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Oceňování podniku

Katedra pravděpodobnosti a matematické statistiky

Vedoucí bakalářské práce: RNDr. Zbyněk Pawlas, Ph.D.
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Děkuji svým rodičům za podporu.
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Prohlašuji, že jsem svou bakalářskou práci napsal samostatně a výhradně s použitím citovaných pramenů. Souhlasím se zapůjčováním práce a jejím zveřejňováním.

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Abstrakt: Cílem práce je seznámit čtenáře se základními a nejpoužívanějšími nástroji pro ohodnocení akcií akciových společností. Druhá část práce se zabývá metodami odvození a odhadu parametrů použitých v modelech oceňování. Jsou prezentovány základní modely oceňování jako metoda současné hodnoty budoucích příjmů a relativní oceňování, které bere v úvahu tržní ceny srovnatelných firem. Na konci práce je praktický příklad ocenění společnosti Nokia. Práce má spíš informativní charakter a jejím cílem není prosadit konkrétní model, ale seznámit čtenáře se základními principy oceňování a poukázat na výhody a nevýhody uvedených modelů. Investor se nakonec neřídí pouze podle modelů oceňování, ale zaujme postoj i díky ostatním zdrojům informací, jako jsou média, výroční zprávy společností, zprávy analytiků, vyhlídky trhu atd.

Klíčová slova: oceňování, současná hodnota, růst, úroková míra

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Abstract: The aim of this work is to familiarize the reader with basic and widely used tools for valuing stocks of joint stock companies. The first part of the work deals with valuation models such as present value of expected cash flows and relative valuation, where we look at how comparable assets are priced on the market. The second part is concerned with methods of deriving and estimating parameters used in the models. At the end of this work, a numerical example (valuation of Nokia) is presented. The role of this work is educational and its objective is not to prefer one of the models to another one, but to show the rationales, examine the underlying assumptions, and to point out their advantages and disadvantages. After all, an investor does not make a decision based only on valuation models, but poses his or her attitude according to other sources of information such as media, annual reports, analyst reports, market perceptions, etc.

Keywords: valuation, present value, growth, interest rate

Introduction

Valuation in portfolio management, acquisition analysis and in corporate finance is examining approaches that can be used to value an asset. The base of this work is the idea that we are able to make reasonable estimates of value for most assets relying on certain fundamental and financial principles. The aim is to evaluate the investment to determine if its market price is consistent with our required return, that is to estimate the value of the security based on its expected cashflows and our required rate of return and rate of growth. These models that will be described relate value to the level of uncertainty and expected cashflows that an asset generates.

When making an investment decision, we tend to build up a model, which usually includes some mathematical expression. A model is an abstraction of the real world which relates to how people or things behave, therefore it must be descriptive. Some of the necessary stages involve the establishment of the objective or goals, and a review of expected performance. This involves the need for information concerning future. Then we construct a model. This model will predict the effects of measurements under certain conditions, e.g. it predicts a probability of reaching certain goals. Then the model must be critically tested whether it predicts efficiently. If the testing is satisfactory, we can use the model and its course of action which best satisfies the objectives. In overall, we choose the model which maximises our expected profit.

When we are valuing an asset at any point in time, we make forecasts for the future, and we have to make our best estimates using the information we have at the time of the valuation. So the matter is to determine the length of a firm's future high growth, growth in earnings and excess returns. An estimate of the expected returns from an investment includes not only size but also the form, time pattern, and the uncertainty of returns, which affect the required rate of return.

We undertake company analysis to identify the best company in a promising industry. This involves examining firm's past performance and its future prospects. After this we determine firm's value, then we compare this estimated intrinsic value to the firm's market price and decide whether its stocks are good investments. Finally, we select the best stock and include it in our portfolio based on its correlation with all other assets in the portfolio.

The role of valuation In a large part it entails the investment philosophy of the investor, and the decision making process. In fundamental analysis the true value of the firm is related to its financial characteristics - growth prospects, risk and cashflows. This is a long-term investment strategy, and the assumptions are that the relationship between value and the financial factors can be measured and is stable and that deviations from this relationship are corrected in a reasonable time period.

Sources of financial information We obtain information for financial analyses from various sources: financial statements (balance sheet, income statement), analyst reports, related disclosures of firm under analyses, news agencies, newspaper and magazine articles, internet. Other sources include industry experts, economic data, purchased data or customers' and competitors' financial reports.

The work is divided into two chapters and appendix. The first chapter defines individual models and the second concerns with estimation of inputs into these models. In the appendix, a short glossary appendix and numerical example can be found.

Chapter 1

Approaches to Valuation

In general, there are three approaches to valuation. First, discounted cash flow (DCF) valuation, relates the value of an asset to the present value of expected future cashflows on that asset. The second, relative valuation, estimates the value of an asset by looking at the price of comparable assets relative to common variable such as earnings, cashflows, book value or sales. The third, contingent claim valuation, uses option pricing models to measure the value of assets that share option characteristics. There can be significant differences in outcomes, depending upon which approach is used. In this work, we will focus on the DCF and the relative valuation.

Common stock valuation approaches

Discounted cash flow

- Present Value of Dividends (Dividend Discount Model)
- Present Value of Operating Cash Flow (Free cash flow to firm model)
- Present Value of Free Cash Flow (Free cash flow to equity model)

Relative valuation (Price Multiples)

- Price/Earnings Ratio (P/E)
- Price/Book Value (P/BV)
- Price/Sales Ratio (P/S)

1.1 Discounted Cash Flow Valuation

In DCF, the value of an asset is the present value of the expected cashflows on the asset, discounted back at a rate that reflects the riskiness of these cashflows:

$$\text{Value of stock} = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t}.$$

Assets with high and predicable cashflows should have higher values than assets with low and volatile cashflows. These cashflows are usually dividends for stocks, coupons, etc., depending on the asset. The discount rate is higher for riskier assets and lower for safer.

There are two ways to approach DCF. First is to value the entire business, that is firm valuation. The second way is to value the equity stake in the business, this is equity valuation.

The value of equity is obtained by discounting expected cashflows to equity. The cashflows after debt payments and reinvestment needs are called free cashflows to the equity and the discount rate reflects just the cost of equity financing and is called the cost of equity. The value of equity must be the same if we are valuing the firm and subtracting the value of all non-equity claims:

$$\text{Value of equity} = \sum_{t=1}^{\infty} \frac{CF_{equity\ t}}{(1+k_e)^t}.$$

The dividend discount model is a specialized case of equity valuation, where the value of the equity is the present value of expected future dividends. This is the most straightforward measure of cash flow because they go clearly to the investor. However, this dividend technique is difficult to apply to firms that do not pay dividends, on the other hand, the dividend discount model (DDM) is very useful when we value stable and mature company where the assumption of relatively constant growth for the long term is appropriate.

The value of the firm is obtained by discounting expected cashflows to the firm. The cashflows before debt payments and after reinvestment needs are called free cashflows to the firm and the discount rate that reflects the cost of financing from all sources of capital, weighted by their market value proportions is called the weighted average cost of capital (WACC):

$$\text{Value of the firm} = \sum_{t=1}^{\infty} \frac{CF_{firm\ t}}{(1+\text{WACC})^t}.$$

This is a useful model when comparing firms with diverse capital structures.

The key error to avoid is mismatching cashflows and discount rates, since discounting cashflows to equity at the cost of capital will lead to an upwardly biased estimate of the value of equity, and vice versa.

Inputs to DCF There are three inputs required to value an asset: the expected cashflow, the timing of the cashflow and the appropriate discount rate. The risk in an investment that should determine discount rates is the market risk of that investment. The expected return on any investment can be obtained starting with the expected return on riskless investment, and adding to it a premium to reflect the amount of market risk in that investment. This expected return yields the cost of equity.

The use and the limitations of DCF DCF valuation is the easiest to use for firms whose cashflows are currently positive and can be estimated with some reliability for future periods, and where the measurement of the risk to obtain discount rates is available.

1.1.1 The Dividend Discount Model (DDM)

The dividend discount model assumes that the value of a share of a common stock is the present value of expected future dividends:

$$\text{Value of stock} = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t},$$

where D_t is dividend during period t and k is the required rate of return for stock. To obtain the expected dividends, we make assumptions about expected future growth rates in earnings and payout ratios. The required rate of return on a stock is determined by its riskiness. If the stock is not held for an infinite period, e.g. we will sell the stock at the end of year 3, it implies the formula:

$$\text{Value} = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \frac{SP_2}{(1+k)^2},$$

the value is equal to the dividend payments during first three years plus the sale price (SP) at the end of year 2. The present value of the expected selling price of the stock at the end of year 2 is the value of all remaining dividend payments discounted back to the present by $1/(1+k)^2$:

$$\text{PV(SP)}_2 = \frac{\frac{D_3}{(1+k)} + \frac{D_4}{(1+k)^2} + \dots}{(1+k)^2} = \sum_{t=3}^{\infty} \frac{D_t}{(1+k)^t},$$

when the stock is sold, its value (the sale price) is the present value of all future dividends. When we discount it to present, we get the DDM. If we have stock that does not pay any dividend, we normally expect that at some point firm will start paying dividends:

$$\text{Value} = \sum_{t=1}^{\infty} \frac{D_1}{(1+k)^t}, \text{ where } D_1 = 0 \text{ and } D_2 = 0.$$

The investor expects that when the firm starts paying dividends, it will be a large initial amount and dividends will grow faster than those of a comparable stock that had paid out dividends. The stock has value because of these future dividends. If we are about to hold the stock for several years and then sell it, we must forecast several future dividend payments and estimate the sale price of the stock several years in the future. To estimate future dividends, we look for earnings growth because earnings are the source of dividends, and for the firm's dividend policy. A firm can have a constant percent payout of earnings each year, which implies a change in dividend each year, or the firm can increase the dividend rate by a constant amount each or every two or three years. The easiest dividend policy to analyze is the one where the firm has a constant growth rate in earnings and maintains a constant dividend payout. The next estimate is the expected sale price for the stock several years in the future and the final estimate is the required rate of return on this stock during this period.

We can now extend the multiperiod model by extending our estimates of dividends into more distant future (5, 10, 20, years, ...). We will use the infinite period DDM, which assumes that investors estimate future dividends for an infinite number of periods. For simplicity, we assume that the future dividend stream will grow at a constant rate for an infinite period. We also assume that the required rate of return is greater than the infinite growth rate:

$$\text{Value} = \frac{D_0(1+g)}{(1+k)} + \frac{D_0(1+g)^2}{(1+k)^2} + \ldots + \frac{D_0(1+g)^n}{(1+k)^n}.$$

Multiplying both sides by $\left[\frac{1+k}{1+g} - 1\right]$ we obtain

$$\left[\frac{1+k}{1+g} - 1\right] \text{Value} = D_0 \left[1 - \frac{(1+g)^n}{(1+k)^n}\right].$$

As $n \to \infty$ and $k > g$ it leaves us $\left[\frac{k-g}{1+g}\right] \text{Value} = D_0$.

To use this model for valuation we must estimate the required rate of return (k) and the expected growth rate of dividends (g). Then D_1 equals $D_0(1+g)$ and Value $= \frac{D_1}{k-g}$. This specific DDM is sometimes referred to as *Gordon Growth Model.* The Gordon growth model is best suited for firms growing at a rate comparable to or lower than the nominal growth in the economy and which have well established stable dividend payout policies that they intend to continue into the future.

Supernormal growth Some firms experience periods of abnormally high rates of growth for some finite periods of time, but a company cannot pernamently maintain a growth rate higher than its required rate of return because competition will eventually enter this moneymaking business, which will reduce the firm's profit margins, and its return on equity (ROE) and growth rate. Therefore, after a few years of exceptional growth, a firm's growth rate is expected to decline. Its growth rate is expected to stabilize at a constant level consistent with the assumptions of the infinite period DDM. The difficult part is estimating the supernormal growth rates and determining how long each growth rates will last. This is called two-stage growth model:

$$\begin{aligned} \text{Value of the Stock} &= \text{PV of Dividends during extraordinary phase} + \\ &\quad \text{PV of terminal price,} \\ P_0 &= \sum_{t=1}^{n} \frac{DPS_t}{(1 + k_{e\ high\ growth})^t} + \frac{P_n}{(1 + k_{e\ high\ growth})^n}, \end{aligned}$$

where

$$P_n = \frac{DPS_{n+1}}{(k_{e\ stable\ growth} - g_n)},$$

and DPS_t = Expected dividends per share in year t, k_e = cost of equity, P_n = Price (terminal value) at the end of year n and g_n = Steady growth rate forever after year n. To obtain terminal value, we calculate the payout ratio. Expected growth rate can be obtained e.g. as g = (RR)(ROE) (see below) and then stable payout ratio=(stable growth rate)/(stable period return on equity).

Sometimes, a company's period of fast growth can be followed by a period of diminishing growth rates followed by a period of constant growth, this is usually called three-stage growth model.

1.1.2 Present Value of Free Cash Flows to Equity (FCFE)

Free cash flows to equity are derived after operating cash flows have been adjusted for debt payments (interest and principle) and after deducting capital expenditures necessary to maintain the firm's asset base:

FCFE = Net Income - (Capital Expenditures - Depreciation) - Δ in Non-Cash Working Capital + New Debt Issues - Principal Debt Repayments.

These cash flows precede dividend payments to the common stockholder. They are 'free' because they are what is left after meeting all obligations to other capital suppliers (debt and preferred stock) and after providing the funds needed to maintain the firm's asset base. These cash flows are then available to equity owners, so the discount rate used is the firm's cost of equity (k):

$$\text{Value} = \sum_{t=1}^{n} \frac{FCFE_t}{(1+k)^t}.$$

Again, we look at the firm's position in its life cycle, and decide how to implement this model. That is, if the firm is expected to experience a stable growth, we can use infinite growth model. In contrast, if the firm is expected to experience a period of temporary supernormal growth, we should use the multistage growth model similar to the process used with dividends and for operating cash flow.

Comparing Dividends to Free Cash Flows to Equity The dividend payout ratio measures the value of dividends as a proportion of earnings. FCFE ratio measures the total cash returned to stockholders as a proportion of the free cash flow to equity:

$$\text{Cash to Stockholders to FCFE Ratio} = \frac{\text{Dividends + equity repurchases}}{\text{FCFE}}.$$

The ratio of cash to FCFE to the stockholders shows how much of the cash available to be paid out to stockholders is actually returned to them in the form of dividends and stock buybacks. If it is significantly less than 1, the firm is paying out less than it can afford to and is using the difference to increase its cash balance.

If we use the dividend discount model and do not allow for the build-up of cash that occurs when firms pay out less than they can afford, we will underestimate the value of equity in firms. Therefore, the free cash flow to equity model represents a model where we discount potential dividends rather than actual dividends. We are then assuming that the FCFE will be paid out to stockholders.

1.1.3 Present Value of Free Cash Flow to the Firm (FCFF)

In this model we derive the value of the total firm because we are discounting the total operating cash flows before the payment of interest to the debt holders. The free cashflow to the firm is the sum of the cashflows to all claim holders in the firm, including stockholders, bondholders and preferred stockholders:

$$\text{FCFF} = \text{EBIT (1 - Tax Rate) + Depreciation Expense - Capital Expenditures - } \Delta \text{ in Working Capital - } \Delta \text{ in other assets.}$$

This is the cash flow generated by a company's operations and available to all who have provided capital to the firm - both equity and debt. We use the firm's WACC as our discount rate because we are discounting the total firm's operating cashflow. Once we estimate the value of the total firm, we subtract the value of debt to return in the value of firm's equity:

$$\text{Value}_{\text{firm}} = \sum_{t=1}^{\infty} \frac{\text{FCFF}_t}{(1+\text{WACC})^t}$$

adapting infinite period constant growth DDM model:

$$\text{Value}_{\text{firm}} = \frac{\text{FCFF}_1}{\text{WACC} - g_{\text{FCFF}}}, \text{ where } \text{FCFF}_1 = \text{FCFF}_0(1 + g_{\text{FCFF}}).$$

Again, after determining the value of the total firm, we subtract the value of all nonequity items, including accounts payable, total interest-bearing debt, deferred taxes, and preferred stock, to arrive at the estimated value of the firm's equity.

1.2 Relative Valuation

In relative valuation, we value an asset by looking at how the market prices similar assets. Investors often decide whether a stock is undervalued or overvalued by comparing its pricing to that of similar stocks. Here, the comparable firm is a firm that has the assets with similar cashflows, risk and growth potential. This entails other companies that are in the same business as the company being valued. When we value stocks this translates into using multiples where we divide the market value by earnings, book value or revenues to arrive at an estimate value. Then we can compare these numbers across companies.

The most common is the use of an industry-average price-earnings (P/E) ratio to value a firm. This assumes that the other firms in the industry are comparable to the firm being valued and that the market prices these firms correctly. Another multiple widely used is the price-to-book value ratio (P/BV), with firms selling at a discount on book value, relative to comparable firms, being considered undervalued. The price-to-sales multiple (P/S) is also used to value firms, with the average price-sales ratios of firms with similar characteristics being used for comparison.

After we construct our list of comparable companies, they are never the same from the firm we are valuing, therefore, we are usually trying to control these differences. One way is to modify the multiple by another variable which can be identified by looking at how multiples are different across firms in a sector or across the entire market. In example, the P/E ratio is divided by the expected growth rate in earnings per share (EPS) for a company to determine a growth-adjusted PE ratio or the PEG ratio. Similarly, the PBV ratio is divided by the ROE to find a Value Ratio and the price sales ratio is divided by the net margin. These modified ratios are then compared across companies in a sector.

1.2.1 Earnings Multiplier Model

Earnings multiples remain the most commonly used measures of relative value. Again, we return to the basic concept that the value of any investment is the present value of future returns. In the case of common stocks, the returns are the net earnings of the firm:

$$\text{Earnings multiplier} = \frac{\text{Current Market Price}}{\text{Expected 12-Month Earnings}}.$$

Investors must decide if they agree with the prevailing P/E ratio based upon how it compares to the P/E ratio of the aggregate market, for the firm's industry, and for similar firms and stocks. We must consider what influences the earnings multiplier over time. The infinite period DDM can be used to indicate the variables that should determine the value of the P/E ratio:

$$P = \frac{D_1}{k-g}$$

dividing both sides by the expected earnings during the next 12 months (E_1)

$$\frac{P}{E_1} = \frac{\frac{D_1}{E_1}}{k-g}$$

therefore, P/E ratio is determined by the expected dividend payout ratio (long-run target payout, typically stable), the estimated required rate of return on the stock (k) and the expected growth rate of dividends for the stock (g). The P/E ratio is an increasing function of the payout ratio and the growth rate and a decreasing function of the riskiness of the firm.

We can easily derive other multiples from P/E ratio. We know that $D_1 = D_0(1+g)$ thus we can write

$$\frac{P}{E_0} = \frac{\text{Payout Ratio} \times (1+g)}{k-g}.$$

Also, dividing both sides of this equation by the book value of equity, we estimate the price/book value ratio for a stable growth firm

$$\frac{P}{BV_0} = \frac{\text{ROE} \times \text{Payout ratio} \times (1+g)}{k-g}.$$

Dividing by the sales per share, the price/sales can be estimated as a function of its profit margin, payout ratio, risk and expected growth

$$\frac{P}{S_0} = \frac{\text{Profit Margin} \times \text{Payout Ratio} \times (1+g)}{k-g}.$$

P/E and DCF model relationship Above we derived the P/E ratio for a stable growth firm from the stable growth dividend discount model. The payout ratio can also be written as a function of the expected growth rate and return on equity

$$\text{Payout Ratio} = 1 - \frac{\text{Expected growth rate}}{\text{Return on equity}} = 1 - \frac{g}{\text{ROE}}$$

Substituting back into the equation above,

$$\frac{P}{E_1} = \text{forward } P/E = \frac{1 - \frac{g}{\text{ROE}}}{k-g}$$

In the special case of the two-stage dividend discount model, when a firm is expected to be in high growth for the next n years and stable growth after, we can write the DDM as follows:

$$\frac{P_0}{\text{EPS}_0} = \frac{(\text{Payout ratio})(1+g)\left(1 - \frac{(1+g)^n}{(1+k_{e\ growth})^n}\right)}{k_{e\ growth} - g} + \frac{(\text{Payout Ratio}_n)(1+g)^n(1+g_n)}{(k_{e\ stable} - g_n)(1+k_{e\ growth})},$$

where EPS_0 = Earnings per share in current year, Payout ratio= Payout ratio in the first n years, g_n = Growth rate after n years forever (Stable growth rate), Payout Ratio_n = Payout ratio after n years for the stable firm. Substituting in the fundamental equation for payout ratios we obtain:

$$\frac{P_0}{\text{EPS}_0} = \frac{(1 - \frac{g}{\text{ROE}_{growth}})(1+g)\left(1 - \frac{(1+g)^n}{(1+k_{e\ growth})^n}\right)}{k_{e\ growth} - g} + \frac{\left(1 - \frac{g_n}{\text{ROE}_{stable}}\right)(1+g)^n(1+g_n)}{(k_{e\ stable} - g_n)(1+k_{e\ growth})}.$$

Therefore, the price-earnings ratio is determined by Payout ratio (and return on equity) during the high growth period and in the stable period, Riskiness (through the discount rate k_e), and Expected growth rate in earnings, in both the high growth and stable phases. The ratio of FCFE to earnings can be substituted for the payout ratio for firms that pay much less in dividends than they can afford to.

Comparing a Market's P/E ratio across *Time* – analysts often compare the market's P/E ratio to its historical average to make judgments about whether the market is undervalued or overvalued. *Countries* – this can be misleading because countries usually have different real interest rates, expected real growth, etc. which explains different P/E ratios. *Markets* – this is a broader comparison of P/E ratios across countries. We usually regress P/E ratio on interest rates and expected growth yields to determine which stocks are undervalued. *Firms in a sector* – we choose a group of comparable firms, calculate its average PE ratio and adjust this average for differences between the firm being valued and the comparable firms.

The PEG ratio Analysts sometimes compare P/E ratios to the expected growth rate to identify undervalued and overvalued stocks. Firms with P/E ratios less than their expected growth rate are viewed as undervalued. This can be a way to control the differences in growth across firms:

$$\text{PEG Ratio} = \frac{P/E \text{ Ratio}}{\text{Expected growth rate}}$$

The PEG ratio should be estimated using the same growth estimates for all firms in the sample.

1.2.2 The Price/Book Value Ratio

The market value of the equity in a firm reflects the market's expectation of the firm's earning power and cashflows. The book value of equity is the difference between the book value of assets and the book value of liabilities. The book value provides a relatively stable measure of value that can be compared to the market price. P/BV ratio gained in popularity and credibility as relative valuation technique after one study indicated an inverse relationship between P/BV ratios and excess rate of return for a cross section of stocks:

$$\frac{P}{BV} = \frac{P_t}{BV_{t+1}},$$

where P_t is the price of the stock in period t and BV_{t+1} is the estimated end-of-year book value per share. As with other multiples, we match the current price with the estimated book value that is expected to prevail at the end of the year. We can derive an estimate of this future book value based upon the historical growth rate for the series or use the growth rate implied by the sustainable growth formula: g = (ROE)(Retention Rate).

The price-book value ratio can be related to the same fundamentals that determine value in discounted cashflow models. In a stable growth DDM we will substitute dividends per share by EPS times the payout ratio:

$$P_0 = \frac{(\text{EPS}_1)(\text{Payout ratio})}{r - g}.$$

Defining the return on equity (ROE) $= \frac{\text{EPS}_1}{BV_0}$, the P/BV ratio is

$$\frac{P_0}{BV_0} = \frac{(\text{ROE})(\text{Payout ratio})}{r - g}.$$

The PBV ratio is an increasing function of the return on equity, the payout ratio and the growth rate and a decreasing function of the riskiness of the firm.

PBV Ratio for a high growth firm In the case of the two-stage dividend discount model the value of equity of a high growth firm is:

$$P_0 = \frac{(\text{EPS}_0)(\text{Payout Ratio})(1+g)\left(1 - \frac{(1+g)^n}{(1+k_{e\ growth})^n}\right)}{k_{e\ growth} - g} + \frac{(\text{EPS}_0)(\text{Payout Ratio}_n)(1+g)^n(1+g_n)}{(k_{e\ stable} - g_n)(1+k_{e\ growth})}.$$

Rewriting EPS_0 in terms of the return on equity, $\text{EPS}_0 = (BV_0)(\text{ROE})$, and dividing by BV_0 we get:

$$\frac{P_0}{BV_0} = (\text{ROE}_{growth})\frac{(\text{Payout Ratio})(1+g)\left(1 - \frac{(1+g)^n}{(1+k_{e\ growth})^n}\right)}{k_{egrowth} - g} +$$

$$(\text{ROE}_{stable})\frac{(\text{Payout Ratio}_n)(1+g)^n(1+g_n)}{(k_{e\ stable}-g_n)(1+k_{e\ growth})},$$

where ROE is the return on equity and k_e is the cost of equity. Therefore P/BV ratio is determined by return on equity, payout ratio during the high growth period and in the stable period, riskiness (through the discount rate r), and growth rate in earnings, in both the high growth and stable phases.

Again, in the case of FCFE, the only substitution is the replacement of the payout ratio by the FCFE as a percent of earnings:

$$\frac{P_0}{BV_0} = (\text{ROE}_{growth})\frac{\left(\frac{\text{FCFE}}{\text{Earnings}}\right)_{growth}(1+g)\left(1-\frac{(1+g)^n}{(1+k_{e\ growth})^n}\right)}{k_{e\ growth}-g} + (\text{ROE}_{stable})\frac{\left(\frac{\text{FCFE}}{\text{Earnings}}\right)(1+g)^n(1+g_n)}{(k_{e\ stable}-g_n)(1+k_{e\ growth})}.$$

In the market, we normally expect the P/BV ratio for a market to increase as the equity return spread (ROE − Cost of equity) earned by firms in the market increases. We can see that besides expected payout ratio, expected growth rate in earnings and riskiness, the P/BV ratio is largely determined by return on equity. Attention has to be paid between return on equity and P/BV ratios (high price/book value ratios with low returns on equity (overvalued) and low price/book value ratios with high returns on equity (undervalued).

1.2.3 The Price/Sales Ratio

This revenue multiple measures the value of the equity or a business relative to the revenues that it generates. The P/S ratio starts from the idea that strong and consistent sales growth is a requirement for a growth company. Although, some investors note the importance of above-average profit margin, they agree that the growth process must begin with sales. Second, sales information is subject to less manipulation than any other data item:

$$\frac{P}{S} = \frac{P_t}{S_{t+1}},$$

where P_t is the price for the stock in period t and S_{t+1} are the expected sales per share. Again, it is important to match the current price with the firm's expected sales per share, which may be difficult to derive for a large cross section of stocks.

The price to sales ratio for a stable firm can be extracted from a stable growth DDM:

$$P_0 = \frac{(\text{EPS}_0)(\text{Payout Ratio})(1+g)}{r-g},$$

defining net profit margin = $\frac{\text{EPS}_0}{\text{Sales per share}}$ we get the P/S ratio as follows:

$$\frac{P_0}{S_0} = \frac{(\text{Net Margin})(\text{Payout Ratio})(1+g)}{r-g}.$$

The P/S ratio is an increasing function of the profit margin, the payout ratio and the growth rate and a decreasing function of the riskiness of the firm. In the case of the two-stage dividend discount model, we obtain:

$$P_0 = \frac{(\text{EPS}_0)(\text{Payout Ratio})(1+g)\left(1-\frac{(1+g)^n}{(1+k_{e\ growth})^n}\right)}{k_{e\ growth}-g} + \frac{(\text{EPS}_0)(\text{Payout Ratio}_n)(1+g)^n(1+g_n)}{(k_{e\ stable}-g_n)(1+k_{e\ growth})},$$

Rewriting EPS_0 in terms of the profit margin, $\text{EPS}_0 = (\text{Sales}_0)(\text{Net Margin})$ and dividing both sides of the equation by sales we get

$$\frac{P_0}{S_0} = (\text{Net Margin})\left(\frac{(\text{Payout Ratio})(1+g)\left(1-\frac{(1+g)^n}{(1+k_{e\ growth})^n}\right)}{k_{e\ growth}-g} + \frac{(\text{Payout Ratio}_n)(1+g)^n(1+g_n)}{(k_{e\ stable}-g_n)(1+k_{e\ growth})}\right).$$

The price-sales ratio is determined by Net Profit Margin (Net Income / Revenues), payout ratio during the high growth period and in the stable period, different riskiness in the high growth and the stable period, expected growth rate in earnings, in both the high growth and stable phases. Analogically, we can substitute in the FCFE for the dividends for firms that pay out dividends that are lower than they can afford.

The determinants of the revenue multiples of a firm are its expected net profit margin, risk, cashflow and growth characteristics. Firms with high revenue ratios and low profit margins as well as firms with low revenue ratios and high profit margins should attract investors' attention as potentially overvalued and undervalued securities, respectively. The P/S ratio is widely used to value technology firms and to compare value across these firms.

The use and the limitations of the prise multiples Relative valuation approach provides information on how the market is currently valuing stock. With multiples, we can quickly and easily obtain value for firms and assets and they are useful when the market is pricing comparable firms correctly. The definition of comparable is very subjective, though, as no two firms are exactly same in terms of risk and growth.

Chapter 2

Estimating The Inputs

2.1 The Required Rate of Return

Three factors influence an investor's required rate of return. The economy's real risk-free rate (RRFR), the expected rate of inflation $E(I)$, and a risk premium (RP). The economy's real risk-free rate is the minimum rate that an investor should require. It depends on the real growth rate of economy because capital invested should grow at least as fast as the economy. This rate can be affected for short periods of time by capital markets. The expected rate of inflation increases the required nominal risk-free rate of return (NRFR), because investors are interested in real rates of return which allows them to increase their rate of consumption:

$$\mathrm{NRFR} = [1 + \mathrm{RRFR}]\,[1 + E(I)] - 1,$$

where $E(I)$ is the expected rate of inflation. The risk premium causes the differences in the required rates of return among alternative investments. Investors demand a risk premium because of the uncertainty of returns expected from an investment. The risk premiums for the same securities can change over time. Risk premium, an expected return in excess of risk-free return as a compensation for risk can be specified as $\mathrm{RP} = \beta(r_m - r_f)$.

For a market-based risk estimate (r_m), the firm's characteristic line is estimated by regressing market returns on the stock returns. Beta, the measure of systematic risk, is the slope of this regression line. Estimates of the economy's real risk-free rate, the future market return, and an estimate of the stock's beta help estimate next year's required rate of return

$$r = r_f + \beta(r_m - r_f).$$

This relationship should hold for any asset. It is known as capital asset pricing model (CAPM), which we can interpret as a theory of the relationship between risk and return which states that the expected risk premium on any security equals its beta times the market risk premium. The expected rates of return demanded by investors depend on the compensation for the time value of money (the risk free rate) and a risk premium, which depends on beta and the market risk premium.

Beta estimate begins with historical market information. Because beta is affected by changes in firm's business and financial risks and other influences, we should increase or decrease the historical beta estimate based upon our analysis of the firm's future risk characteristics

After arriving at a required rate of return, we must estimate the growth rate of cash flows, earnings and dividends because the alternative valuation models for common stock depend heavily on the estimates of growth (g) for these variables.

2.1.1 Measuring Beta (β)

Risk of individual stocks can be measured as the sensitivity of a stock's returns to fluctuations in returns on the market portfolio. This sensitivity is called the stock's beta (β). The average beta of all stocks is equal to one. Stocks with beta greater than 1 are more sensitive to market fluctuations. Now we will introduce two approaches how to measure firm's beta.

Historical market betas As mentioned above, beta is the slope of the fitted regression line regressing stock returns (R_i) on the market returns (R_m). Therefore, first we observe the rates of return for the stock and the market (usually monthly), plot the observations and fit a line showing the average return to the stock at different market returns. In practice, we use a stock index, such as the S&P 500, as a proxy for the market portfolio, and we estimate betas for stocks against the index:

$$R_i = \alpha + \beta R_m,$$

where α = Intercept from the regression, β = Slope of the regression = $\frac{\mathrm{Cov}(R_i, R_m)}{\sigma_m^2}$. The intercept of the regression provides a measure of performance of the investment during the period of the regression, when returns are measured against the expected returns from the capital asset pricing model. Comparing

$$R_i = R_f + \beta(R_m - R_f) = R_f(1-\beta) + \beta R_m \text{ with } R_i = \alpha + \beta R_m,$$

we arrive at $\alpha = R_f(1-\beta)$, which is a measure of the stock's performance. The intercept of the regression should be zero if the actual returns equal the expected returns from the CAPM, greater than zero if the stock does better than expected and less than zero if it does worse than expected. *R squared* (R^2) of the regression provides an estimate of the proportion of the risk of a firm that can be attributed to market risk; the balance ($1 - R^2$) can then be attributed to firm-specific risk. Finally, the standard error of the beta estimate can be used to arrive at confidence intervals for the "true" beta value from the slope estimate.

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

Since 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. The degree of operating leverage is a function of the cost structure of a firm. 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:

Degree of Operating leverage = % Change in Operating Profit / % Change in Sales.

An increase in financial leverage will increase the beta of the equity in a firm. If all the firm's risk is carried by the stockholders (the beta of debt is zero) and debt has a tax benefit to the firm, then,

$$\beta_L = \beta_U \left(1 + (1-t)\left(\frac{D}{E}\right)\right),$$

β_L = Levered Beta for equity in the firm, β_U = Unlevered beta of the firm (i.e., the beta of the firm without any debt), t = Corporate tax rate, D/E = Debt/Equity Ratio. 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 unlevered beta of a firm is determined by the types of the businesses in which it operates and its operating leverage. It is often also referred to as the asset beta since it is determined by the assets owned by the firm. Thus, the levered beta, which is also the beta for an equity investment in a firm or the equity beta, is determined both by the riskiness of the business it operates in and by the amount of financial leverage risk it has taken on:

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

$$\text{Levered Beta} = \text{Unlevered Beta}(1 + (1 - \text{tax rate})(\text{Debt/Equity})).$$

Bottom Up Betas The beta of two assets put together is a weighted average of the individual asset betas, with the weights based upon market value. Consequently, the beta for a firm is a weighted average of the betas of all the different businesses it is in. To estimate the beta for a firm we identify the business or businesses the firm operates in, then we find other publicly traded firms in these businesses and obtain their regression betas, which we use to compute an average beta for the firms, and their financial leverage. After we estimate the average unlevered beta for the business, by unlevering the average beta for the firm by their average debt to equity ratio:

$$\text{Unlevered Beta}_{\text{business}} = \frac{\text{Beta}_{\text{comparable firms}}}{1 + (1-t)(D/E\text{ratio}_{\text{comparable firms}}}.$$

To estimate an unlevered beta for the firm that we are analyzing, we take a weighted average of the unlevered betas for the businesses it operates in, using the proportion of firm value derived from each business as the weights. If values are not available, we use operating income or revenues as weights. This weighted average is called the bottom-up unlevered beta:

$$\text{Unlevered Beta}_{\text{firm}} = \sum_{j=1}^{k} \text{Unlevered beta}_j \times \text{Value Weight}_j.$$

Finally, we estimate the current market values of debt and equity of the firm and use this debt to equity ratio to estimate a levered beta.

These bottom up betas improve regression betas since the average across a number of regression betas will have much lower standard error. They also provide better adjustments for debt ratios and changes in a firm's business mix.

Portfolio Betas Beta of a portfolio is just an average of the betas of the securities in the portfolio, weighted by the investment in each security:

$$\text{Beta of portfolio} = \sum_{i=1}^{n} w_i \beta_i,$$

where w_i is the fraction of i-th stock in portfolio.

2.1.2 Capital Asset Pricing Model (CAPM)

This valuation model that describes the relationship between risk and return has following assumptions. There are no transactions costs, all assets are traded and investments are infinitely divisible (i.e., we can buy any fraction of a unit of the asset). It also assumes that everyone has access to the same information and that investors therefore cannot find undervalued or overvalued assets in the market place. These assumptions allow investors to keep diversifying without additional cost. Their portfolios will include every traded asset in the market (that is called market portfolio), and will have same weights on risky assets.

In CAPM, investors adjust for their risk preferences in their allocation decision, where they decide how much to invest in a riskless asset and how much in the market portfolio. In a world in which investors hold a combination of only two assets - the riskless asset and the market portfolio - the risk of any individual asset will be measured relative to the market portfolio. The risk of any asset will be the risk that it adds on to the market portfolio, and this risk is measured by the covariance of the asset with the market portfolio. To arrive at the appropriate measure of this added risk, assume that σ_m^2 is the variance of the market portfolio prior to the addition of the new asset and that the variance of the individual asset being added to this portfolio is σ_i^2 . The market value portfolio weight on this asset is w_i, and the covariance in returns between the individual asset and the market portfolio is $\mathrm{Cov}_{i,m}$. The variance of the market portfolio prior to and after the addition of the individual asset is

$$\text{Variance prior to asset } i \text{ being added} = \sigma_m^2$$

$$\text{Variance after asset } i \text{ is added} = \sigma_{m\,i}^2 = w_i^2\sigma_i^2 + (1-w_i)^2\sigma_m^2 + 2w_i(1-w_i)\,\mathrm{Cov}_{i,m}\,.$$

The market value weight on any individual asset in the market portfolio should be small (w_i is very close to 0) since the market portfolio includes all traded assets in the economy. Consequently, the first term in the equation should approach zero, and the second term should approach σ_m^2, leaving the third term ($\mathrm{Cov}_{i,m}$, the covariance) as the measure of the risk added by individual asset i. We standardize the risk measure by dividing the covariance of each asset with the market portfolio by the variance of the market portfolio. This yields a risk measure called the beta of the asset:

$$\text{Beta of an asset } i = \frac{\text{Covariance of asset } i \text{ with Market Portfolio}}{\text{Variance of the Market Portfolio}} = \frac{\mathrm{Cov}_{i,m}}{\sigma_m^2}.$$

Since the covariance of the market portfolio with itself is its variance, the beta of the market portfolio, and by extension, the average asset in it, is one. Assets that are riskier than average (using this measure of risk) will have betas that are greater than 1 and assets that are less riskier than average will have betas that are less than 1. The riskless asset will have a beta of 0.

The fact that every investor holds some combination of the riskless asset and the market portfolio leads to the next conclusion: the expected return of an asset is linearly related to the beta of the asset. In particular, the expected return of an asset can be written as a function of the risk-free rate and the beta of that asset:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f),$$

where $E(R_i)$ is the expected return on asset i, R_f is the rate free of risk, $E(R_m)$ expected Return on market portfolio, and β_i is beta of investment i. In the CAPM, all the market risk is captured in the beta, measured relative to a market portfolio, which at least in theory should include all traded assets in the market place held in proportion to their market value.

Estimating market risk premium As far as the risk premium is concerned, we would like to know what investors, on average, require as a premium over the riskfree rate for an investment with average risk, for each factor. We estimate the risk premium by looking at the historical premium earned by stocks over default-free securities over long time periods, that are the actual returns earned on stocks over a long time period is estimated and compared to the actual returns earned on a default-free asset (usually government security). The riskfree rate chosen in computing the premium has to be consistent with the riskfree rate used to compute expected returns. We would then prefer geometric average return on stocks because it looks at the compounded return. Also, the arithmetic average return is likely to overstate the premium.

Implied Equity Premiums There is an alternative to estimating risk premiums that does not require historical data or corrections for country risk, but does assume that the market overall is correctly priced. Consider, a simple valuation model for stocks (the present value of dividends growing at a constant rate)

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

When we solve this DDM for the variable ROE, we get an implied expected return on stocks. Subtracting the riskfree rate will yield an implied equity risk premium. 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.

2.2 The Expected Growth Rate

Estimating growth rate of dividends from fundamentals The growth rate of dividends is determined by the growth rate of earnings and the proportion of earnings paid out in dividends (the payout ratio). When a firm retains earnings and acquires additional assets, if it earns some positive rate of return on these additional assets, the total earnings of the firm will increase. The amount of this increase depends on the proportion of earnings and reinvests in new assets and the rate of return it earns on these new assets. The growth rate of equity earnings (EPS – earnings per share) is equal to the percentage of net earnings retained (the retention rate) times the rate of return on equity capital:

$$g = (\text{Retention Rate})(\text{Return on Equity}) = \text{RR} \times \text{ROE}\,.$$

A firm can increase its growth rate by reducing its payout ratio and investing these added funds at its historic ROE:

$$\begin{aligned} \text{ROE} &= \frac{\text{Net Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total Assets}} \times \frac{\text{Total Assets}}{\text{Equity}} \\ &= \begin{matrix}\text{Profit}\\ \text{Margin}\end{matrix} \times \begin{matrix}\text{Total Asset}\\ \text{Turnover}\end{matrix} \times \begin{matrix}\text{Financial}\\ \text{Leverage}\end{matrix}\,. \end{aligned}$$

An increase in any of the three ratios will cause an increase in ROE. The first two ratios reflect operating performance and the third one indicates a firm's financing decision. With this breakdown of ROE, we must examine past results and expectations for a firm and develop estimates of the three components and therefore an estimate of a firm's ROE. The dividend growth rate is also influenced by the age of industry, structural changes, and economic trends.

In FCFF model, we can apply an alternative measure of growth

$$g = (\text{RR})(\text{ROIC}),$$

where RR is the average retention rate and return on invested capital (ROIC) = EBIT (1 - Tax Rate) / Total Capital. Instead of RR we can also use reinvestment rate defined as (Capital Expenditures−Depreciation+Δ non-cash WC)/(EBIT(1− tax rate)).

The reinvestment rate measures how much a firm is plowing back to generate future growth. In FCFE model, instead of retention rate we can use reinvestment rate of equity which measures the percent of net income that is invested back into the firm

$$\text{Equity Reinvestment Rate} = 1 - \frac{\text{Net Cap Expenditures} + \Delta \text{ in WC-Net Debt Issues}}{\text{Net Income}}$$

Estimating growth based on history To estimate future growth, analysts also consider the historical growth rate of sales, earnings, cash flow and dividends. The specific measurement can be done using arithmetic or geometric average of annual percentage changes, linear regression models, and/or log-linear regression models. We should plot the data into the time-series graph. The geometric mean might be better because it provides the average annual compound growth rate:

$$\text{Average dividend growth rate} = \sqrt[n]{\frac{D_n}{D_0}} - 1.$$

The historical growth rate may sometimes need to be raised or lowered. The linear regression model goes well with the time-series plot

$$\text{EPS}_t = a + bt,$$

where EPS_t are earnings per share in year t ($t = 1, \ldots, n$) and b is the coefficient of the average absolute change in the series during the period. We should interpose this regression line on the time-series plot because we can look at the changes in absolute growth. The log-linear model considers that the series might be better described in terms of a constant growth rate

$$ln(\text{EPS}_t) = a + bt,$$

where b shows the average percentage change in the series during the period. With the time series graph and the alternative calculations we get insights into the trend of the growth rates as well as variability of the growth rates over time. The log-linear model converts the coefficient into a percentage change.

2.3 Estimating Terminal Value

As a firm grows, it becomes more difficult for it to maintain high growth and it eventually will grow at a rate less than or equal to the growth rate of the economy. This stable growth rate can be sustained in perpetuity, allowing us to estimate the value of all cash flows beyond that point as a terminal value. We usually estimate cash flows for the next several years and then calculate the terminal value that reflects the value of the firm at that point:

$$\text{Value of a Firm} = \sum_{t=1}^{n} \frac{CF_t}{(1+k_e)^t} + \frac{\text{Terminal Value}_n}{(1+k_e)^n.}$$

If we assume that cash flows, beyond the terminal year, will grow at a constant rate forever, the terminal value can be estimated as

$$\text{Terminal Value} = \frac{CF_{t+1}}{r-g},$$

where the cash flow and the discount rate used will depend upon whether we are valuing the firm or valuing the equity. Since no firm can grow forever at a rate higher than the growth rate of the economy in which it operates, the constant growth rate cannot be greater than the overall growth rate of the economy. It also ensures that the growth rate will be less than the discount rate. The assumptions we need to make on stable growth are: *when* the firm that we are valuing will become a stable growth firm, if it is not one already. *What* the characteristics of the firm will be in stable growth, in terms of return on investments and costs of equity and capital. *How* the firm that we are valuing will make the transition from high growth to stable growth.

Once we estimate the terminal value and operating cash flows, we discount them back to the present to yield the value of the operating assets of the firm. To this value, we add the value of cash, near-cash investments and marketable securities as well as the value of holdings in other firm to arrive at the value of the firm. Subtracting out the value of non-equity claims yields the value of equity in the firm.

2.4 Estimating Cash Flows

The value of an asset comes from its capacity to generate cash flows. When valuing a firm, these cash flows should be after taxes, prior to debt payments and after reinvestment needs. When valuing equity, the cash flows should be after debt payments. There are three basic steps to estimating these cash flows. The first is to estimate the earnings generated by a firm on its existing assets and investments.

The second step is to estimate the portion of this income that would go towards taxes. The third is to develop a measure of how much a firm is reinvesting back for future growth.

Measuring Earnings Free cash flows to the firm are based upon after-tax operating earnings. Free cashflow to equity estimates start with net income. When we obtain and use measures of operating and net income from accounting statements, we must adjust them to get a measure of earnings that is more appropriate for valuation.

Correcting Earnings Misclassification The expenses of a firm can be categorized into three groups: *Operating expenses* are the current costs associated with operating a property including maintenance, repairs, management, utilities, taxes and insurance. *Capital expenses* are expenses related to the purchase of long-term assets such as tangible property. *Financial expenses* are expenses associated with non-equity capital raised by a firm.

The operating income for a firm is equal to its revenues minus its operating expenses. The net income of a firm should be its revenues minus both its operating and financial expenses. No capital expenses should be deducted to arrive at net income. Operating, capital and financial expenses are sometimes misclassified. The two most common misclassifications are including capital expenses such as Research and Development (R&D) in the operating expenses, what affects the estimation of both operating and net income, and when financial expenses are treated as operating expenses, what affects only operating income.

The tax effect To compute the after-tax operating income, we multiply the earnings before interest and taxes by an estimated tax rate. The most widely reported tax rate in financial statements is the effective tax rate, which is computed from the reported income statement:

$$\text{Effective Tax Rate} = \frac{\text{Taxes Paid}}{\text{Total Income}}.$$

The tax benefit Firms are allowed to deduct their entire R&D expense for tax purposes. In contrast, they are allowed to deduct only the depreciation on their capital expenses. Adjusted after-tax Operating Earnings = (Operating Earnings + Current year's R&D expense − Amortization of Research Asset)(1−Tax rate) + (Current year's R&D expense − Amortization of Research Asset) × Tax rate = Operating Earnings (1−tax rate) + Current year's R&D expense − Amortization of Research Asset.

The tax benefit from R&D expensing allows us to add the difference between R&D expense and amortization directly to the after-tax operating income.

Reinvestment needs The cash flow to the firm is computed after reinvestments. To examine how much a firm is reinvesting, we should distinguish reinvestment in tangible and long-lived assets (net capital expenditures) and short-term assets (working capital).

Net Capital Expenditures Net capital expenditures is the difference between capital expenditures (a cash outflow) and depreciation (effectively a cash inflow). Forecasting these expenditures can be difficult, because firms can go through periods when capital expenditures are very high (a new product is introduced) followed by periods of small capital expenditures. Consequently, when estimating the capital expenditures to use for forecasting future cash flows, we should normalize capital expenditures, e.g. averaging them over a number of years.

Investment in Working Capital Working capital is the difference between current assets and current liabilities. Decreases in working capital release cash and positive cash flows. The non-cash working capital, which is the net change in current assets and current liabilities other than cash, mainly accounts receivable and inventory, is better measure of cash in working capital. Increases in non-cash working capital represent cash outflows to the firm, while decreases represent cash inflows. The non-cash working capital at most firms tends to be volatile and may need to be smoothed out when forecasting future cash flows, e.g. to base our changes on the non-cash working capital as a percent of revenues over a historical period.

Chapter 3

Appendix

3.1 Short Glossary

- Capital expenditures (CAPEX) = spendings used to acquire or upgrade tangible assets such as equipment, property, industrial buildings. They increase the asset's basis.
- Change in working capital (Δ in WC) = the difference between current assets and current liabilities.
- Cost of debt measures the current cost to the firm of borrowing funds to finance projects. It is determined by the following variables: The riskless rate, the default risk of the company, the tax advantage associated with debt: Since interest is tax deductible, the after-tax cost of debt is a function of the tax rate.

$$\text{After-tax cost of debt} = \text{Pre-tax cost of debt } (1 - \text{tax rate})$$

- Cost of equity reflects the riskiness of equity to investors in the firm. It is the investors' minimum required return on equity in a firm.
- 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:

$$\text{Geometric Average} = \sqrt[N]{\frac{\text{Value}_N}{\text{Value}_0}} - 1.$$

- EBIT = earnings before interest and taxes = operating revenue after having subtracted operating expenses, depreciation, and amortization, but before subtracting charges for interest payments and taxes.

- Financial leverage = total assets divided by shareholders' equity.
- Operating leverage = Fixed operating costs divided by total operating costs.
- The retention rate of earnings = 1 − (Dividends declared / operating income after taxes).
- Return on Equity (ROE) = percentual indicator of profitability. Determined by dividing net income for the past 12 months by common stockholders' equity.
- The returns on the S&P 500 market index:

$$\text{Market Return}_j = \frac{\text{Index}_j - \text{Index}_{j-1} + \text{Dividends}_j}{\text{Index}_{j-1}},$$

  where Market Return$_j$ = returns of the index in month j.

- $$\text{Stock return}_{firm\ j} = \frac{\text{Price}_{firm\ j} - \text{Price}_{firm\ j-1} + \text{Dividends}_j}{\text{Price}_{firm\ j-1}} \text{in } j\text{-th month.}$$

- The weighted-average cost of capital is the return that company needs to earn after tax in order to satisfy its stockholders

$$\begin{aligned} \text{WACC} &= \text{Cost of equity (Equity/(Debt + Equity))} + \\ &\quad \text{Cost of Debt (Debt/(Debt + Equity)).} \end{aligned}$$

3.2 Valuation of Nokia

As an example, we will value the share of Nokia, listed on New York Stock Exchange.

Estimating Inputs As a risk-free rate, we will use U.S. 10-year treasury bond with current yield 5.05% (05/26/2006) and maturity date 05/15/2016, which we obtained at Bloomberg (`http://www.bloomberg.com`). We will use market risk premium 4.5% which is a rough average historical premium over past 10 years in the US. We obtained Nokia's levered beta estimate from E*TRADE Financial (`http://www.etrade.com`), and it equals 1.79. Now we can calculate the unlevered beta estimate:

$$\begin{aligned} \text{Market debt to equity} &= \text{Book debt to equity/Price to book ratio} \\ &= 0.21/6.59 = 0.032, \end{aligned}$$

then

$$\beta_L = \beta_u \left(1 + (1-t)\left(\frac{D}{E}\right)\right),$$

where the effective tax rate is 25.69%, thus, the unlevered beta equals

$$\beta_u = \frac{1.79}{1 + (1 - 0.2569)(0.032)} = 1.75.$$

Now we can calculate the cost of equity for Nokia

$$k_e = 5.05 + 1.75 \times 4.5 = 12.925\%.$$

Nokia Corporation has a current Overall Rating of B (Positive). Relative to the S&P 500 Composite, Nokia has moderate Growth characteristics. As to May 24, according to Reuters research (`http://www.reuters.com`), 60 analysts recommendations for Nokia showed the mean rating of 2.32 on the following 1-5 linear scale: (1) Buy-19, (2) Outperform-18, (3) Hold-14, (4) Underperform-3, (5)Sell-6.

Dividends Nokia has paid out a stable amount on dividends over past five years, but the firm has not stable payout ratio and the dividends are distributed upon a shareholders' resolution, in the amount proposed by Board of Directors. Thus, the firm distributes a significant part of the retained earnings in form of share buy-backs. In 2005 firm has paid $1 947.52 million in dividends, and the pay out ratio was 0.43, so the retention ratio was 0.57. The average pay out ratio over the past five years was 0.315, Dividend 5 Year Growth Rate is 5.73% and 10 year pay out ratio growth is 4.4%. Firm's earnings are quite stable, Nokia is a global market leader with a good competitive position. Regressing company's pay out ratio against time in ten years we arrive at year 2006 estimate equalling 0.47.

Expected growth rate in dividends is retention ratio times return on equity

$$g_{div} = 0.57 \times 32.57 = 18.56\%.$$

Growth Growth in sales will be estimated as expected compound growth rate in sales

$$\sqrt[5]{\frac{43\,441.41}{39\,629.76}} - 1 = 4.2\%.$$

Then we use analyst estimate for the growth in net income for the next five years which is 10%. After that, the growth will decrease to 5%.

In Table 3.2 return on stock is calculated using firm's financial statements and past historical stock info. Risk-free rate is obtained using US government 10 year bond rate data from the Federal reserve board (`http://www.federalreserve.gov`), return on market is return on S&P 500 index data from Standard&Poor's.

Year	Net Income	Depreciation & Amort	Capital Spending	Chg in Non-Cash WC	Net Debt Issued	FCFE
1	$2 417.86	$1 819.04	$1 872.46	$1 789.78	$31,39	$574,66
2	$4 577.80	$1 667.66	$1 081.25	$830.65	($602.95)	$4 333.56
3	$5 205.45	$1 447.60	$826.84	$516.45	($92.86)	$5 309,76
4	$4 247.45	$905.70	$825.56	$684.37	($326.92)	$3 643.22
5	$4 551.11	$0.00	$966.76	$44.52	$208.62	$3 539.83

Table 3.1: Calculating FCFE using Nokia financial statements

Year	BV: Equity	Returns on stock	Riskfree rate	Return on market
1	$15 525.42	−42.83%	5.02%	−11.89%
2	$18 166.21	−35.34%	4.61%	−22.10%
3	$19 269.08	12.19%	4.01%	28.69%
4	$18 102.60	−5.53%	4.27%	10.88%
5	$15 461.82	19.78%	4.29%	4.91%

Table 3.2: Calculating performance

	Average	Standard Deviation	Maximum	Minimum
Free CF to Equity	$3 323.66	$1 681.95	$5 216.90	$606.05
Dividends	$1 797.67	$89.19	$1 947.52	$1 714.73
Dividends+Repurchases	$3 841.60	$2 460.33	$7 361.38	$1 529.01
Dividend Payout Ratio	42.80%	Return on Stock	−10.35%	
Cash Paid as % of FCFE	115.58%	Required Return	0.34%	
ROE	18.26%	ROE − Required return	17.92%	

Table 3.3: Analysing past dividends

	1	2	3	4	5
Net Income	$5 006	$5 507	$6 058	$6 663	$7 330
− (Cap Ex − Depreciation) (1 − DR)	$116	$120	$126	$131	$136
− Change in Working Capital (1 − DR)	$66	$69	$72	$75	$78
FCFE	**$4 824**	**$5 317**	**$5 860**	**$6 457**	**$7 115**
Expected Dividends	$2 309	$2 738	$3 246	$3 848	$4 562
Cash available for stock buybacks	$2 515	$2 580	$2 614	$2 609	$2 553
Revenues	$45 266	$47 167	$49 148	$51 212	$53 363
Non-cash WC	$36	$38	$40	$41	$43

Table 3.4: Forecasting FCFE and dividends

Valuation We decreased Beta in stable growth to 1.2 leading to the cost of equity in stable phase (r) = 10.45. Using data computed in Table 3.2 and implementing the two-stage FCFE model we get

$$\begin{aligned}\text{Value} &= \sum_{t=1}^{5} \frac{\text{FCFE}_t}{(1+k_e)^t} + \frac{\text{FCFE}_5 \times (1+g)}{(r-g)(1+k_e)^5} \\ &= \frac{4824}{1+0.12925} + \frac{5317}{(1+0.12925)^2} \frac{5860}{(1+0.12925)^3} \frac{6457}{(1+0.12925)^4} \frac{7115}{(1+0.12925)^5} \\ &= 95064.35.\end{aligned}$$

Value per share = 95064.35 / 4172.38 = \$22.78. Nokia share was trading at 21.82 on the day of this analysis (May 25, 2006).

Example: estimating Nokia's WACC To estimate firm's cost of debt, we will take a look at Reuters Corporate Spreads for Industrials, where 10 year B+ rating is 375 basis points. Adding this adding this default spread to the 10-year riskless rate, we will get

$$\text{cost of debt} = 5.05\% + 3.75\% = 8.8\%.$$

The marginal tax rate can be round up to 30 percent to allow for the tax differentials in other countries where Nokia is also liable for tax, therefore,

$$\text{after tax cost of debt} = 8.8 \times (1 - 0.3) = 6.16\%.$$

Now, we can calculate the overall cost of capital. To get market capitalization, that is the market value of equity, we multiply the number of shares outstanding with market price of a share (05/25/06)

$$\text{Market cap.} = 4172.38 \text{ millions} \times 21.82 = \$91\,041\,331\,600.$$

Total debt (from company's 2005 balance sheet) = \$505 680 000.

The cost of capital as a weighted average cost of equity and debt =

$$12.925 \times \frac{91\,041\,331\,600}{505\,680\,000 + 91\,041\,331\,600} + 6.16 \times \frac{505\,680\,000}{505\,680\,000 + 91\,041\,331\,600} = 12.89\%.$$

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