are estimated from a factor analysis on historical stock returns, which yields the number of common economic factors determining these returns, the risk premium for each factor, and the factor-specific betas for each firm.

Factor Analysis: This is a statistical technique in which past data is analyzed with the intent of extracting common factors that might have affected the data.

Once the factor-specific betas are estimated for each firm, and the factor premiums are measured, the APM can be used to estimated expected returns on a stock.

$$\text{Cost of Equity} = R_f + \sum_{j=1}^{j=k} \beta_j \, (E(R_j) - R_f)$$

where

R_f = Risk-free rate

β_j = Beta specific to factor j

$E(R_j) - R_f$ = Risk premium per unit of factor j risk

k = Number of factors

In a multifactor model, the betas are estimated relative to the specified factors, using historical data for each firm.

B. Fundamental Betas

The beta for a firm may be estimated from a regression, but it is determined by fundamental decisions that the firm has made on what business to be in, how much operating leverage to use in the business, and the degree to which the firm uses financial

leverage. In this section, we will examine an alternative way of estimating betas, where we are less reliant on historical betas and more cognizant of the intuitive underpinnings of betas.

Determinants of Betas

The beta of a firm is determined by three variables: (1) the type of business or businesses the firm is in, (2) the degree of operating leverage in the firm, and (3) the firm's financial leverage. Much of the discussion in this section will be couched in terms of CAPM betas, but the same analysis can be applied to the betas estimated in the APM and the multifactor model as well.

Type of Business Because betas measure the risk of a firm relative to a market index, the more sensitive a business is to market conditions, the higher its beta. Thus, other things remaining equal, cyclical firms can be expected to have higher betas than noncyclical firms. Other things remaining equal, then, companies involved in housing and automobiles, two sectors of the economy that are very sensitive to economic conditions, will have higher betas than companies involved in food processing and tobacco, which are relatively insensitive to business cycles.

Cyclical Firm: A cyclical firm has revenues and operating income that tend to move strongly with the economy—up when the economy is doing well and down during recessions.

Building on this point, we would also argue that the degree to which a product's purchase is discretionary will affect the beta of the firm manufacturing the product. Thus, the betas of discount retailers, such as Wal-Mart, should be lower than the betas of high-end specialty retailers, such as Tiffany's or Gucci, because consumers can defer the purchase of the latter's products during bad economic times.

It is true that firms have only limited control over how discretionary a product or service is to their customers. There are firms, however, that have used this limited control to maximum effect to make their products less discretionary to buyers and by extension lowered their business risk. One approach is to make the product or service a much more integral and necessary part of everyday life, thus making its purchase more of a requirement. A second approach is to effectively use advertising and marketing to build

brand loyalty. The objective in good advertising, as we see it, is to make discretionary products or services seem like necessities to the target audience. Thus corporate strategy, advertising, and marketing acumen can, at the margin, alter business risk and betas over time.

4.6 Betas and Business Risk

Polo Ralph Lauren, the upscale fashion designer, went public in 1997. Assume that you were asked to estimate its beta. Based on what you know about the firm's products, would you expect the beta to be

a. greater than one?

b. about one?

c. less than one?

Why?

Degree of Operating Leverage The degree of operating leverage is a function of the cost structure of a firm and is usually defined in terms of the relationship between fixed costs and total costs. A firm that has high operating leverage (i.e., high fixed costs relative to total costs) will also have higher variability in operating income than would a firm producing a similar product with low operating leverage.[26] Other things remaining equal, the higher variance in operating income will lead to a higher beta for the firm with high operating leverage.

Operating Leverage: A measure of the proportion of the operating expenses of a company that are fixed costs.

Although operating leverage affects betas, it is difficult to measure the operating leverage of a firm, at least from the outside, because fixed and variable costs are often aggregated in income statements. It is possible to get an approximate measure of the operating leverage of a firm by looking at changes in operating income as a function of changes in sales.

[26]To see why, compare two firms with revenues of $100 million and operating income of $10 million, but assume that the first firm's costs are all fixed, whereas only half of the second firm's costs are fixed. If revenues increase at both firms by $10 million, the first firm will report a doubling of operating income (from $10 to $20 million), whereas the second firm will report a rise of 55 percent in its operating income (because costs will rise by $4.5 million, 45 percent of the revenue increment).

Degree of Operating Leverage = % Change in Operating Profit/% Change in Sales

For firms with high operating leverage, operating income should change more than proportionately when sales change, increasing when sales increase and decreasing when sales decline.

Can firms change their operating leverage? Although some of a firm's cost structure is determined by the business it is in (an energy utility has to build costly power plants, and airlines have to lease expensive planes), firms in the United States have become increasingly inventive in lowering the fixed cost component in their total costs. Labor contracts that emphasize flexibility and allow the firm to make its labor costs more sensitive to its financial success; joint venture agreements, where the fixed costs are borne by someone else; and subcontracting of manufacturing, which reduces the need for expensive plant and equipment, are only some of the manifestations of this phenomenon. The arguments for such actions may be couched in terms of competitive advantages and cost flexibility, but they do reduce the operating leverage of the firm and its exposure to market risk.

Illustration 4.5: Measuring Operating Leverage for Disney

In Table 4.11, we estimate the degree of operating leverage for Disney from 1987 to 2008 using earnings before interest and taxes (EBIT) as the measure of operating income.

Table 4.11 Degree of Operating Leverage: Disney

Year	Net Sales	% Change in Sales	EBIT	% Change in EBIT
1987	$2,877		$756	
1988	$3,438	19.50%	$848	12.17%
1989	$4,594	33.62%	$1,177	38.80%
1990	$5,844	27.21%	$1,368	16.23%
1991	$6,182	5.78%	$1,124	-17.84%
1992	$7,504	21.38%	$1,287	14.50%
1993	$8,529	13.66%	$1,560	21.21%
1994	$10,055	17.89%	$1,804	15.64%
1995	$12,112	20.46%	$2,262	25.39%
1996	$18,739	54.71%	$3,024	33.69%
1997	$22,473	19.93%	$3,945	30.46%
1998	$22,976	2.24%	$3,843	-2.59%
1999	$23,435	2.00%	$3,580	-6.84%
2000	$25,418	8.46%	$2,525	-29.47%
2001	$25,172	-0.97%	$2,832	12.16%
2002	$25,329	0.62%	$2,384	-15.82%
2003	$27,061	6.84%	$2,713	13.80%
2004	$30,752	13.64%	$4,048	49.21%
2005	$31,944	3.88%	$4,107	1.46%
2006	$33,747	5.64%	$5,355	30.39%
2007	$35,510	5.22%	$6,829	27.53%
2008	$37,843	6.57%	$7,404	8.42%
Average: 87-08		13.73%		13.26%
Average: 96-08		9.91%		11.72%

Source: Bloomberg

The degree of operating leverage changes dramatically from year to year, because of year-to-year swings in operating income. Using the average changes in sales and operating income over the period, we can compute the operating leverage at Disney:

Operating Leverage = % Change in EBIT/% Change in Sales

= 13.26%/13.73% = 0.97

There are two important observations that can be made about Disney over the period, though. First, the operating leverage for Disney is lower than the operating leverage for other entertainment firms, which we computed to be 1.15.[27] This would suggest that Disney has lower fixed costs than its competitors. Second, the acquisition of Capital

[27]To compute this statistic, we looked at the aggregate revenues and operating income of entertainment companies each year from 1987 to 2008.

Cities by Disney in 1996 may be affecting the operating leverage. Looking at the numbers since 1996, we get a higher estimate of operating leverage:

$$\text{Operating Leverage}_{1996\text{–}03} = 11.71\%/9.91\% = 1.18$$

We would not read too much into these numbers because Disney has such a wide range of businesses. We would hypothesize that Disney's theme park business has higher fixed costs (and operating leverage) than its movie division.

4.7 Social Policy and Operating Leverage

Assume that you are comparing a European automobile manufacturing firm with a U.S. automobile firm. European firms are generally much more constrained in terms of laying off employees, if they get into financial trouble. What implications does this have for betas, if they are estimated relative to a common index?

The European firm will have much a higher beta than the U.S. firms.

The European firm will have a similar beta to the U.S. firm.

The European firm will have a much lower beta than the U.S. firms.

In Practice: Should Small or High-Growth Firms Have Higher Betas than Larger and More Mature Firms?

Though the answer may seem obvious at first sight—that smaller, higher-growth firms should are riskier than larger firms—it is not an easy question to answer. If the question were posed in terms of total risk, smaller and higher-growth firms will tend to be riskier simply because they have more volatile earnings streams (and their market prices reflect that). When it is framed in terms of betas or market risk, smaller and higher-growth firms should have higher betas only if the products and services they offer are more discretionary to their customers or if they have higher operating leverage. It is possible that smaller firms operate in niche markets and sell products that customers can delay or defer buying and that the absence of economies of scales lead to higher fixed costs for these firms. These firms should have higher betas than their larger counterparts. It is also possible that neither condition holds for a particular small firm. The answer will therefore depend on both the company in question and the industry in which it operates.

In practice, analysts often add what is called a small firm premium to the cost of equity for smaller firms. This small firm premium is usually estimated from historical data and is the difference between the average annual returns on small market cap stocks and the rest of the market—about 3 to 3.5 percent when we look at the 1926–2008 period. This practice can be dangerous for three reasons. The first is that the small firm premium has been volatile and disappeared for an extended period in the 1980s. The second is that the definition of a small market cap stock varies across time and that the historical small cap premium is largely attributable to the smallest (among the small cap) stocks. The third is that using a constant small stock premium adjustment removes any incentive that the analyst may have to examine the product characteristics and operating leverage of individual small market cap companies more closely.

Degree of Financial Leverage Other things remaining equal, an increase in financial leverage will increase the equity beta of a firm. Intuitively, we would expect that the fixed interest payments on debt to increase earnings per share in good times and to push it down in bad times.[28] Higher leverage increases the variance in earnings per share and makes equity investment in the firm riskier. If all of the firm's risk is borne by the stockholders (i.e., the beta of debt is zero),[29] and debt creates a tax benefit to the firm, then

$$\beta_L = \beta_u (1 + (1 - t)(D/E))$$

where

β_L = Levered beta for equity in the firm

β_u = Unlevered beta of the firm (i.e., the beta of the assets of the firm)

t = Marginal tax rate for the firm

D/E = Debt/equity ratio

The marginal tax rate is the tax rate on the last dollar of income earned by the firm and generally will not be equal to the effective or average rates; it is used because interest

[28]Interest expenses always lower net income, but the fact that the firm uses debt instead of equity implies that the number of shares will also be lower. Thus, the benefit of debt shows up in earnings per share.

[29]If we ignore the tax effects, we can compute the levered beta as $\beta_L = \beta_u (1 + D/E)$. If debt has market risk (i.e., its beta is greater than zero), the original formula can be modified to take it into account. If the beta of debt is β_D, the beta of equity can be written as $\beta_L = \beta_u (1 + (1 - t)(D/E)) - \beta_D (1 - t)D/E$.

expenses save taxes on the marginal income. Intuitively, we expect that as leverage increases (as measured by the debt to equity ratio), equity investors bear increasing amounts of market risk in the firm, leading to higher betas. The tax factor in the equation captures the benefit created by the tax deductibility of interest payments.

The unlevered beta of a firm is determined by the types of the businesses in which it operates and its operating leverage. This unlevered beta is often also referred to as the *asset beta* because its value is determined by the assets (or businesses) owned by the firm. Thus, the equity beta of a company is determined both by the riskiness of the business it operates in as well as the amount of financial leverage risk it has taken on. Because financial leverage multiplies the underlying business risk, it stands to reason that firms that have high business risk should be reluctant to take on financial leverage. It also stands to reason that firms operating in relatively stable businesses should be much more willing to take on financial leverage. Utilities, for instance, have historically had high debt ratios but not high betas, mostly because their underlying businesses have been stable and fairly predictable.

Breaking risk down into business and financial leverage components also provides some insight into why companies have high betas, because they can end up with high betas in one of two ways—they can operate in a risky business, or they can use very high financial leverage in a relatively stable business.

Illustration 4.6: Effects of Financial Leverage on Betas: Disney

From the regression for the period 2004 to 2008, Disney had a beta of 0.95. To estimate the effects of financial leverage on Disney, we began by estimating the average debt/equity ratio between 2004 and 2008 using market values for debt and equity.

Average Market Debt/Equity Ratio between 2004 and 2008 = 24.64%

The unlevered beta is estimated using a marginal corporate tax rate of 38%:[30]

$$\text{Unlevered Beta} = \text{Current Beta}/(1 + [1 - \text{tax rate}]\,[\text{Average Debt/Equity}])$$

$$= 0.95/(1 + [1 - 0.38]\,[0.2464]) = 0.8241$$

[30]The marginal federal corporate tax rate in the United States in 2003 was 35 percent. The marginal state and local tax rates, corrected for federal tax savings, is estimated by Disney in its annual report to be 3% percent. Disney did report some offsetting tax benefits in 2008 that reduced their effective tax rate to 36.1 percent. We assumed that these offsetting tax benefits were temporary.

The levered beta at different levels of debt can then be estimated:

Levered Beta = Unlevered Beta * [1 + (1 – tax rate) (Debt/Equity)]

For instance, if Disney were to increase its debt equity ratio to 10 percent, its equity beta will be

Levered Beta (@10% *D/E*) = 0.8241*(1+ (1 – 0.38) (0.10)) = 0.88

If the debt equity ratio were raised to 25 percent, the equity beta would be

Levered Beta (@25% *D/E*) = 0.8215 *[1 + (1 – 0.38) (0.25)] = 0.95

Table 4.12 summarizes the beta estimates for different levels of financial leverage ranging from 0 to 90 percent debt.

Table 4.12 Financial Leverage and Betas

Debt to Capital	Debt/Equity Ratio	Beta	Effect of Leverage
0.00%	0.00%	0.82	0.00
10.00%	11.11%	0.88	0.06
20.00%	25.00%	0.95	0.13
30.00%	42.86%	1.04	0.22
40.00%	66.67%	1.16	0.34
50.00%	100.00%	1.34	0.51
60.00%	150.00%	1.59	0.77
70.00%	233.33%	2.02	1.19
80.00%	400.00%	2.87	2.04
90.00%	900.00%	5.42	4.60

As Disney's financial leverage increases, the beta increases concurrently.

 levbeta.xls: This spreadsheet allows you to estimate the unlevered beta for a firm and compute the betas as a function of the leverage of the firm.

 ctrytaxrate.xls: This data set online has marginal tax rates for different countries.

In Practice: Dueling Tax Rates

The marginal tax rate, which is the tax rate on marginal income (or the last dollar of income) is a key input not only for the levered beta calculation but also for the after-tax cost of debt, which we will be estimating later in this chapter. Estimating it can be problematic because firms seldom report it in their financials. Most firms report an

effective tax rate on taxable income in their annual reports and filings with the SEC. This rate is computed by dividing the taxes paid by the net taxable income, reported in the financial statement. The effective tax rate can be different from the marginal tax rate for several reasons.

- If it is a small firm and the tax rate is higher for higher income brackets, the average tax rate across all income will be lower than the tax rate on the last dollar of income. For larger firms, where most of the income is at the highest tax bracket, this is less of an issue.
- Publicly traded firms, at least in the United States, often maintain two sets of books, one for tax purposes and one for reporting purposes. They generally use different accounting rules for the two and report lower income to tax authorities and higher income in their annual reports. Because taxes paid are based on the tax books, the effective tax rate will usually be lower than the marginal tax rate.
- Actions that defer or delay the payment of taxes can also cause deviations between marginal and effective tax rates. In the period when taxes are deferred, the effective tax rate will lag the marginal tax rate. In the period when the deferred taxes are paid, the effective tax rate can be much higher than the marginal tax rate.

The best source of the marginal tax is the tax code of the country where the firm earns its operating income. If there are state and local taxes, they should be incorporated into the marginal tax rate as well. For companies in multiple tax locales, the marginal tax rate used should be the average of the different marginal tax rates, weighted by operating income by locale.

Bottom-Up Betas

Breaking down betas into their business, operating leverage, and financial leverage components provides an alternative way of estimating betas, whereby we do not need past prices on an individual firm or asset to estimate its beta.

To develop this alternative approach, we need to introduce an additional feature that betas possess that proves invaluable. The beta of two assets put together is a weighted average of the individual asset betas, with the weights based on market value. Consequently, the beta for a firm is a weighted average of the betas of all of different

businesses it is in. Thus, the bottom-up beta for a firm, asset, or project can be estimated as follows.

1. Identify the business or businesses that make up the firm whose beta we are trying to estimate. Most firms provide a breakdown of their revenues and operating income by business in their annual reports and financial filings.
2. Estimate the average unlevered betas of other publicly traded firms that are primarily or only in each of these businesses. In making this estimate, we have to consider the following estimation issues:
   - *Comparable firms*: In most businesses, there are at least a few comparable firms and in some businesses, there can be hundreds. Begin with a narrow definition of comparable firms, and widen it if the number of comparable firms is too small.
   - *Beta Estimation*: Once a list of comparable firms has been put together, we need to estimate the betas of each of these firms. Optimally, the beta for each firm will be estimated against a common index. If that proves impractical, we can use betas estimated against different indices.
   - *Unlever First or Last*: We can compute an unlevered beta for each firm in the comparable firm list, using the debt to equity ratio, and tax rate for that firm, or we can compute the average beta, debt to equity ratio, and tax rate for the sector and unlever using the averages. Given the standard errors of the individual regression betas, we would suggest the latter approach.
   - *Averaging Approach*: The average beta across the comparable firms can be either a simple average or a weighted average, with the weights based on market capitalization. Statistically, the savings in standard error are larger if a simple averaging process is used.
   - *Adjustment for Cash*: Investments in cash and marketable securities have betas close to zero. Consequently, the unlevered beta that we obtain for a business by looking at comparable firms may be affected by the cash holdings of these firms. To obtain an unlevered beta cleansed of cash:

$$\text{Unlevered Beta corrected for Cash} = \frac{\text{Unlevered Beta}}{(1 - \text{Cash/ Firm Value})}$$

The resulting number is sometimes called a pure play beta, indicating that it measures the risk of only the business and not any other corporate holdings.

3. To calculate the unlevered beta for the firm, we take a weighted average of the unlevered betas, using the proportion of firm value derived from each business as the weights. These firm values will have to be estimated because divisions of a firm usually do not have market values available.[31] If these values cannot be estimated, we can use operating income or revenues as weights. This weighted average is called the bottom-up unlevered beta. In general, it is good practice to estimate two unlevered betas for a firm, one for just the operating assets of the firm, and one with cash and marketable securities treated as a separate business, with a beta of zero.
4. Calculate the current debt to equity ratio for the firm, using market values if available. Alternatively, use the target debt to equity ratio specified by the management of the firm or industry-typical debt ratios.
5. Estimate the levered beta for the equity in the firm (and each of its businesses) using the unlevered beta from Step 3 and the debt to equity ratio from Step 4.

Clearly, this process rests on being able to identify the unlevered betas of individual businesses.

There are three advantages associated with using bottom-up betas, and they are significant:

- We can estimate betas for firms that have no price history because all we need is an identification of the business or businesses they operate in. In other words, we can estimate bottom-up betas for initial public offerings, private businesses, and divisions of companies.
- Because the beta for the business is obtained by averaging across a large number of regression betas, it will be more precise than any individual firm's regression beta estimate. The standard error of the average beta estimate will be a function of the number of comparable firms used in Step 2 and can be approximated as follows:

$$\sigma_{\text{Average Beta}} = \frac{\text{Average } \sigma_{\text{Beta}}}{\sqrt{\text{Number of firms}}}$$

Thus, the standard error of the average of the betas of 100 firms, each of which has a standard error of 0.25, will be only 0.025 (0.25/√100).

- The bottom-up beta can reflect recent and even forthcoming changes to a firm's business mix and financial leverage, because we can change the mix of businesses and the weight on each business in making the beta estimate.

 Betas.xls: This data set online has updated betas and unlevered betas by business sector for four groupings – the United States, Europe, Emerging Markets and Japan.

Illustration 4.7: Bottom-Up Beta for Disney

Disney is an entertainment firm with diverse holdings. In addition to its theme parks, it has significant investments in broadcasting and movies. To estimate Disney's beta, we broke their business into four major components:

1. *Studio entertainment*, which is the production and acquisition of motion pictures for distribution in theatrical, television, and home video markets as well as TV programming for network and syndication markets. In addition to the television and movie productions from Disney Studios, this segment also includes Pixar Studios and Miramax Studios, with the former specializing in computer animated movies and the latter on movies for the grown-ups.
2. *Media networks,* which includes the ABC Television and radio networks and reflects the acquisition made in 1995. In addition, Disney has an extensive exposure in the cable market through the Disney channel, A&E, and ESPN, among others.
3. *Park resorts*, which include Walt Disney World (in Orlando, Florida), Disneyland (in Anaheim, California) and the recently opened Hong Kong Disney. It also includes royalty holdings in Tokyo Disneyland and Euro Disney. The hotels at each of these theme parks are considered part of the parks, because they derive their revenue almost exclusively from visitors to these parks.
4. *Consumer products*, which includes a grab-bag of businesses including Disney's retail outlets, its licensing revenues, software, interactive products, and publishing.

[31]The exception is when you have tracking stocks with each division traded separately in financial markets.

This breakdown reflects Disney's reporting in its annual report. In reality, there are a number of smaller businesses that Disney is in that are embedded in these four businesses, including:

- *Cruise lines*: Disney operates two ships—*Disney Magic* and *Disney Wonder*—that operate out of Florida and visit Caribbean ports.
- *Internet operations*: Disney made extensive investments in the GO network and other online operations. Much of this investment was written off by 2002, but they still represent a potential source of future revenues. In recent years, Disney has ventured again online and that portion of the business, while small, is growing.
- *Sports franchises*: Disney owns the National Hockey League franchise the Mighty Ducks of Anaheim; in 2002 it sold its stake in the Anaheim Angels, a Major League Baseball team.

Without detailed information on the operations of these businesses, we will assume that they represent too small a portion of Disney's overall revenues to make a significant difference in the risk calculation. For the four businesses for which we have detailed information, we estimated the unlevered beta by looking at comparable firms in each business.[32] Table 4.13 summarizes the comparables used and the unlevered beta for each of the businesses.

Table 4.13 Estimating Unlevered Betas for Disney's Business Area

Business	Comparable firms	Number of firms	Median levered beta	Median D/E	Unlevered beta	an Cash/Firm V	beta correcte
Media Networks	Radio and TV broadcasting companies -US	19	0.83	38.71%	0.6735	4.54%	0.7056
Parks and Resorts	Theme park & Resort companies - Global	26	0.80	65.10%	0.5753	1.64%	0.5849
Studio Entertainment	Movie companies -US	19	1.57	53.89%	1.1864	8.93%	1.3027
Consumer Products	Toy companies- US	12	0.83	27.21%	0.7092	33.66%	1.0690

To obtain the beta for Disney, we have to estimate the weight that each business is of Disney as a company. The value for each of the divisions was estimated by applying the typical revenue multiple at which comparable firm trade at to the revenue reported by Disney for that segment in 2008.[33] The unlevered beta for Disney as a company in 2008

[32] We used a 40% marginal tax rate for the comparable firms.

[33]We first estimated the enterprise value for each firm by adding the market value of equity to the book value of debt and subtracting out cash. We divided the enterprise value by the revenues of each firm to

is a value-weighted average of the betas of each of the different business areas. Table 4.14 summarizes this calculation.

Table 4.14 Estimating Disney's Unlevered Beta

Business	*Revenues in 2008*	*EV/Sales*	*Estimated Value*	*Firm Value Proportion*	*Unlevered beta*
Media Networks	$16,116	2.13	$34,328	58.92%	0.7056
Parks and Resorts	$11,504	1.51	$17,408	29.88%	0.5849
Studio Entertainment	$7,348	0.78	$5,755	9.88%	1.3027
Consumer Products	$2,875	0.27	$768	1.32%	1.0690
Disney Operations	$37,843		$58,259	100.00%	0.7333

The equity beta can then be calculated using the current financial leverage for Disney as a firm. Combining the market value of equity of $45,193 million with an estimated market value of debt of $16,682 million,[34] we arrive at the levered (equity) beta for Disney's operating assets:

$$\text{Debt/Equity Ratio for Disney} = \frac{\$16,682}{\$45,193} = 36.91\%$$

$$\text{Equity Beta for Disney's Operating Assets} = 0.7333\ \ (1 + (1 - 0.38)(0.3691)) = 0.9011$$

These are the estimates of unlevered beta and equity beta that we will be using for the rest of the book, when analyzing operating assets.

We can also compute an unlevered beta for all of Disney's assets including its cash holdings and the resulting equity beta:

$$\beta_{\text{Disney}} = \beta_{\text{Operating Assets}} \frac{\text{Value}_{\text{Operating Assets}}}{(\text{Value}_{\text{Operating Assets}} + \text{Value}_{\text{Cash}})} + \beta_{\text{Cash}} \frac{\text{Value}_{\text{Cash}}}{(\text{Value}_{\text{Operating Assets}} + \text{Value}_{\text{Cash}})}$$

$$= 0.7333\left(\frac{58,529}{(58,529 + 3,795)}\right) + 0\left(\frac{3,795}{(58,529 + 3,795)}\right) = 0.6885$$

$$\text{Equity Beta}_{\text{Disney as company}} = 0.6885\ \ (1 + (1 - 0.38)(0.3691)) = 0.8460$$

obtain the EV/Sales multiple and then used the median value of these estimates. We did not use the averages of these revenue multiples of the individual firms because a few outliers skewed the results.

[34]The details of this calculation will be explored later in this chapter.

This beta can be compared to the regression beta of 0.95. While it is lower, it is more precise (because of the averaging) and reflects Disney's current mix of businesses. There will be far less call for us to use these cash-adjusted beta values in analyses.[35]

In Practice: Can't Find Comparable Firms?

A problem faced by analysts using the bottom-up approach for some firms is a paucity of comparable firms, either because the company is unique in terms of the product it offers or because the bulk of the firms in the sector are private businesses. Rather than fall back on the regression approach, which is likely to yield a very wide range for the beta, we would suggest one of the following ways to expand the comparable firm sample.

- *Geographic expansion*: When analyzing firms from smaller markets, such as Brazil or Greece, the number of comparable firms will be small if we restrict ourselves only to firms in the market. One way to increase sample size is to consider firms in the same business that are listed and traded in other markets—European markets for Greece and Latin American markets for Brazil. With commodity companies that trade in global markets, like paper and oil companies, we can consider a global sample.
- *Production chain*: Another way to expand the sample is to look for firms that either provide supplies to the firm that you are analyzing or firms that feed off your firm. For instance, when analyzing book retailers, we can consider book publishers part of the sample because the fortunes of the two are entwined. It is unlikely that one of these groups can have a good year without the other partaking in the success.
- *Customer specialization*: Using the same rationale, the betas of firms that derive the bulk of their revenues from a sector is best estimated using firms in the sector. Thus, the beta of a law firm that derives all of its revenues from investment banks can be estimated by looking at the betas of investment banks.

[35] The only setting where these betas will be used is if you are valuing the equity in Disney directly and basing your cash flows on net income (which includes the interest income from the cash). If you are computing a cost of capital to value the operating assets of the firm, you should stick with the betas of just the operating assets.

Illustration 4.8: Bottom-Up Beta for Bookscape Books

We cannot estimate a regression beta for Bookscape Books, the private firm, because it does not have a history of past prices. We can, however, estimate the beta for Bookscape Books using the bottom-up approach. Because we were able to find only three publicly traded book retailers in the United States, we expanded the sample to include book publishers. We list the betas of these firms as well as debt, cash, and equity values in Table 4.15.

Table 4.15 Betas and Leverage of Publicly Traded Book Retailers and Publishers

Company Name	Industry Name	Beta	D/E Ratio	Unlevered Beta	Cash/Firm Value	Unlevered beta corrected for cash
Courier Corp.	Publishing	0.98	12.33%	0.91	0.46%	0.92
Educational Devel.	Publishing	0.57	0.00%	0.57	15.38%	0.67
McGraw-Hill Ryerson Ltd.	Publishing	0.26	0.00%	0.26	46.97%	0.49
Meredith Corp.	Publishing	1.37	66.85%	0.98	3.11%	1.01
Presstek Inc.	Publishing	1.68	41.09%	1.35	10.83%	1.51
PRIMEDIA Inc	Publishing	1.65	340.84%	0.54	9.20%	0.60
Scholastic Corp.	Publishing	1.13	84.49%	0.75	13.36%	0.87
Torstar 'B'	Publishing	0.48	54.21%	0.36	4.93%	0.38
Wiley (John) & Sons	Publishing	1.03	52.73%	0.78	1.93%	0.80
Barnes & Noble	Retail (Special Lines)	1.34	0.00%	1.34	48.46%	2.60
Books-A-Million	Retail (Special Lines)	1.98	97.49%	1.25	7.90%	1.36
Borders Group	Retail (Special Lines)	2.44	240.87%	1.00	7.78%	1.08
Median		**1.235**	**53.47%**	**0.94**	**8.55%**	**1.02**

Although the firms in this sample are very different in terms of market capitalization, the betas are consistent. To estimate the unlevered beta for the sector, we first unlevered the beta for each firm and corrected each unlevered beta for the firm's cash holdings. The median value for the unlevered beta, corrected for cash holdings, is 1.02.[36]

[36] Alternate approaches for estimating the beta yielded similar values, with aggregate values for debt, equity and cash generating an unlevered beta of 1.00 for the sector and simple averages for the beta, debt to equity ratio and cash to firm value across the firms provided an estimate of 0.97 for the beta.

Because the debt/equity ratios used in computing levered betas are market debt equity ratios, and the only debt equity ratio we can compute for Bookscape is a book value debt equity ratio, we have assumed that Bookscape is *close to the book industry median* debt to equity ratio of 53.47 percent. Using a marginal tax rate of 40 percent for Bookscape, we get a levered beta of 1.35.

Levered beta for Bookscape = 1.02 [1 + (1 – 0.40) (0.5347)] = 1.35

Illustration 4.9: Bottom-Up Beta for Aracruz & Tata Chemicals

The bottom-up beta for Aracruz is difficult to estimate if we remain within its home market (Brazil) for two reasons. First, there are only three publicly traded firms within the market that are in the same line of business as Aracruz (i.e., paper and pulp production). Second, the betas for all Brazilian firms are unreliable because the index used to estimate these betas, the Bovespa, is a narrow one, dominated by a few large companies. There are three groups of comparable firms that we can use as comparable firms in the bottom-up beta estimate:

- *Emerging market paper and pulp companies*: This is a much larger sample of firms. Although the individual firm betas may be skewed by the limitations of the local indices, the errors should average out over the sample.
- *U.S. paper and pulp companies*: The advantage gained is not just in terms of the number of firms but also in terms of reliable betas. The peril in this approach is that the risk in U.S. companies can be different from the risk in Brazilian because of regulatory differences.[37]
- *Global paper and pulp companies*: This is the largest group and includes a diverse group of companies in both emerging and developed markets. Because betas are measures of relative risk, we argue that barring significant differences in regulation and monopoly power across markets, it is reasonable to compare betas across markets.

The bottom-up betas estimated with each group are summarized in table 4.16.

Table 4.16 Bottom up Beta- Paper and Pulp Business

	Number of firms	*Median Beta*	*Median D/E*	*Median Unlevered Beta*	*Cash/Value*	*Unlevered Beta Corrected for Cash*
Emerging Markets	46	1.03	4.47%	1.00	0.74%	1.01
US	13	1.16	92.29%	0.75	2.87%	0.77
Global	111	0.91	9.82%	0.86	1.24%	0.87

The tax rates used were 32 percent for emerging market companies, 40 percent for U.S. companies, and 35 percent for global companies, based on averaging the marginal tax rates in each group. The unlevered beta of emerging market companies is higher than the U.S. and global groupings. Although the average beta for U.S. companies is higher than the rest of the sample, this can be attributed to the higher debt to equity ratios of these companies. We will use an emerging market unlevered beta of 1.01 as the beta for the paper and pulp business in which Aracruz is involved.

When computing the levered beta for Aracruz's paper and pulp business, we used the gross debt outstanding of 9,805 million BR and the market value of equity of 8907 million BR, in conjunction with the marginal tax rate of 34% for Brazil:

Gross Debt to Equity ratio = Debt/Equity = 9805/8907 = 110.08%

Levered Beta for Aracruz Paper business = 1.01 (1+(1-.34)(1.1008)) = 1.74

As with Disney, we can compute a beta for Aracruz as a company, including its cash balance, and an equity beta based upon this computation. At the end of 2008, the firm had a negligible cash holding of 20 million BR, thus making almost no difference to the estimate.

Tata Chemicals is in two businesses – diversified chemicals and fertilizers. To compute the bottom-up beta for Tata Chemicals, we faced a similar choice of using just Indian companies, emerging market companies or globally listed companies. As with Aracruz, we decided to go with the emerging market companies as our comparable firms. Table 4.17 summarizes the revenues that Tata Chemicals generates from its two businesses, our estimates of value for each business (based upon the multiples of

[37]As a counterpoint, paper and pulp companies are commodity companies and are governed by the vagaries of the price of paper and pulp. In other words, there is a reasonable argument to be made that paper and pulp companies globally are governed by the same primary risk factors.

revenues that comparable companies trade at) and the unlevered beta for each business and for all of Tata Chemicals' operating assets:

Table 4.17: Beta for Tata Chemicals: Divisions and Company

Business(# of comparables)	Revenues (millions)	EV/Sales (from comparable firms)	Estimated Value (millions)	Weights	Unlevered Beta	D/E Ratio	Levered Beta
Fertilizers (105)	INR 2,506	1.28	INR 3,208	62.18%	0.72	51.56%	0.965
Chemicals (31)	INR 1,586	1.23	INR 1,951	37.82%	0.68	51.56%	0.911
Tata Chemicals			INR 5,158		0.70		0.945

We used the marginal tax rates of 33.99% for India in levering the betas.

In Practice: Gross Debt or Net Debt

Many analysts in Europe and Latin America prefer to subtract the cash from the gross debt to arrive at a net debt figure, which they then use in both levering betas and in computing cost of capital.

Net Debt = Gross Debt – Cash and Marketable Securities

The rationale for this netting is that the presence of cash reduces the effective debt burden of the firm.

We have no quarrel with that logic. In fact, there are two ways, we can reflect the presence of cash in the levered beta of equity of a firm. In the gross debt approachm the unlevered beta for a firm (as opposed to just the operating assets of the firm) is a weighted average of the unlevered beta of its operations and the unlevered beta of its cash holdings. If we make the assumption that cash has a beta of 0, the unlevered beta for the firm:

$$\text{Unlevered Beta}_{\text{Firm}} = 0\ (\text{Cash/ Firm Value}) + \text{Unlevered Beta}_{\text{Operations}}(1\text{-Cash/ Firm Value})$$

We can then apply the gross debt to equity ratio to this unlevered beta to arrive at the levered beta of equity. In the net debt approach, we ignore cash while computing the unlevered beta for the firm, but then lever that beta, using the net debt to equity ratio.

Consider a simple example of a chemical company with $80 million in operating assets and $ 20 million in cash, funded with $ 60 million in equity and $ 40 million in debt. Assume that the unlevered beta of the chemical business is 1.20 and that the marginal tax rate is 40%. First, compute betas using the gross debt approach:

$$\text{Unlevered Beta}_{\text{Company}} = 0\ (20/100) + 1.20\ (80/100) = 0.96$$

$$\text{Gross Debt to Equity Ratio} = 40/\ 60 = 0.6667$$

$$\text{Levered beta} = 0.96\ (1+ (1-.40)\ (0.6667)) = 1.344$$

Now, let's try the net debt approach.

$\text{Unlevered Beta}_{\text{Company}} = 1.20$

Net Debt to Equity Ratio = (Debt-Cash)/ Equity = (40-20)/ 60 = 0.3333

Levered beta = 1.20 (1+ (1-.40) (0.3333)) = 1.44

Notice that the levered beta of 1.344, computed using the gross debt to equity ratio approach, does not match the computation using the net debt to equity ratio. The reason lies in an implicit assumption that we make when we net cash against debt. We assume that both debt and cash are riskless and that the tax benefit from debt is exactly offset by the tax paid on interest earned on cash. It is generally not a good idea to net debt if the debt is very risky or if the interest rate earned on cash is substantially lower than the interest rate paid on debt. With a net debt to equity ratio, there is one more potential complication. Any firm that has a cash balance that exceeds its debt will have negative net debt and using this negative net D/E ratio will yield an unlevered beta that exceeds the levered beta. Although this may trouble some, it makes sense because the unlevered beta reflects the beta of the business that the firm operates in. Firms that have vast cash balances that exceed their borrowing can have levered betas that are lower than the unlevered betas of the businesses they operate in.

Illustration 4.10: Bottom-Up Beta for Deutsche Bank

There are a few banks in Germany that can be viewed as competitors to Deutsche Bank, though none of them are as large as it is or have as large of a stake in investment banking. Because the rules and regulatory constraints governing banking in the United States are different from the rules governing banks in much of Europe, we will look at the betas of diversified European banks to estimate the beta for the commercial banking arm of Deutsche Bank. To estimate the beta of Deutsche Bank's investment banking arm, we

use the betas of investment banking and brokerage firms, listed in the United States.[38] The results are presented in table 4.18:

Table 4.18: Beta for Deutsche Bank

Business	Comparable firms	Number	Average Beta	Weights
Commercial banking	Diversified European Banks	90	1.05	65%
Investment Banking	US investment banks	32	1.37	35%
Deutsche Bank			1.162	

Note that we do not adjust for differences in financial leverage, because regulatory constraints and the needs of the business keep the leverage of most commercial banks at similar levels.[39] The beta for Deutsche Bank as a firm can be estimated as a weighted average of these two betas, using estimated value weights of 65 percent for the commercial banking and 35 percent for the investment banking arms, based on the revenues that Deutsche Bank made from each in the most recent year.

Calculating Betas after a Major Restructuring

The bottom-up process of estimating betas provides a solution when firms go through a major restructuring, where they change both their business mix and leverage. In these cases, the regression betas are misleading because they do not fully reflect the effects of these changes. Disney's beta, estimated from the bottom-up approach, is likely to provide a more precise estimate than the beta from a regression, given Disney's changing business mix and its increase in financial leverage in recent years. In fact, a firm's beta can be estimated even before the restructuring becomes effective using this approach. In the illustration that follows, for instance, we estimate Disney's beta just before and after its acquisition of Capital Cities/ABC in 1995, allowing for the changes in both the business mix and the leverage.

Illustration 4.11: Beta of a Firm after an Acquisition: Disney/Capital Cities

In 1995, Disney announced that it was acquiring Capital Cities, the owner of the ABC television and radio network, for approximately $120 per share, and that it would

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[38] In much of the rest of the world, investment banking is an arm of commercial banking rather than a stand-alone operation.

[39] Regulators often specify capital ratios, specified in terms of book values of debt and equity that banks must meet to stay in business. Most banks stay close to these ratios, though some tend to be better capitalized than others.

finance the acquisition partly through the issue of $10 billion in debt. At the time of the acquisition, Disney had a market value of equity of $31.1 billion, debt outstanding of $3.186 billion, and a levered beta of 1.15. Capital Cities, based on the $120 offering price, had a market value of equity of $18.5 billion, debt outstanding of $615 million, and a levered beta of 0.95.

To evaluate the effects of the acquisition on Disney's beta, we do the analysis in two parts. First, we examine the effects of the merger on the business risk of the combined firm, by estimating the unlevered betas of the two companies, and calculating the combined firm's unlevered beta (using a tax rate of 36% for both firms).

Disney's unlevered beta = 1.15/(1 + (1-.36)*(3,186/31,100)) = 1.08

Capital Cities unlevered beta = 0.95/(1 + (1-.36)*(615/18500)) = 0.93

The unlevered beta for the combined firm can be calculated as the weighted average of the two unlevered betas, with the weights being based upon the *market values of the two firms*.[40]

Value of Disney = $31,100 + $3,186 = $34,286 million

Value of Capital Cities = $18,500 + $ 615 = $19,115 million

Unlevered Beta for combined firm = 1.08 (34,286/53,401) + 0.93 (19,115/53,401)

= 1.026

Then we examine the effects of the financing of the merger on the betas by calculating the debt/equity ratio for the combined firm after the acquisition. Because Disney is assuming the old debt of Capital Cities, we add that debt to Disney's existing debt and add the additional $10 billion in debt used to fund this acquisition:[41]

Post-acquisition Debt = Capital Cities Old Debt + Disney's Old Debt + New Debt

= $615 + $3,186 + $10,000 = $13,801 million

Post-acquisition Equity = Disney's Old Equity + New Equity Used for Acquisition

= $31,100 + $8,500 = $39,600 million

where New Equity = Total Cost of Acquisition – New Debt Issued

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[40]Unlevered betas should always be weighted based on firm values. With levered (equity) betas, the values of equity can be used as weights.

[41]If Disney had paid off Capital Cities' existing debt instead of assuming it, we could have ignored it in the debt calculation. However, Disney would then have had to raise an extra $615 million in financing to fund this acquisition.

= $18,500 – $10,000 = $8,500 million

Notice that the equity in Capital Cities of $18,500 million disappears after the acquisition and is replaced with new debt of $10,000 million and new Disney equity of $8,500 million. The debt/equity ratio can then be computed as follows.

D/E Ratio = 13,801/39600 = 34.82%

This debt/equity ratio in conjunction with the new unlevered beta for the combined firm yields a new beta of

New Beta = 1.026 (1 + 0.64 (.3482)) = 1.25

Based on this computation, we would expect Disney's beta to increase from 1.15 to 1.25 after the acquisition of Capital Cities.

C. Accounting Betas

A third approach is to estimate the beta of a firm or its equity from accounting earnings rather than from traded prices. Thus, changes in earnings at a division or a firm, on a quarterly or annual basis, can be regressed against changes in earnings for the market, in the same periods, to arrive at an estimate of a "market beta" to use in the CAPM. The approach has some intuitive appeal, but it suffers from three potential pitfalls. First, accounting earnings tend to be smoothed out relative to the underlying value of the company, resulting in betas that are "biased down," especially for risky firms, or "biased up," for safer firms. In other words, betas are likely to be closer to one for all firms using accounting data. Second, accounting earnings can be influenced by non-operating factors, such as changes in depreciation or inventory methods, and by allocations of corporate expenses at the division level. Finally, accounting earnings are measured, at most, once every quarter, and often only once every year, resulting in regressions with few observations and not much power.

Illustration 4.12: Estimating Accounting Betas: Bookscape Books

Bookscape Books, even though it is a private business, has been in existence since 1980 and has accounting earnings going back to that year. Table 4.19 summarizes accounting earnings changes at Bookscape and for companies in the S&P 500 for each year since 1980.

Table 4.19: Change in Earnings (%) for Bookscape versus S&P 500

Year	S&P 500	Bookscape	Year	S&P 500	Bookscape
1980	3.01%	3.55%	1995	18.74%	11.55%
1981	1.31%	4.05%	1996	7.77%	19.88%
1982	-8.95%	-14.33%	1997	8.52%	16.55%
1983	-3.84%	47.55%	1998	0.41%	7.10%
1984	26.69%	65.00%	1999	16.74%	14.40%
1985	-6.91%	5.05%	2000	8.61%	10.50%
1986	-7.93%	8.50%	2001	-30.79%	-8.15%
1987	11.10%	37.00%	2002	18.51%	4.05%
1988	50.42%	45.17%	2003	18.79%	12.56%
1989	0.83%	3.50%	2004	23.75%	14.50%
1990	-6.87%	-10.50%	2005	12.96%	8.35%
1991	-14.79%	-32.00%	2006	14.74%	16.74%
1992	8.13%	55.00%	2007	-5.91%	2.50%
1993	28.89%	31.00%	2008	-20.78%	-12.20%
1994	18.03%	21.06%			

Regressing the changes in profits at Bookscape against changes in profits for the S&P 500 yields the following:

Bookscape Earnings Change = 0.08 + 0.8211 (S&P 500 Earnings Change)

Based on this regression, the beta for Bookscape is 0.82. In calculating this beta, we used net income to arrive at an equity beta. Using operating earnings for both the firm and the S&P 500 should yield the equivalent of an unlevered beta.

Technically, there is no reason why we cannot estimate accounting betas for Disney, Aracruz Cellulose, Tata Chemicals and Deutsche Bank. In fact, for Disney, we could get net income numbers every quarter, which increases the data we have in the regression. We could even estimate accounting betas by division, because the divisional income is reported. We do not attempt to estimate accounting betas for the following reasons:

1. To get a sufficient number of observations in our regression, we would need to go back in time at least ten years and perhaps more. The changes that many large companies undergo over time make this a hazardous exercise.
2. Publicly traded firms smooth out accounting earnings changes even more than private firms do. This will bias the beta estimates downward.

 spearn.xls: This data set online has earnings changes, by year, for the S&P 500 going back to 1960.

Market, Fundamental, and Accounting Betas: Which One Do We Use?

For most publicly traded firms, betas can be estimated using accounting data, market data, or fundamentals. Because the betas will almost never be the same, the question then becomes one of choosing between them. We would almost never use accounting betas for all of the reasons already specified. We are almost as reluctant to use historical market betas for individual firms because of the standard errors in beta estimates, the failures of the local indices, and the inability of these regressions to reflect the effects of major changes in the business and financial risk at the firm. Fundamental betas, in our view, provide the best beta estimates because they not only are more precise (because of the averaging) but also allow us to reflect changes in business and financial mix. In summary, we will use the fundamental estimates of equity betas, based upon the operating assets, of 0.90 for Disney, 0.94 for Tata Chemicals, 1.35 for Bookscape, 1.74 for Aracruz, and 1.16 for Deutsche Bank.

IV. Estimating the Cost of Equity

Having estimated the risk-free rate, the risk premium(s), and the beta(s), we can now estimate the expected return from investing in equity at any firm. In the CAPM, this expected return can be written as:

Expected Return = Risk-Free Rate + Beta * Expected Risk Premium

where the risk-free rate would be the rate on a long-term government bond; the beta would be either the historical, fundamental, or accounting betas; and the risk premium would be either the historical premium or an implied premium.

In the APM and multifactor model, the expected return would be written as follows:

$$\text{Expected Return} = \text{Risk-free Rate} + \sum_{j=1}^{j=n} \beta_j * \text{Risk Premium}_j$$

where the risk-free rate is the long term government bond rate, β_j is the beta relative to factor *j*, estimated using historical data or fundamentals, and Risk Premium$_j$ is the risk premium relative to factor *j*, estimated using historical data.

The expected return on an equity investment in a firm, given its risk, has key implications for both equity investors in the firm and the managers of the firm. For equity investors, it is the *rate they need to make* to be compensated for the risk that they have taken on investing in the equity of a firm. If after analyzing a stock, they conclude that they cannot make this return, they would not buy it; alternatively, if they decide they can make a higher return, they would make the investment. For managers in the firm, the return that investors need to make to break even on their equity investments becomes the return that they have to try to deliver to keep these investors from becoming restive and rebellious. Thus, it becomes the rate that they have to beat in terms of returns on their equity investments in individual projects. In other words, this is the *cost of equity* to the firm.

Illustration 4.13: Estimating the Cost of Equity

In Illustration 4.7, we estimated a bottom-up unlevered beta for Disney and each of its divisions. To estimate the levered beta for Disney, we estimated a debt to equity ratio of 36.91%, based upon the total market value of equity ($45,193 million) and debt ($16,682 million). To estimate the levered beta for each of the divisions, we face a challenge in determining the debt to equity ratio at the divisional level, since we do not have market equity values for the individual divisions nor do we have full details on which divisions are responsible for the borrowing. We have two choices. One is to assume that Disney debt to equity ratio applies to all of its individual divisions. The other is to try to make judgments about the debt to equity ratios for the individual divisions, based upon the information available. In table 4.20, we tried to do the latter:

Table 4.20: Allocating Debt and Equity to divisions

Business	Estimated EV	Allocated Debt	Estimated Equity	D/E Ratio	D/E Ratio of comps	Estimated debt	Proportions
Media Networks	$34,328	$8,582	$25,746	33.33%	38.71%	$9,581	51.44%
Parks and Resorts	$17,408	$6,148	$11,260	54.61%	65.10%	$6,864	36.86%

Studio Entertainment	$5,755	$1,805	$3,950	45.70%	53.89%	$2,015	10.82%
Consumer Products	$768	$147	$621	23.70%	27.21%	$164	0.88%
						$18,624	100.00%

We started with the estimates of enterprise value that we obtained in table 4.14, obtained by multiplying the revenues in each division by the median EV/Sales ratio of comparable companies in the division. We then used the D/E ratios of these same comparable firms to estimate the debt in each division in the second to last column and used the proportions derived from these estimated debt numbers to allocate the existing debt ($16,682 million) across the divisions.[42] Finally, we estimated the value of equity in each division by subtracting the debt from the estimated enterprise value.

Using the US dollar riskfree rate (from illustration 4.1) and the equity risk premium estimated for mature markets (from illustration 4.2), we estimate the cost of equity for Disney's operating assets and for each of its divisions, listed in Table 4.21.

Table 4.21 Levered Beta and Cost of Equity: Disney

Business	Unlevered Beta	D/E Ratio	Levered Beta	Cost of Equity
Media Networks	0.7056	33.33%	0.8514	8.61%
Parks and Resorts	0.5849	54.61%	0.7829	8.20%
Studio Entertainment	1.3027	45.70%	1.6718	13.53%
Consumer Products	1.0690	23.70%	1.2261	10.86%
Disney	0.7333	36.91%	0.9011	8.91%

The costs of equity vary across the remaining divisions, with studio entertainment having the highest beta (and cost of equity) and parks and resorts the lowest.

To estimate the cost of equity for Deutsche Bank, we will use the same risk premium (6 percent) that we have used for the United States, because Deutsche Bank's business is still primarily in mature markets in Europe and the United States. Using the ten-year German Euro bond rate of 3.60 percent as the Euro risk-free rate (from

[42] Some analysts use the industry average debt to equity ratios to estimate levered betas by division. The problem with doing this is that the sum total of the debt that they estimate for the divisions may not match up to the actual debt of the company. In the case of Disney, for instance, the dollar debt that we would have obtained with this approach ($18,624 million) would have greater than the debt owed by the company ($16,682 million)

illustration 4.1) and Deutsche Bank's bottom up beta of 1.16, the cost of equity for Deutsche Bank is shown in Table 4.22.

Table 4.22: Cost of Equity for Deutsche Bank

Business	Beta	Cost of Equity
Commercial banking	1.05	3.6%+1.05 (6%) = 9.90%
Invesetment Banking	1.37	3.6%+1.37 (6%) = 11.82%
Deutsche Bank	1.162	3.6%+1.162 (6%) = 10.55%

Note that the cost of equity for investment banking is significantly higher than the cost of equity for commercial banking, reflecting the higher risks.

For Aracruz, we will add the country risk premium estimated for Brazil of 3.95% percent, estimated earlier in the chapter, to the mature market premium, estimated from the United States, of 6 percent to arrive at a total risk premium of 9.95 percent (see illustration 4.2). The cost of equity for Aracruz can then be computed in US dollar terms using the bottom-up beta estimated in Illustration 4.9 and the US treasury bond rate of 3.5%:

$$\text{Cost of Equity}_{\text{US dollars}} = \text{Risk-Free Rate}_{\$} + \text{Beta} * \text{Risk Premium}$$
$$= 3.5\% + 1.74\ (9.95\%) = 20.82\%$$

Note that we can compute Aracruz's cost of equity in nominal Brazilian Reals in one of two ways. The first is to replace the US dollar riskfree rate with a nominal Brazilian Real riskfere rate (estimated to be 8.5% in illustration 4.1):

$$\text{Cost of Equity}_{\text{Nominal \$R}} = \text{Riskfree Rate}_{\text{R\$}} + \text{Beta}* \text{Risk Premium}$$
$$= 8.5\% + 1.74\ (9.95\%) = 25.82\%$$

This approach assumes that the equity risk premium, which was computed using dollar-based securities, will stay constant even if we switch to a higher inflation currency. The second and more precise approach scales up the equity risk premium, when we switch to the higher inflation currency. If we assume that the expected inflation rate is 7% in nominal \$R and 2% in US \$, we obtain:

$$\text{Cost of Equity}_{\text{Nominal R\$}} = (1+ \text{Cost of Equity}_{\text{US \$}}) \frac{(1+\text{Expected Inflation}_{\text{R\$}})}{(1+\text{Expected Inflation}_{\text{US \$}})} - 1$$

$$= (1.2082)\ \frac{(1.07)}{(1.02)} - 1 = 26.75\%$$

As an emerging market company with a high debt to equity ratio, Aracruz clearly faces a much higher cost of equity than its competitors in developed markets.

For Tata Chemicals, we estimate the cost of equity in Indian rupees, using the rupee riskfree rate of 4% (estimated in illustration 4.1) and the equity risk premium for India of 10.51% (estimated in illustration 4.2). Table 4.23 summarizes the cost of equity estimates for the fertilizer and chemical businesses separately, as well as for the entire company.

Table 4.23: Cost of Equity by division: Tata Chemicals

Business	Beta	Cost of equity
Fertilizers	0.965	4%+ 0.965 (10.51%) = 14.14%
Chemicals	0.911	4%+ 0.911(10.51%) = 13.58%
Tata Chemicals	0.945	4%+ 0.945 (10.51%) = 13.93%

Finally, for Bookscape, we will use the beta of 1.35 estimated from Illustration 4.8 in conjunction with the risk-free rate and risk premium for the United States:

Cost of Equity = 3.5% + 1.35 (6%) = 11.60%

Implicit in the use of beta as a measure of risk is the assumption that the marginal investor in equity is a well-diversified investor. Although this is a defensible assumption when analyzing publicly traded firms, it becomes much more difficult to sustain for private firms. The owner of a private firm generally has the bulk of his or her wealth invested in the business. Consequently, he or she cares about the total risk in the business rather than just the market risk. Thus, for a business like Bookscape, the beta that we have estimated of 1.35 (leading to a cost of equity of 11.60 percent) will understate the risk perceived by the owner. There are three solutions to this problem:

1. Assume that the business is run with the near-term objective of sale to a large publicly traded firm. In such a case, it is reasonable to use the market beta and cost of equity that comes from it.
2. Add a premium to the cost of equity to reflect the higher risk created by the owner's inability to diversify. This may help explain the high returns that some venture capitalists demand on their equity investments in fledgling businesses.
3. Adjust the beta to reflect total risk rather than market risk. This adjustment is relatively simple, because the R^2 of the regression measures the proportion of the

variance that is market risk. Dividing the market beta by the square root of the R^2 (which yields the correlation coefficient) yields a total beta. In the Bookscape example, the regressions for the comparable firms against the market index have an average correlation with the market of 46.45% (the average R^2 was 21.58%). The total beta for Bookscape can then be computed as follows:

Total Beta = (Market Beta)/Correlation with the market = 1.35/0.4645= 2.91

Using this total beta would yield a much higher and more realistic estimate of the cost of equity.

Cost of Equity = 3.5% + 2.91 (6%) = 20.94%

Thus, private businesses will generally have much higher costs of equity than their publicly traded counterparts, with diversified investors. Although many of them ultimately capitulate by selling to publicly traded competitors or going public, some firms choose to remain private and thrive. To do so, they have to diversify on their own (as many family-run businesses in Asia and Latin America did) or accept the lower value as a price paid for maintaining total control.

In Practice: Company Exposure to Country Risk

In our computations of cost of equity for companies, note that we attached country risk premiums to Aracruz (Brazil) and Tata Chemicals (India) and used only a mature market premium for Disney and Deutsche Bank. While we are following conventional practice in assessing country risk based upon where a company is incorporated, it can also lead to misleading values for companies that are incorporated in an emerging market (developed market) and have a significant portion of their operations in a developed market (emerging market). This would have been the case, for instance, if we had been analyzing Embraer, a Brazilian aerospace company with less than 10% of its revenues from Brazil and the rest from developed markets, or Infosys, an Indian technology company that derives more than half of its revenues in the United States.

There is a simple (perhaps even simplistic) way of adjusting for operating risk exposure.[43] Rather than use the risk premium of the country of incorporation, we can use a weighted average of the total risk premiums of the countries in which the company

operates, using revenues as the basis for the weighting. Thus, the equity risk premium used for a company that derives half its revenues in India and half in the United States would be:

Equity Risk Premium = (.5) (6%) + (.5) (10.51%) = 8.26%

Thus, the costs of equity of companies like Nestle and Coca Cola, which have substantial operations in emerging markets, will increase. We did break down Disney's revenues geographically and noted that while it does have significant non-US operations, most are still centered in Western Europe and Japan and thus do not affect the risk premium. However, as its Hong Kong theme park's revenues increase, we may have to adjust the equity risk premium to reflect greater emerging market risk. Tata Chemicals gets almost 90% of its revenues from India and the use of the Indian total risk premium seems appropriate. We are a little more concerned about our equity risk premium assessments for Deutsche Bank (which we feel is exposed to more emerging market risk) and Aracruz (which has significant revenues outside Brazil). However, we made no adjustments because of the absence of a clear measure of emerging market operations for the former and the offsetting additional risk of being a natural resource company for the latter.[44]

From Cost of Equity to Cost of Capital

Equity is undoubtedly an important and indispensable ingredient of the financing mix for every business, but it is only one ingredient. Most businesses finance some or much of their operations using debt or some hybrid of equity and debt. The costs of these sources of financing are generally very different from the cost of equity, and the minimum acceptable hurdle rate for a project will reflect their costs as well, in proportion to their use in the financing mix. Intuitively, the *cost of capital* is the weighted average of the costs of the different components of financing—including debt, equity, and hybrid securities—used by a firm to fund its financial requirements.

4.8: Interest Rates and the Relative Costs of Debt and Equity

[43] For more comprehensive ways of estimating company risk exposure to country risk, see the working paper on my web site: Damodaran, A., 2003, Estimating Company Risk Exposure to Country Risk.

[44] Natural resource companies are particularly exposed to country risk, because they do not have the option of moving operations if the country that their resources are in is in trouble. Manufacturing companies can move their factories to more stable locations but oil, mining and forestry companies cannot.

It is often argued that debt becomes a more attractive mode of financing than equity as interest rates go down and a less attractive mode when interest rates go up. Is this true?

a. Yes

b. No

Why or why not?

The Costs of Non-equity Financing

To estimate the cost of the funding that a firm raises, we have to estimate the costs of all of the non-equity components. In this section, we consider the cost of debt first and then extend the analysis to consider hybrids, such as preferred stock and convertible bonds.

Default Risk: The risk that a firm will fail to make obligated debt payments, such as interest expenses or principal payments.

The Cost of Debt

The *cost of debt* measures the current cost to the firm of borrowing funds to finance projects. In general terms, it is determined by the following variables:

1. ***The current level of interest rates****:* As market interest rates rise, the cost of debt for all firms will also increase.

2. ***The default risk of the company****:* As the default risk of a firm increases, lenders will charge higher interest rates (a default spread) to compensate for the additional risk.

3. ***The tax advantage associated with debt****:* Because interest is tax-deductible, the after-tax cost of debt is a function of the tax rate. The tax benefit that accrues from paying interest makes the after-tax cost of debt lower than the pretax cost. Furthermore, this benefit increases as the tax rate increases.

After-Tax Cost of Debt = (Riskfree rate + Default Spread) (1 – Marginal Tax Rate)

The challenge in estimating cost of debt is really one of estimating the correct default spread for a company.

4.9: Costs of Debt and Equity

Can the cost of equity ever be lower than the cost of debt for any firm at any stage in its life cycle?

Yes
No

Estimating the Default Risk and Default Spread of a Firm

The simplest scenario for estimating the cost of debt occurs when a firm has long-term bonds outstanding that are widely traded and have no special features, such as convertibility or first claim on assets, skewing interest rates. The market price of the bond, in conjunction with its coupon and maturity, can serve to compute a yield we use as the cost of debt. For instance, this approach works for firms that have dozens of outstanding bonds that are liquid and trade frequently.

Many firms have bonds outstanding that do not trade on a regular basis. Because these firms are usually rated, we can estimate their costs of debt by using their ratings and associated default spreads. Thus, Disney with an A rating can be expected to have a cost of debt approximately 2.5 percent higher than the Treasury bond rate, in May 2009, because this was the spread typically paid by A rated firms at the time.

Some companies choose not to get rated. Many smaller firms and most private businesses fall into this category. Ratings agencies have sprung up in many emerging markets, but there are still a number of markets in which companies are not rated on the basis of default risk. When there is no rating available to estimate the cost of debt, there are two alternatives:

- *Recent Borrowing History:* Many firms that are not rated still borrow money from banks and other financial institutions. By looking at the most recent borrowings made by a firm, we can get a sense of the types of default spreads being charged and use these spreads to come up with a cost of debt.
- *Estimate a Synthetic Rating and Default Spread*: An alternative is to play the role of a ratings agency and assign a rating to a firm based on its financial ratios; this rating is called a synthetic rating. To make this assessment, we begin with rated firms and examine the financial characteristics shared by firms within each ratings class. Consider a very simpler version, where the ratio of operating income to interest expense, that is, the interest coverage ratio, is computed for each rated firm. In Table 4.24, we list the range of interest coverage ratios for manufacturing

firms in each S&P ratings class, classified by market capitalization into large (>$5 billion) and small (<$5 billion).[45] We also report the typical default spreads for bonds in each ratings class in early 2009.[46]

Table 4.24 Interest Coverage Ratios and Ratings

Interest Coverage Ratio: Small market cap(<$5 billion)	*Interest Coverage Ratio: Large market cap (>US $ 5 billion)*	*Rating*	*Typical Default*
> 12.5	>8.5	AAA	1.25%
9.50–12.50	6.5-8.5	AA	1.75%
7.50–9.50	5.5-6.5	A+	2.25%
6.00–7.50	4.25- 5.5	A	2.50%
4.50–6.00	3- 4.25	A–	3.00%
4.00-4.50	2.5-3.0	BBB	3.50%
3.50–4.00	2.25-2.5	BB+	4.25%
3.00–3.50	2.0-2.25	BB	5.00%
2.50–3.00	1.75-2.0	B+	6.00%
2.00–2.50	1.5-1.75	B	7.25%
1.50–2.00	1.25-1.5	B–	8.50%
1.25–1.50	0.8-1.25	CCC	10.00%
0.80–1.25	0.65-0.8	CC	12.00%
0.50–0.80	0.2-0.65	C	15.00%
< 0.65	<0.2	D	20.00%

Source: Compustat and Bondsonline.com.

Now consider a private firm with $10 million in earnings before interest and taxes and $3 million in interest expenses; it has an interest coverage ratio of 3.33. Based on this ratio, we would assess a synthetic rating of BB for the firm and attach a default spread of 5.00 percent to the risk-free rate to come up with a pretax cost of debt. A large market cap firm with the same interest coverage ratio would be assigned a rating of A- and a default spread of 3.00%.

By basing the synthetic rating on the interest coverage ratio alone, we run two risks. One is that using last year's operating income as the basis for the rating may yield too low or too high a rating for a firm that had an exceptionally good or bad earnings years. We can counter that by using the average operating income over a period, say 5

[45]This table was first developed in early 2000, by listing all rated firms with market capitalization lower than $5 billion and their interest coverage ratios, and then sorting firms based on their bond ratings. The ranges were adjusted to eliminate outliers and to prevent overlapping ranges. It has been updated every two years since.

[46]These default spreads are obtained from an online site, found at www.bondsonline.com. You can find default spreads for industrial and financial service firms; these spreads are for industrial firms.

years, to compute the coverage ratio. The other is that we risk missing the information that is available in the other financial ratios and qualitative information used by ratings agencies. The counter to that is to extend the approach to incorporate other ratios. The first step would be to develop a score based on multiple ratios. For instance, the Altman *z*-score, which is used as a proxy for default risk, is a function of five financial ratios, which are weighted to generate a *z*-score. The ratios used and their relative weights are usually based on past history on defaulted firms. The second step is to relate the level of the score to a bond rating, much as we did in Table 4.24, with interest coverage ratios. In making this extension, though, note that complexity comes at a cost. Credit or *z*-scores may, in fact, yield better estimates of synthetic ratings than those based only on interest coverage ratios, but changes in ratings arising from these scores are much more difficult to explain than those based on interest coverage ratios. That is the reason we prefer the flawed but more transparent ratings from interest coverage ratios.


ratings.xls: This spreadsheet allows you to estimate a synthetic rating for a firm.

In Practice: Debt Betas and Costs of Debt

Given our use of equity betas to compute the cost of equity, you may be wondering why we cannot use debt betas to compute the pre-tax cost of debt. In other words, instead of estimating a bond rating for a company and a default spread based upon the rating, why not estimate a beta for debt, by regressing bond returns against a market index, and use that beta in the capital asset pricing model to estimate the cost of debt. There are two reasons why we are reluctant to go down the road:

a. Non-traded debt: Even at large publicly traded companies, a significant portion of the debt is not traded, thus making it impossible to regress returns against a market index.
b. Asymmetric payoffs: Beta as a measure of risk draws on the mean-variance framework, which in turn assumes returns that are roughly symmetric, with upside risk offset by downside risk. When you lend to a firm, your risks tend to be asymmetric, with your best case scenario being that you get your promised interest and principal payments and your worst case scenarios containing far worse outcomes.

That is why we focus on downside risk, i.e. default risk, when assessing the cost of debt for a firm.

It is conceivable that debt begins to have more symmetric payoffs as it gets riskier and that debt betas may therefore make sense, if we are looking at low rated companies. It is unlikely that debt betas will be of much use in assessing the cost of debt for most other firms.

Short-Term and Long-Term Debt

Most publicly traded firms have multiple borrowings—short-term and long-term bonds and bank debt with different terms and interest rates. Although there are some analysts who create separate categories for each type of debt and attach a different cost to each category, this approach is both tedious and dangerous. Using it, we can conclude that short-term debt is cheaper than long-term debt and that secured debt is cheaper than unsecured debt.

The solution is simple. Combine all debt—short- and long-term, bank debt and bonds—and attach the long-term cost of debt to it. In other words, add the default spread to the long-term risk-free rate and use that rate as the pretax cost of debt. Firms will undoubtedly complain, arguing that their effective cost of debt is lowered by using short-term debt. This is technically true, largely because short-term rates tend to be lower than long-term rates in most developed markets, but it misses the point of computing the cost of debt and capital. If this is the hurdle rate we want our long-term investments to beat, we want the rate to reflect the cost of long-term borrowing and not short-term borrowing. After all, a firm that funds long-term projects with short-term debt will have to return to the market to roll over this debt.

Operating Leases and Other Fixed Commitments

The essential characteristic of debt is that it gives rise to a tax-deductible *obligation that firms have to meet in both good times and bad, and the failure to meet this obligation can result in bankruptcy or loss of equity control over the firm*. If we use this definition of debt, it is quite clear that what we see reported on the balance sheet as debt may not reflect the true borrowings of the firm. In particular, a firm that leases substantial assets and categorizes them as operating leases owes substantially more than is reported

in the financial statements.[47] After all, a firm that signs a lease commits to making the lease payment in future periods and risks the loss of assets if it fails to make the commitment.

For corporate financial analysis, we should treat all lease payments as financial expenses and convert future lease commitments into debt by discounting them back the present, using the current pretax cost of borrowing for the firm as the discount rate. The resulting present value can be considered the debt value of operating leases and can be added on to the value of conventional debt to arrive at a total debt figure. To complete the adjustment, the operating income of the firm will also have to be restated:

Adjusted Operating Income = Stated Operating Income + Operating Lease Expense for the Current Year – Depreciation on Leased Asset

To the extent that estimating depreciation on the leased asset can be tedious, an approximation can also be used:

Adjusted Operating Income = Stated Operating Income + PV of lease commitments * Pre-tax cost of debt

In effect, we are computing the imputed interest expense on the lease debt and adding it back to the stated operating income, since it is income before interest expenses. In fact, this process can be used to convert any set of financial commitments into debt.

To convert leases to debt, we need a listing of all lease commitments into the future that <u>have already been made</u>; this is required already in the US and is available for more and more non-US firms. We also need a <u>pre-tax cost of debt</u> to do the discounting. While this may be simple if the firm has a bond rating, it becomes more complicated if the firm is not rated. We can try to compute a synthetic rating but will run into a problem of circularity, since we need interest expenses to compute the rating but we need the rating to compute the present value of debt and the potential interest expenses from that debt. There are three solutions. One is to use the unadjusted interest coverage ratio, based

[47]In an operating lease, the lessor (or owner) transfers only the right to use the property to the lessee. At the end of the lease period, the lessee returns the property to the lessor. Because the lessee does not assume the risk of ownership, the lease expense is treated as an operating expense in the income statement, and the lease does not affect the balance sheet. In a capital lease, the lessee assumes some of the risks of ownership and enjoys some of the benefits. Consequently, the lease, when signed, is recognized both as an asset and as a liability (for the lease payments) on the balance sheet. The firm gets to claim depreciation each year on

upon the stated operating income and interest expenses, but we will over rate companies if we do so. The second is to treat the entire current year's lease expense as an interest expense, and compute an interest coverage ratio by adding the lease expense to both the stated operating income and interests expenses. This will generally result in ratings that are too low and a cost of debt that is too high. The third and preferred solution is to use an iterative process, where we compute the synthetic rating and the present value of debt simultaneously.[48]


oplease.xls: This spreadsheet allows you to convert operating lease commitments into debt and to adjust operating income and interest expenses.

Book and Market Interest Rates

When firms borrow money, they often do so at fixed rates. When they issue bonds to investors, this rate that is fixed at the time of the issue is called the coupon rate. The cost of debt is not the coupon rate on outstanding bonds, nor is it the rate at which the company was able to borrow at in the past. Although these factors may help determine the interest cost the company will have to pay in the current year, they do not determine the pretax cost of debt in the cost of capital calculations. Thus, a company that has debt that it took on when interest rates were low cannot contend that it has a low cost of debt.

To see why, consider a firm that has $2 billion of debt on its books and assume that the interest expense on this debt is $80 million. The book interest rate on the debt is 4 percent. Assume also that the current risk-free rate is 6 percent. If we use the book interest rate of 4 percent in our cost of capital calculations, we require the projects we fund with the capital to earn more than 4 percent to be considered good investments. Because we can invest that money in Treasury bonds and earn 6 percent, without taking any risk, this is clearly not a high enough hurdle. To ensure that projects earn more than what we can make on alternative investments of equivalent risk today, the cost of debt has to be based on market interest rates today rather than book interest rates.

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the asset and also deducts the interest expense component of the lease payment each year. In general, capital leases recognize expenses sooner than equivalent operating leases.

[48] This can be accomplished in Excel by checking the iteration box. The ratings spreadsheet that we referenced earlier does this.

Assessing the Tax Advantage of Debt

Interest is tax-deductible, and the resulting tax savings reduce the cost of borrowing to firms. In assessing this tax advantage, we should keep the following things in mind.

- Interest expenses offset the marginal dollar of income and the tax advantage has to be therefore calculated using the marginal tax rate.

  After-Tax Cost of Debt = Pretax Cost of Debt (1 – Marginal Tax Rate)

- To obtain the tax advantages of borrowing, firms have to be profitable. In other words, there is no tax advantage from interest expenses to a firm that has operating losses. It is true that firms can carry losses forward and can offset them against profits in future periods. The most prudent assessment of the tax effects of debt will therefore provide for no tax advantages in the years of operating losses and will begin adjusting for tax benefits only in future years when the firm is expected to have operating profits.

  After-tax Cost of Debt = Pretax Cost of Debt If Operating Income < 0

  Pretax Cost of Debt $(1 - t)$ If Operating Income > 0

Illustration 4.14: Estimating the Costs of Debt

Disney, Deutsche Bank, and Aracruz are all rated companies, and we will estimate their pretax costs of debt based on their ratings. To provide a contrast, we will also estimate synthetic ratings for Disney and Aracruz. For Tata Chemicals and Bookscape, we have to depend upon synthetic ratings for estimating the cost of debt.

- *Bond Ratings*: S&P, Moody's, and Fitch rate three of the five companies, but the ratings are consistent, and we will use the S&P ratings and the associated default spreads (from Table 4.24) to estimate the costs of debt in Table 4.25.

Table 4.25: Cost of Debt (based on actual rating

Company	S&P Rating	Risk-Free Rate	Default Spread	Cost of Debt	Tax Rate	After-Tax Cost of Debt
Disney	A	3.50% (US $)	2.50%	6.00%	38%	3.72%
Deutsche Bank	A+	3.60% (Euros)	2.25%	5.85%	29.50%	4.12%
Aracruz	BB	3.50% (US $)	5%	8.50%	34%	5.61%

The marginal tax rates of the United States (Disney), Brazil (Aracruz) and Germany (Deutsche Bank) are used to compute the after-tax cost of debt. We will assume that all of Disney's divisions have the same cost of debt and marginal tax rate as the parent company. To estimate Aracruz's nominal R$ cost of debt, we use the same inflation adjustment that we used for the cost of equity on the pre-tax dollar cost of debt:

$$\text{Cost of debt}_{R\$} = (1+\text{Cost of debt}_{US\$})\frac{(1+\text{Expected Inflation}_{R\$})}{(1+\text{Expected Inflation}_{US\$})} - 1$$

$$= (1.085)\ \frac{(1.07)}{(1.02)} - 1 = 13.82\%$$

- *Synthetic Ratings*: The synthetic ratings for the four non-financial service companies can be estimated using the interest coverage ratios and the look-up table (table 4.26).

Table 4.26: Interest coverage ratios and Synthetic ratings

Company	Operating income	Interest Expense	Interest coverage ratio	Synthetic rating
Disney	$6,819	$821	8.31	AA
Aracruz	R$ 574	R$ 155	3.70	BB+
Tata Chemicals	INR 6,263	INR 1,215	5.15	A-
Bookscape	$3,575	$575	6.22	A

For Bookscape, the A rating yields a default spread of 2.50%, which when added to the US dollar riskfree of 3.5%, yields a pre-tax cost of debt of 6%. Allowing for the tax benefits, we estimate an after-tax cost of debt of 3.60% for Bookscape:

$$\text{After-Tax Cost of Debt} = 6.0\%\ (1 - 0.40) = 3.60\%$$

For Tata Chemicals, things are a little more complicated. While the rating of A- for the company would result in a default spread of 3%, adding this default spread to the Indian rupee riskfree rate of 4% would miss a key component: the Indian government is perceived to be exposed to default risk and faces a default spread of 3% as a consequence. To estimate the pre-tax cost of debt for the firm, we will therefore add the default spreads for both the country and the company to the riskfree rate:

$$\text{Cost of debt}_{\text{Tata Chemcals}} = \text{Riskfree Rate}_{Rs} + \text{Default Spread}_{\text{India}} + \text{Default Spread}_{\text{Tata}}$$

$$= 4.00\% + 3.00\% + 3.00\% = 10.00\%$$

For Disney, we used the large market capitalization categorizations, resulting in a AA rating for the company, higher than the synthetic rating.

In Practice: Actual and Synthetic Ratings

It is usually easy to estimate the cost of debt for firms that have bond ratings available for them. There are, however, a few potential problems that sometimes arise in practice.

- *Disagreement between ratings agencies*: Although the ratings are consistent across agencies for many firms, there are a few firms over which the ratings agencies disagree with one agency assigning a much higher or lower rating to the firm than the others.
- *Multiple bond ratings for same firm*: Because ratings agencies rate bonds, rather than firms, the same firm can have many bond issues with different ratings depending on how the bond is structured and secured.
- *Lags or Errors in the Rating Process*: Ratings agencies make mistakes, and there is evidence that ratings changes occur after the bond market has already recognized the change in the default risk.

It is a good idea to estimate synthetic ratings even for firms that have actual ratings. If there is disagreement between ratings agencies or a firm has multiple bond ratings, the synthetic rating can operate as a tiebreaker. If there is a significant difference between actual and synthetic ratings, and there is no fundamental reason that can be pinpointed for the difference, the synthetic rating may be providing an early signal of a ratings agency mistake.

Consider the synthetic and actual ratings for Disney and Aracruz in the last illustration. We estimated a synthetic rating of AA for Disney, whereas the ratings agency assigned it a rating of A. The discrepancy can be traced to our use of the 2008 operating income as the basis for the synthetic rating. The ratings agencies might be looking at Disney's volatile earnings history and drawing a more conservative conclusion. With Aracruz, the synthetic rating we derive of BB+ is higher than the actual rating of BB, but note that the latter is really a composite rating that incorporates both company and country risk. In effect, the ratings agencies are assigning Aracruz a lower

rating because it is a Brazilian company.[49] With both companies, we will assume that the actual rating is a better estimate of default risk because it does draw on more information than the synthetic rating process.

Calculating the Cost of Preferred Stock

Preferred stock shares some of the characteristics of debt—the preferred dividend is prespecified at the time of the issue and is paid out before common dividend—and some of the characteristics of equity—the payments of preferred dividends are not tax-deductible. If preferred stock is viewed as perpetual, the cost of preferred stock can be written as follows:

k_{ps} = Preferred Dividend per Share/Market Price per Preferred Share

This approach assumes that the dividend is constant in dollar terms forever and that the preferred stock has no special features (convertibility, callability, etc.). If such special features exist, they will have to be valued separately to come up with a good estimate of the cost of preferred stock. In terms of risk, preferred stock is safer than common equity but riskier than debt. Consequently, it should, on a pretax basis, command a higher cost than debt and a lower cost than equity.

Illustration 4.15: Calculating the Cost of Preferred Stock: Disney and Deutsche Bank

None of the companies that we are analyzing have outstanding preferred stock in 2009. In 2004, however, both Disney and Deutsche Bank had preferred stock. The preferred dividend yields on the issues are computed in March 2004 in Table 4.27.

Table 4.27 Cost of Preferred Stock

Company	*Preferred Stock Price*	*Annual Dividends/Share*	*Dividend Yield*
Disney	$26.74	$ 1.75	1.75/26.74 = 6.54%
Deutsche Bank	103.75 Euros	6.60 Euros	6.6/103.75 = 6.36%

[49] Ratings agencies used to be even more explicit about this linkage. In fact, the rating for a company was constrained to be less than or equal to the rating of the country in which it was incorporated for a long period.

Notice that the cost of preferred stock for Disney would have been higher than its pretax cost of debt of 5.25 percent in May 2004, and lower than its cost of equity of 10 percent. For Deutsche Bank as well, the cost of preferred stock was higher than its pretax cost of debt (5.05 percent) and lower than its cost of equity of 8.76 percent, in May 2004. For both firms, the market value of preferred stock was so small relative to the market values of debt and equity that it makes almost no impact on the overall cost of capital.

4.10: Why Do Companies Issue Preferred Stock?

Which of the following are good reasons for a company issuing preferred stock?

a. Preferred stock is cheaper than equity.

b. Preferred stock is treated as equity by the ratings agencies and regulators.

c. Preferred stock is cheaper than debt.

d. Other:

Explain.

Calculating the Cost of Other Hybrid Securities

In general terms, *hybrid securities* share some of the characteristics of debt and some of the characteristics of equity. A good example is a convertible bond, which can be viewed as a combination of a straight bond (debt) and a conversion option (equity). Instead of trying to calculate the cost of these hybrid securities individually, they can be broken down into their debt and equity components and treated separately.

In general, it is not difficult to decompose a hybrid security that is publicly traded (and has a market price) into debt and equity components. In the case of a convertible bond, this can be accomplished in two ways:

- An option pricing model can be used to value the conversion option, and the remaining value of the bond can be attributed to debt.
- The convertible bond can be valued as if it were a straight bond, using the rate at which the firm can borrow in the market, given its default risk (pretax cost of debt) as the interest rate on the bond. The difference between the price of the convertible bond and the value of the straight bond can be viewed as the value of the conversion option.

If the convertible security is not traded, we have to value both the straight bond and the conversion options separately.

Illustration 4.16: Breaking Down a Convertible Bond into Debt and Equity Components: Disney

Convertible Debt: Debt that can be converted into stock at a specified rate, called the conversion ratio.

In March 2004, Disney had convertible bonds outstanding with nineteen years left to maturity and a coupon rate of 2.125 percent trading at $1,064 a bond. Holders of this bond have the right to convert the bond into 33.9444 shares of stock any time over the bond's remaining life.[50] To break the convertible bond into straight bond and conversion option components, we will value the bond using Disney's pretax cost of debt of 5.25 percent in 2004:[51]

Straight Bond Component

= Value of a 2.125% coupon bond due in 19 years with a market interest rate of 5.25%

= PV of $21.25 in coupons each year for 19 years[52] + PV of $1000 at end of year 19

$$= 21.25\left[\frac{1-(1.0525)^{-19}}{.0525}\right] + \frac{1000}{(1.0525)^{19}} = \$629.91$$

Conversion Option = Market Value of Convertible – Value of Straight Bond

= $1064 – $629.91 = $434.09

The straight bond component of $630 would have been treated as debt, whereas the conversion option of $434 would have been treated as equity. (Postscript: In 2009,

4.11: Increases in Stock Prices and Convertible Bonds

As stock prices go up, which of the following is likely to happen to the convertible bond (you can choose more than one)?

a. The convertible bond will increase in value.

b. The straight bond component of the convertible bond will decrease in value.

[50]At this conversion ratio, the price that investors would be paying for Disney shares would be $29.46, much higher than the stock price of $20.46 prevailing at the time of the analysis.

[51]This rate was based on a ten-year Treasury bond rate. If the five-year Treasury bond rate had been substantially different, we would have recomputed a pretax cost of debt by adding the default spread to the five-year rate.

[52]The coupons are assumed to be annual. With semi-annual coupons, you would divide the coupon by two and apply a semi-annual rate to calculate the present value.

c. The equity component of the convertible bond will increase as a percentage of the total value.
d. The straight bond component of the convertible bond will increase as a percentage of the total value.

Explain.

Calculating the Weights of Debt and Equity Components

Once we have costs for each of the different components of financing, all we need are weights on each component to arrive at a cost of capital. In this section, we consider the choices for weighting, the argument for using market value weights, and whether the weights can change over time.

Choices for Weighting

In computing weights for debt, equity, and preferred stock, we have two choices. We can take the accounting estimates of the value of each funding source from the balance sheet and compute book value weights. Alternatively, we can use or estimate market values for each component and compute weights based on relative market value. *As a general rule, the weights used in the cost of capital computation should be based on market values*. This is because the cost of capital is a forward-looking measure and captures the cost of raising new funds to finance projects. Because new debt and equity has to be raised in the market at prevailing prices, the market value weights are more relevant.

There are some analysts who continue to use book value weights and justify them using four arguments, none of which are convincing:

- *Book value is more reliable than market value because it is not as volatile*: Although it is true that book value does not change as much as market value, this is more a reflection of weakness than strength, because the true value of the firm changes over time as new information comes out about the firm and the overall

economy. We would argue that market value, with its volatility, is a much better reflection of true value than is book value.[53]

- *Using book value rather than market value is a more conservative approach to estimating debt ratios*. The book value of equity in most firms in developed markets is well below the value attached by the market, whereas the book value of debt is usually close to the market value of debt. Because the cost of equity is much higher than the cost of debt, the cost of capital calculated using book value ratios will be lower than those calculated using market value ratios, making them less conservative estimates, not more so.[54]
- *Because accounting returns are computed based on book value, consistency requires the use of book value in computing cost of capital:* Although it may seem consistent to use book values for both accounting return and cost of capital calculations, it does not make economic sense. The funds invested in these projects can be invested elsewhere, earning market rates, and the costs should therefore be computed at market rates and using market value weights.

Estimating Market Values

In a world where all funding was raised in financial markets and are securities were continuously traded, the market values of debt and equity should be easy to get. In practice, there are some financing components with no market values available, even for large publicly traded firms, and none of the financing components are traded in private firms.

The Market Value of Equity

The market value of equity is generally the number of shares outstanding times the current stock price. Because it measures the cost of raising funds today, it is not good

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[53]There are some who argue that stock prices are much more volatile than the underlying true value. Even if this argument is justified (and it has not conclusively been shown to be so), the difference between market value and true value is likely to be much smaller than the difference between book value and true value.

[54]To illustrate this point, assume that the market value debt ratio is 10 percent, and the book value debt ratio is 30 percent, for a firm with a cost of equity of 15 percent and an after-tax cost of debt of 5 percent. The cost of capital can be calculated as follows:

With market value debt ratios: 15% (0.9) + 5% (0.1) = 14%
With book value debt ratios: 15% (0.7) + 5% (0.3) = 12%

practice to use average stock prices over time or some other normalized version of the price.

- *Multiple Classes of Shares*: If there is more than one class of shares outstanding, the market values of all of these securities should be aggregated and treated as equity. Even if some of the classes of shares are not traded, market values have to be estimated for non-traded shares and added to the aggregate equity value.
- *Equity Options*: If there other equity claims in the firm—warrants and conversion options in other securities—these should also be valued and added on to the value of the equity in the firm. In the past decade, the use of options as management compensation has created complications, because the value of these options has to be estimated.

How do we estimate the value of equity for private businesses? We have two choices. One is to estimate the market value of equity by looking at the multiples of revenues and net income at which publicly traded firms trade. The other is to bypass the estimation process and use the market debt ratio of publicly traded firms as the debt ratio for private firms in the same business. This is the assumption we made for Bookscape, for whom we used the industry average debt to equity ratio for the book/publishing business as the debt to equity ratio for Bookscape.

The Market Value of Debt

The market value of debt is usually more difficult to obtain directly because very few firms have all of their debt in the form of bonds outstanding trading in the market. Many firms have nontraded debt, such as bank debt, which is specified in book value terms but not market value terms. To get around the problem, many analysts make the simplifying assumptions that the book value of debt is equal to its market value. Although this is not a bad assumption for mature companies in developed markets, it can be a mistake when interest rates and default spreads are volatile.

A simple way to convert book value debt into market value debt is to treat the entire debt on the books as a coupon bond, with a coupon set equal to the interest expenses on all of the debt and the maturity set equal to the face-value weighted average maturity of the debt, and to then value this coupon bond at the current cost of debt for the

company. Thus, the market value of $1 billion in debt, with interest expenses of $60 million and a maturity of six years, when the current cost of debt is 7.5 percent can be estimated as follows:

$$\text{Estimated Market Value of Debt} = 60\left[\frac{(1-\frac{1}{(1.075)^6}}{.075}\right] + \frac{1{,}000}{(1.075)^6} = \$930$$

This is an approximation; a more accurate computation would require valuing each debt issue separately using this process. As a final point, we should add the present value of operating lease commitments to this market value of debt to arrive at an aggregate value for debt in computing the cost of capital.

In Practice: Can Financing Weights Change over Time?

Using the current market values to obtain weights will yield a cost of capital for the current year. But can the weights attached to debt and equity and the resulting cost of capital change from year to year? Absolutely, and especially in the following scenarios:

- *Young firms*: Young firms often are all equity-funded largely because they do not have the cash flows (or earnings) to sustain debt. As they become larger, increasing earnings and cash flow usually allow for more borrowing. When analyzing firms early in their life cycle, we should allow for the fact that the debt ratio of the firm will probably increase over time toward the industry average.
- *Target debt ratios and changing financing mix*: Mature firms sometimes decide to change their financing strategies, pushing toward target debt ratios that are much higher or lower than current levels. When analyzing these firms, we should consider the expected changes as the firm moves from the current to the target debt ratio.

As a general rule, we should view the cost of capital as a year-specific number and change the inputs each year. Not only will the weights attached to debt and equity change over time, but so will the estimates of beta and the cost of debt. In fact, one of the advantages of using bottom-up betas is that the beta each year can be estimated as a function of the expected debt to equity ratio that year.

Illustration 4.17: Market Value and Book Value Debt Ratios: Disney and Aracruz

Disney has a number of debt issues on its books, with varying coupon rates and maturities. Table 4.28 summarizes Disney's outstanding debt, broken down by when the debt comes due; we treat the debt due in 2009 as due in 1 year, the debt due in 2010 as due in 2 years and so on. The debt due after 2013 is given a maturity of 10 years, based upon a perusal of the actual due dates on the long term debt.

Table 4.28 Debt at Disney: May 2009

Due in	Maturity	Amount due	% due
2009	1	$3,513	24.33%
2010	2	$1,074	7.44%
2011	3	$1,205	8.35%
2012	4	$1,479	10.24%
2013	5	$1,842	12.76%
Thereafter	10	$5,324	36.88%
Weighted Average	5.38 years	$14,437	

To convert the book value of debt to market value, we use the current pretax cost of debt for Disney of 6 percent as the discount rate, the face value of debt ($16,003 million) in May 2009 as the book value of debt and the current year's interest expenses of $728 million as the coupon payment:

$$\text{Estimated MV of Disney Debt} = 728\left[\frac{(1-\frac{1}{(1.06)^{5.38}}}{.06}\right] + \frac{16,003}{(1.06)^{5.38}} = \$14,962 \text{ million}$$

To this amount, we add the present value of Disney's operating lease commitments. This present value is computed by discounting the lease commitment each year at the pretax cost of debt for Disney (6 percent) in table 4.29:[55]

Table 4.29: Present Value of Operating Leases at Disney

Year	Commitment (in millions)	Present Value (in millions)
1	$392.00	$369.81
2	$351.00	$312.39
3	$305.00	$256.08

[55]Disney reports total commitments of $715 million beyond year six. Using the average commitment from years one through five as an indicator, we assumed that this total commitment would take the form of an annuity of $178.75 million a year for four years.

4	$265.00	$209.90
5	$198.00	$147.96
6–7	$309.50	$424.02
Debt value of leases =		$1,720.17

Adding the debt value of operating leases to the market value of debt of $14,962 million yields a total market value for debt of $ 16,682 million at Disney.

For Aracruz and Tata Chemicals, we use the book value of debt as a proxy for the market value of debt. For the former, this is because a significant portion of its debt is recent (and should therefore reflect current market interest rates and prices.). For the latter, a large portion of the debt is short term, which should ensure that the market value and book value of debt will converge. In Table 4.30 we contrast the book value debt ratios with the market value debt ratios for Disney, Aracruz and Tata Chemicals. The market value of equity is estimated using the current market price and the number of shares outstanding.

Table 4.30 Book Value versus Market Value: Debt Ratios

Company	Book D/E	Book Debt/Capital	Market D/E	Market Debt/Capital
Disney	49.01%	32.89%	36.91%	26.96%
Aracruz	1012.22%	91.01%	110.41%	52.47%
Tata Chemicals	75.83%	43.13%	51.56%	34.02%

For Disney, the market value debt ratio of 26.96% percent is lower than the book value debt ratio of 32.89 percent. That pattern is repeated for Aracruz and Tata Chemicals, with the difference being largest at Aracuz, where book value of equity recorded a significant write-down in 2008 (as a result of their trading losses in derivatives).

Estimating and Using the Cost of Capital

With the estimates of the costs of the individual components—debt, equity and preferred stock (if any)—and the market value weights of each of the components, the cost of capital can be computed. Thus if E, D, and PS are the market values of equity, debt, and preferred stock respectively, the cost of capital can be written as follows:

$$\text{Cost of Capital} = k_E [E/(D + E + PS)] + k_D[D/(D + E + PS)] + k_{PS} [PS/(D + E + PS)]$$

The cost of capital is a measure of the composite cost of raising money that a firm faces. It will generally be lower than the cost of equity, which is the cost of just equity funding.

It is a source of confusion to many analysts that both the cost of equity and the cost of capital are used as hurdle rates in investment analysis. The way to resolve this confusion is to recognize when it is appropriate to use each one.

- If we want to adopt the perspective of just the equity investors in a business or a project and measure the returns earned just by these investors on their investment, the cost of equity is the correct hurdle rate to use. In measuring the returns to equity investors then, we have to consider only the income or cash flows left over after all other claimholders needs (interest payments on debt and preferred dividends, for instance) have been met.
- If the returns that we are measuring are composite returns to all claimholders, based on earnings before payments to debt and preferred stockholders, the comparison should be to the cost of capital.

Although these principles are abstract, we will consider them in more detail in the next chapter when we look at examples of projects.

 wacc.xls: This data set online has the average cost of capital, by industry (sector), for the United States.

 *Hurdle Rates: A Behavioral Perspective*

Our discussion of cost of equity and capital has centered on a critical premise that the right hurdle rate for a firm should reflect the weighted average of the cost of financing the firm today. As a consequence, we used the current costs of debt and equity, updated to reflect today's riskfree rates and risk premiums, and weighted them based upon market values. But do managers subscribe to this approach? There is substantial evidence that some of them do not and the reasons may have more to do with behavioral considerations than financial arguments. Surveys of how firms set hurdle rates for investments indicate the following:

a. Book value versus Market value: Many firms continue to use book values for debt and equity to compute weights, rather than market values. One reason, stated or unstated, for this practice is that book debt ratios are more stable than market debt

ratios. This is almost a given since the market values (at least of equity) change continuously but the book values do not change until the next financial statement is put together. Intellectually, we can argue (as we have) that the stability of debt ratios is an illusion, but it is human nature to prefer stability to volatility.

b. Outsourcing risk premiums and betas: In the earlier parts of this chapter, we noted that it is common practice for firms to purchase estimates of equity risk premiums and betas for external sources, Ibbotson Associates for the former and Barra for the latter. While we believe that it is dangerous to outsource key components of the cost of capital to an outside source, it makes sense from a behavioral standpoint. Using external sources for data gives managers someone else to blame, if things go wrong, and thus deflects any criticism that they may have faced for bad decisions.

c. Hurdle rate not equal to cost of capital: In many firms, the hurdle rate that is used for assessing investments is not based upon the cost of capital. Instead, it is set at a value above or below the cost of capital and often reflects what the firm has earned on projects it has invested in the past.[56] Thus, a firm that has generated a 15% return on capital on past investments will use a hurdle rate of 15% for future investments, rather than its computed cost of capital. From a behavioral finance perspective, this practice does make sense since it reflects both anchoring (where managers start with the familiar, i.e., past returns, as their anchors for estimates) and availability biases (where they overweight recent project return experience too much).

So, how should managers set hurdle rates in a world that is composed of irrational investors? In a paper examining this question, Stein argues that firms that are focused on long term value maximization should continue to use the conventional cost of capital as the hurdle rate, with the proviso that betas reflect the true economic risk of the enterprise rather than returns over short time periods. However, if the objective is to maximize the current stock price, the hurdle rate used should not be the cost of capital but should be adjusted for whatever errors investors are making in assessing stock price; he suggests

[56] Driver, C. and P. Temple, 2009, Why do hurdle rates differ from the cost of capital? Cambridge Journal of Economics, 1-23. They compare the costs of capital and hurdle rates for 3000 business units at 450 companies that are part of the PIMS database and find that while 1425 units use hurdle rates that are roughly equal to their costs of capital, 505 units use hurdle rates less than the cost of capital and 452 use hurdle rates that are higher than their costs of capital.

using the price to book ratio as a proxy for this adjustment. This can lead to hurdle rates being lower than the cost of capital for some firms and higher for others.[57]

Illustration 4.18: Estimating Cost of Capital

Culminating the analysis in this chapter, we first estimate the costs of capital for each of Disney's divisions. In making these estimates, we use the costs of equity that we obtained for the divisions in Illustration 4.13 and Disney's cost of debt from Illustration 4.14. We also assume that all of the divisions are funded with the same mix of debt and equity as the parent company. Table 4.31 provides estimates of the costs of capital for the divisions:

Table 4.31 Cost of Capital for Disney's Divisions

Business	Cost of Equity	After-tax cost of debt	E/(D+E)	D/(D+E)	Cost of capital
Media Networks	8.61%	3.72%	75.00%	25.00%	7.39%
Parks and Resorts	8.20%	3.72%	64.68%	35.32%	6.62%
Studio Entertainment	13.53%	3.72%	68.64%	31.36%	10.45%
Consumer Products	10.86%	3.72%	80.84%	19.16%	9.49%
Disney	8.91%	3.72%	73.04%	26.96%	7.51%

The cost of capital for Disney's operating assets is 7.51 percent, but the costs of capital vary across divisions with a low of 6.62 percent for the parks and resorts division to a high or 10.45 percent for studio entertainment.

To estimate the cost of capital in U.S. dollars for Aracruz, we use the cost of equity of 20.82%,(from Illustration 4.13), the after-tax cost of debt of 5.61% (from Illustration 4.14) and the debt to capital ratio of 52.47% (estimated based upon the current market values of debt and equity):

$$\text{Cost of capital}_{\$} = 20.82\% \ (1-0.5247) + 5.61\% \ (0.5247) = 12.84\%$$

This dollar cost of capital can be converted into nominal $R cost of capital or a real cost of capital, by adjusting for inflation:

$$\text{Cost of capital}_{R\$} = (1+ \text{Cost of capital}_{\$}) \ \frac{(1+\text{Expected Inflation}_{R\$})}{(1+\text{Expected Inflation}_{US\ \$})} - 1$$

[57] Stein, J., 1996, 'Rational capital budgeting in an irrational world', *Journal of Business*, Vol. 69, pp. 429–55.

$$= 1.1284 \ \frac{(1.07)}{(1.02)} - 1 = 18.37\%$$

$$\text{Cost of capital}_{\text{Reak}} = (1 + \text{Cost of capital}_{\$}) \ \frac{1}{(1 + \text{Expected Inflation}_{\text{US \$}})} - 1$$

$$= 1.1284 \ \frac{1}{(1.02)} - 1 = 10.63\%$$

Note again that the only reason for the differences across the estimates of cost of capital is different expectations for inflation: 0% for real, 2% for US dollars and 7% for $R.

To estimate the cost of capital for Tata Chemicals, we look at its two businesses – fertilizers and chemicals – and use the estimates of cost of equity and debt obtained in earlier illustrations. Table 4.32 summarizes the estimates:

Table 4.32: Cost of capital- Tata Chemicals

Business	Cost of equity	Pre-tax cost of debt	After-tax cost of debt	D/(D+E)	Cost of capital
Fertilizers	14.14%	10.0%	6.60%	34.02%	11.58%
Chemicals	13.58%	10.0%	6.60%	34.02%	11.21%
Tata Chemicals	13.93%	10.0%	6.60%	34.02%	11.44%

We stayed with the assumption that we made earlier that the debt ratios of the two divisions would the same as the overall company.

When estimating the cost of equity for Bookscape, we assumed that the company would be funded using the same market debt to equity ratio as the book/publishing industry. Staying consistent, we will use the market debt to capital ratio of the sector to compute the cost of capital for the firm. We will also present two estimates of the cost of capital—one using the market beta and the other using the total beta – in table 4.33:

Table 4.33: Cost of capital for Bookscape- Market and Total Beta

	Cost of equity	Pre-tax Cost of debt	After-tax cost of debt	D/(D+E)	Cost of capital
Market Beta	11.60%	6.00%	3.60%	34.84%	8.81%
Total Beta	20.94%	6.00%	3.60%	34.84%	14.90%

The cost of capital estimated using the total beta is a more realistic estimate, given that this is a private company, and we will use it as the cost of capital for Bookscape in the coming chapters.

In Practice: Equity, Debt, and Cost of Capital for Banks

Note that we did not estimate a cost of capital for Deutsche Bank even though we have estimates of the costs of equity and debt for the firm. The reason is simple and goes to the heart of how firms view debt. For nonfinancial service firms, debt is a source of capital and is used to fund real projects—building a factory or making a movie. For banks, debt is raw material that is used to generate profits. Boiled down to its simplest elements, it is a bank's job to borrow money (debt) at a low rate and lend it out at a higher rate. It should come as no surprise that when banks (and their regulators) talk about capital, they mean equity capital.[58]

There is also a practical problem in computing the cost of capital for a bank. If we define debt as any fixed commitment where failure to meet the commitment can lead to loss of equity control, the deposits made by customers at bank branches would qualify and the debt ratio of a bank will very quickly converge on 100 percent. If we define it more narrowly, we still are faced with a problem of where to draw the line. A pragmatic compromise is to view only long-term bonds issued by a bank as debt, but it is an artificial one. Deutsche Bank, for instance, had long-term debt in December 2008 with a value of 143 billion Euros and common equity with a market value of 30 billion Euros. Using the cost of equity of 10.55 percent (from Illustration 4.13) and the after-tax cost of debt of 3.13 percent (from Illustration 4.14), we obtain a cost of capital:

$$\text{Cost of capital} = 10.55\% \ (30/173) + 4.12\%(143/173)$$
$$= 5.23\%$$

However, this number is tainted by the arbitrary definition of debt as only long term debt. With Deutsche Bank, we will do almost all of our analyses using the cost of equity rather than the cost of capital.

[58]All of the capital ratios that govern banks are stated in terms of book value of equity, though equity is defined broadly to include preferred stock.

Conclusion

This chapter explains the process of estimating discount rates, by relating them to the risk and return models described in the previous chapter:

- The cost of equity can be estimated using risk and return models—the CAPM, where risk is measured relative to a single market factor; the APM, where the cost of equity is determined by the sensitivity to multiple unspecified economic factors; or a multifactor model, where sensitivity to macroeconomic variables is used to measure risk.
    - In both these models, the key inputs are the risk-free rate, the risk premiums, and the beta (in the CAPM) or betas (in the APM). The last of these inputs is usually estimated using historical data on prices.
    - Although the betas are estimated using historical data, they are determined by the fundamental decisions that a firm makes on its business mix, operating, and financial leverage. Consequently, we can get much better estimates of betas by looking at sector averages and correcting for differences across firms.
- The cost of capital is a weighted average of the costs of the different components of financing, with the weights based on the market values of each component. The cost of debt is the market rate at which the firm can borrow long term, adjusted for any tax advantages of borrowing. The cost of preferred stock, on the other hand, is the preferred dividend.
- The cost of capital is the minimum acceptable hurdle rate that will be used to determine whether to invest in a project.

While we will use the cost of capital as our hurdle rate, when assessing investments, in the next two chapters, we are also aware that many firms use hurdle rates that are different from their costs of capital.

Live Case Study

Risk and Return: Analysis for the Firm

Objective: To develop a risk profile for your company, estimate its risk parameters and use these parameters to estimate costs of equity and capital for the firm.

Key Questions:

- What is the risk profile of your company? (How much overall risk is there in this firm? Where is this risk coming from (market, firm, industry or currency)? How is the risk profile changing?)
- What is the performance profile of an investment in this company? What return would you have earned investing in this company's stock? Would you have under or out performed the market? How much of the performance can be attributed to management?
- How risky is this company's equity? Why? What is its cost of equity?
- How risky is this company's debt? What is its cost of debt?
- What is the mix of debt and equity used by this firm to fund its investments?
- What is this company's current cost of capital?

Framework for Analysis:

1. *Estimating Historical Risk Parameters (Top Down Betas)*

   Run a regression of returns on your firm's stock against returns on a market index, preferably using monthly data and 5 years of observations (or)

   - What is the intercept of the regression? What does it tell you about the performance of this company's stock during the period of the regression?
   - What is the slope of the regression?
     - What does it tell you about the risk of the stock?
     - How precise is this estimate of risk? (Provide a range for the estimate.)
   - What portion of this firm's risk can be attributed to market factors? What portion to firm-specific factors? Why is this important?
   - How much of the "risk" for this firm is due to business factors? How much of it is due to financial leverage?

2. *Comparing to Sector Betas (Bottom up Betas)*

- Break down your firm by business components, and estimate a business beta for each component
- Attach reasonable weights to each component and estimate a unlevered beta for the business.
- Using the current leverage of the company, estimate a levered beta for each component.

3. *Choosing Between Betas*
    - Which of the betas that you have estimated for the firm (top down or bottom up) would you view as more reliable? Why?
    - Using the beta that you have chosen, estimate the expected return on an equity investment in this company to equity investors in the company?
    - As a manager in this firm, how would you use this expected return?
4. *Estimating Default Risk and Cost of Debt*
    - If your company is rated,
        - What is the most recent rating for the firm?
        - What is the default spread and interest rate associated with this rating?
        - If your company has bonds outstanding, estimate the yield to maturity on a long term bond? Why might this be different from the rate estimated in the last step?
        - What is the company's marginal tax rate?
    - If your company is not rated,
        - Does it have any recent borrowings? If yes, what interest rate did the company pay on these borrowing?
        - Can you estimate a "synthetic" rating? If yes, what interest rate would correspond to this rating?)
5. *Estimating Cost of Capital*
    - Weights for Debt and Equity
        - What is the market value of equity?
        - Estimate a market value for debt. (To do this you might have to collect information on the average maturity of the debt, the interest expenses in the most recent period and the book value of the debt)

    - What are the weights of debt and equity?
- *Cost of Capital*
    - What is the cost of capital for the firm?

Getting Information on Risk and Return

If you want to run a regression of stock returns against a market index to estimate a beta, you will need to estimate past returns for both the stock and index. Several data services provide access to the data. If you want a beta estimate for your firm, you can find it online or obtain it from a data service. If you want to estimate bottom-up betas, based upon comparable firms, you will first have to identify the businesses that your firm operates in (which should be available in the firm's 10-K), find comparable firms in each business and then estimate the average beta and debt to equity ratio for these firms.

You can find the rating for your company from the S&P and Moody publications that list all traded bonds and their ratings. Alternatively, you can estimate an interest coverage ratio and a synthetic rating.

Online sources of information:

http://www.stern.nyu.edu/~adamodar/cfin2E/project/data.htm

Problems and Questions

1. In December 1995, Boise Cascade's stock had a beta of 0.95. The Treasury bill rate at the time was 5.8 percent, and the Treasury bond rate was 6.4 percent. The firm had debt outstanding of $1.7 billion and a market value of equity of $1.5 billion; the corporate marginal tax rate was 36 percent.

a. Estimate the expected return on the stock for a short-term investor in the company.

b. Estimate the expected return on the stock for a long-term investor in the company.

c. Estimate the cost of equity for the company.

2. Boise Cascade also had debt outstanding of $1.7 billion and a market value of equity of $1.5 billion; the corporate marginal tax rate was 36 percent. <AQ: Question 2 is a repeat of the info for question 1. Couldn't parts a and be become d and e of question 1 instead? No new information introduced here. Leave as is>

a. Assuming that the current beta of 0.95 for the stock is a reasonable one, estimate the unlevered beta for the company.

b. How much of the risk in the company can be attributed to business risk and how much to financial leverage risk?

3. Biogen, a biotechnology firm, had a beta of 1.70 in 1995. It had no debt outstanding at the end of that year.

a. Estimate the cost of equity for Biogen, if the Treasury bond rate is 6.4 percent.

b. What effect will an increase in long-term bond rates to 7.5 percent have on Biogen's cost of equity?

c. How much of Biogen's risk can be attributed to business risk?

4. Genting Berhad is a Malaysian conglomerate with holdings in plantations and tourist resorts. The beta estimated for the firm, relative to the Malaysian stock exchange, is 1.15, and the long-term government borrowing rate in Malaysia is 11.5 percent.

a. Estimate the expected return on the stock.

b. If you were an international investor, what concerns (if any) would you have about using the beta estimated relative to the Malaysian index? If you do, how would you modify the beta?

5. You have just done a regression of monthly stock returns of HeavyTech, a manufacturer of heavy machinery, on monthly market returns over the past five years and come up with the following regression:

$$R_{HeavyTech} = 0.5\% + 1.2R_M$$

The variance of the stock is 50 percent, and the variance of the market is 20 percent. The current Treasure bill rate is 3 percent (it was 5 percent one year ago). The stock is currently selling for $50, down $4 over the past year, and has paid a dividend of $2 during the past year and expects to pay a dividend of $2.50 over the next year. The NYSE composite has gone down 8 percent over the past year, with a dividend yield of 3 percent. HeavyTech has a tax rate of 40 percent.

a. What is the expected return on HeavyTech over the next year?

b. What would you expect HeavyTech's price to be one year from today?

c. What would you have expected HeavyTech's stock returns to be over the past year?

d. What were the actual returns on HeavyTech over the past year?

e. HeavyTech has $100 million in equity and $5 million in debt. It plans to issue $50 million in new equity and retire $50 million in debt. Estimate the new beta.

6. Safecorp, which owns and operates grocery stores across the United States, currently has $50 million in debt and $100 million in equity outstanding. Its stock has a beta of 1.2. It is planning a leveraged buyout, where it will increase its debt/equity ratio of 8. If the tax rate is 40 percent, what will the beta of the equity in the firm be after the leveraged buyout?

7. Novell, which had a market value of equity of $2 billion and a beta of 1.50, announced that it was acquiring WordPerfect, which had a market value of equity of $1 billion and a beta of 1.30. Neither firm had any debt in its financial structure at the time of the acquisition, and the corporate tax rate was 40 percent.

a. Estimate the beta for Novell after the acquisition, assuming that the entire acquisition was financed with equity.

b. Assume that Novell had to borrow the $1 billion to acquire WordPerfect. Estimate the beta after the acquisition.

8. You are analyzing the beta for Hewlett Packard and have broken down the company into four broad business groups, with market values and betas for each group.

Business Group	*Market Value of Equity*	*Beta*

Mainframes	$2.0 billion	1.10
Personal computers	2.0 billion	1.50
Software	1.0 billion	2.00
Printers	3.0 billion	1.00

a. Estimate the beta for Hewlett Packard as a company. Is this beta going to be equal to the beta estimated by regressing past returns on their stock against a market index. Why or why not?

b. If the Treasury bond rate is 7.5 percent, estimate the cost of equity for Hewlett Packard. Estimate the cost of equity for each division. Which cost of equity would you use to value the printer division?

c. Assume that HP divests itself of the mainframe business and pays the cash out as a dividend. Estimate the beta for HP after the divestiture. (HP had $1 billion in debt outstanding.)

9. The following table summarizes the percentage changes in operating income, percentage changes in revenue ,and betas for four pharmaceutical firms.

Firm	*% Change in Rev*	*% Change in Operating In*	*Beta*
PharmaCorp	27%	25%	1.00
SynerCorp	25%	32%	1.15
BioMed	23%	36%	1.30
Safemed	21%	40%	1.40

a. Calculate the degree of operating leverage for each of these firms.

b. Use the operating leverage to explain why these firms have different betas.

10. A prominent beta estimation service reports the beta of Comcast Corporation, a major cable TV operator, to be 1.45. The service claims to use weekly returns on the stock over the prior five years and the NYSE composite as the market index to estimate betas. You replicate the regression using weekly returns over the same period and arrive at a beta estimate of 1.60. How would you reconcile the two estimates?

11. Battle Mountain is a mining company that mines gold, silver, and copper in mines in South America, Africa, and Australia. The beta for the stock is estimated to be 0.30. Given the volatility in commodity prices, how would you explain the low beta?

12. You have collected returns on AnaDone , a large diversified manufacturing firm, and the NYSE index for five years:

Year	*Returns (%) for AnaDone*	*Returns (%) for NYSE*
1981	10%	5%
1982	5%	15%
1983	–5%	8%
1984	20%	12%
1985	–5%	–5%

a. Estimate the intercept (alpha) and slope (beta) of the regression.
b. If you bought stock in AnaDone today, how much would you expect to make as a return over the next year? (The six-month Treasure bill rate is 6 percent.)
c. Looking back over the past five years, how would you evaluate AnaDone's performance relative to the market?
d. Assume now that you are an undiversified investor and that you have all of your money invested in AnaDone. What would be a good measure of the risk that you are taking on? How much of this risk would you be able to eliminate if you *diversify*?
e. AnaDone is planning to sell off one of its divisions. The division under consideration has assets which comprise half of the book value of AnaDone and 20 percent of the market value. Its beta is twice the average beta for AnaDone (before divestment). What will the beta of AnaDone be after divesting this division?

13. You run a regression of monthly returns of Mapco, an oil- and gas-producing firm, on the S&P 500 Index and come up with the following output for the period 1991 to 1995.

Intercept of the regression = 0.06%

X-coefficient of the regression = 0.46

Standard error of *X*-coefficient = 0.20

R^2 = 5%

There are 29.5 million shares outstanding, and the current market price is $53. The firm has $753 million in debt outstanding. (The firm has a tax rate of 36 percent.)

a. What would an investor in Mapco's stock require as a return, if the Treasure bond rate is 6 percent?
b. What proportion of this firm's risk is diversifiable?
c. Assume now that Mapco has three divisions, of equal size (in market value terms). It plans to divest itself of one of the divisions for $20 million in cash and acquire another for $50 million (it will borrow $30 million to complete this acquisition). The division it is divesting is in a business line where the average unlevered beta is 0.20, and the division it is acquiring is in a business line where the average unlevered beta is 0.80. What will the beta of Mapco be after this acquisition?

14. You have just run a regression of monthly returns of American Airlines (AMR) against the S&P 500 over the past five years. You have misplaced some of the output and are trying to derive it from what you have.

a. You know the R^2 of the regression is 0.36, and that your stock has a variance of 67 percent. The market variance is 12 percent . What is the beta of AMR?
b. You also remember that AMR was not a very good investment during the period of the regression and that it did worse than expected (after adjusting for risk) by 0.39 percent a month for the five years of the regression. During this period, the average risk-free rate was 4.84 percent. What was the intercept on the regression?
c. You are comparing AMR to another firm that also has an R^2 of 0.48. Will the two firms have the same beta? If not, why not?

15. You have run a regression of *monthly* returns on Amgen, a large biotechnology firm, against *monthly* returns on the S&P 500 Index, and come up with the following output:

$$R_{stock} = 3.28\% + 1.65\ R_{Market} \qquad R^2 = 0.20$$

The current one-year Treasury bill rate is 4.8 percent and the current thirty-year bond rate is 6.4 percent. The firm has 265 million shares outstanding, selling for $30 per share.

a. What is the expected return on this stock over the next year?
b. Would your expected return estimate change if the purpose was to get a discount rate to analyze a thirty-year capital budgeting project?

c. An analyst has estimated correctly that the stock did 51.10 percent better than expected annually during the period of the regression. Can you estimate the annualized risk-free rate that she used for her estimate?

d. The firm has a debt/equity ratio of 3 percent and faces a tax rate of 40 percent. It is planning to issue $2 billion in new debt and acquire a new business for that amount, with the same risk level as the firm's existing business. What will the beta be after the acquisition?

16. You have just run a regression of monthly returns on MAD, a newspaper and magazine publisher, against returns on the S&P 500, and arrived at the following result:

$$R_{MAD} = -0.05\% + 1.20\ R_{S\&P}$$

The regression has an R^2 of 22 percent. The current Treasure bill rate is 5.5 percent and the current Treasure bond rate is 6.5 percent. The risk-free rate during the period of the regression was 6 percent. Answer the following questions relating to the regression:

a. Based on the intercept, you can conclude that the stock did
   i. 0.05 percent worse than expected on a monthly basis, during the regression.
   ii. 0.05 percent better than expected on a monthly basis during the period of the regression.
   iii. 1.25 percent better than expected on a monthly basis during the period of the regression.
   iv. 1.25 percent worse than expected on a monthly basis during the period of the regression.
   v. None of the above.

b. You now realize that MAD went through a major restructuring at the end of last month (which was the last month of your regression), and made the following changes:
   - The firm sold off its magazine division, which had an unlevered beta of 0.6, for $20 million.
   - It borrowed an additional $20 million, and bought back stock worth $40 million.

After the sale of the division and the share repurchase, MAD had $40 million in debt and $120 million in equity outstanding. If the firm's tax rate is 40 percent, reestimate the beta after these changes.

17. Time Warner, the entertainment conglomerate, has a beta of 1.61. Part of the reason for the high beta is the debt left over from the leveraged buyout of Time by Warner in 1989, which amounted to $10 billion in 1995. The market value of equity at Time Warner in 1995 was also $10 billion. The marginal tax rate was 40 percent.

a. Estimate the unlevered beta for Time Warner.

b. Estimate the effect of reducing the debt ratio by 10 percent each year for the next two years on the beta of the stock.

18. Chrysler, the automotive manufacturer, had a beta of 1.05 in 1995. It had $13 billion in debt outstanding in that year and 355 million shares trading at $50 per share. The firm had a cash balance of $8 billion at the end of 1995. The marginal tax rate was 36 percent.

a. Estimate the unlevered beta of the firm.

b. Estimate the effect of paying out a special dividend of $5 billion on this unlevered beta.

c. Estimate the beta for Chrysler after the special dividend.

19. You are trying to estimate the beta of a private firm that manufactures home appliances. You have managed to obtain betas for publicly traded firms that also manufacture home appliances.

Firm	*Beta*	*Debt (in million*	*MV of Equi millions)*
Black & Decker	1.40	$2,500	$ 3,000
Fedders Corp.	1.20	$ 5	$ 200
Maytag Corp.	1.20	$ 540	$ 2250
National Presto	0.70	$ 8	$ 300
Whirlpool	1.50	$ 2900	$ 4000

The private firm has a debt equity ratio of 25 percent and faces a tax rate of 40 percent. The publicly traded firms all have marginal tax rates of 40 percent, as well.

a. Estimate the beta for the private firm.

b. What concerns, if any, would you have about using betas of comparable firms?

20. As the result of stockholder pressure, RJR Nabisco is considering spinning off its food division. You have been asked to estimate the beta for the division and decide to do so by obtaining the beta of comparable publicly traded firms. The average beta of comparable publicly

traded firms is 0.95, and the average debt/equity ratio of these firms is 35 percent. The division is expected to have a debt ratio of 25 percent. The marginal corporate tax rate is 36 percent.

a. What is the beta for the division?

b. Would it make any difference if you knew that RJR Nabisco had a much higher fixed cost structure than the comparable firms used here?

21. Southwestern Bell, a phone company, is considering expanding its operations into the media business. The beta for the company at the end of 1995 was 0.90, and the debt/equity ratio was 1. The media business is expected to be 30 percent of the overall firm value in 1999, and the average beta of comparable firms is 1.20; the average debt/equity ratio for these firms is 50 percent. The marginal corporate tax rate is 36 percent. <AQ: Should the dates in this question be updated?>

a. Estimate the beta for Southwestern Bell in 1999, assuming that it maintains its current debt/equity ratio.

b. Estimate the beta for Southwestern Bell in 1999, assuming that it decides to finance its media operations with a debt/equity ratio of 50 percent.

22. The chief financial officer of Adobe Systems, a software manufacturing firm, has approached you for some advice regarding the beta of his company. He subscribes to a service that estimates Adobe System's beta each year, and he has noticed that the beta estimates have gone down every year since 1991—2.35 in 1991 to 1.40 in 1995. He would like the answers to the following questions

a. Is this decline in beta unusual for a growing firm?

b. Why would the beta decline over time?

c. Is the beta likely to keep decreasing over time?

23. You are analyzing Tiffany's, an upscale retailer, and find that the regression estimate of the firm's beta is 0.75; the standard error for the beta estimate is 0.50. You also note that the average unlevered beta of comparable specialty retailing firms is 1.15.

a. If Tiffany's has a debt/equity ratio of 20 percent, estimate the beta for the company based on comparable firms. (The tax rate is 40 percent)

b. Estimate a range for the beta from the regression.

c. How would you reconcile the two estimates? Which one would you use in your analysis?