Part II: Share Valuation Theories

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2 How to Value a Share

Introduction

The key to understanding the basic measures of stock market performance (price, yield, P/E ratio and cover) used by investors to analyse trading decisions requires a theoretical appreciation of the relationship between a share's price and its return (dividend or earnings) using various models based on discounted revenue theory.

To set the scene, we shall keep the analysis simple by outlining the theoretical determinants of share price with particular reference to the *capitalisation of a perpetual annuity* using both a dividend yield, and earnings yield. Detailed consideration of the controversy as to whether dividends or earnings are a prime determinant of share price will be covered in Chapter Three.

2.1 The Capitalisation Concept

Discounted revenue theory defines an investment's present value (PV) as the sum of its relevant periodic cash flows (C_t) discounted at an appropriate opportunity cost of capital, or rate of return (r) on alternative investments of equivalent risk over time (n). Expressed algebraically:

$$(1) \quad PV_n = \sum_{t=1}^{n} C_t / (1+r)^t$$

The equation has a convenient property. If the investment's annual return (r) and cash receipts (C_t) are *constant and tend to infinity*, ($C_t = C_1 = C_2 = C_3 = C\infty$) their PV simplifies to the formula for the *capitalisation of a constant perpetual annuity*:

$$(2) \quad PV_\infty = C_t / r = C_1 / r$$

The return term (r) is called the *capitalisation* rate because the transformation of a cash flow series into a capital value (PV) is termed "capitalisation". With data on PV∞ and r, or PV∞ and C_t, we can also determine C_t and r respectively. Rearranging Equation (2) with one unknown:

$$(3) \quad C_t = PV_\infty \cdot r$$

$$(4) \quad r = PV_\infty / C_t$$

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Activity 1

The previous PV equations are vital to your understanding of the various share valuation models that follow. They also underpin the remainder of this study. If you are unsure of their theory and application, then I recommend that you download *Strategic Financial Management (SFM)* from the author's *bookboon* series and read Chapters Two and Five before you continue.

Having completed this reading, you will appreciate that shares may be traded either *cum-div* or *ex-div*, which means they either include (cumulate) or exclude the latest dividend. For example, if you sell a share *cum-div* today for P_0 the investor also receives the current dividend D_0. Excluding any transaction costs, the investor therefore pays a total price of (D_0 + P_0). Sold *ex -div* you would retain the dividend. So, the trade is based on current price (P_0) only.

This distinction between *cum-div* and *ex-div* is important throughout the remainder of our study because unless specified otherwise, we shall adopt the time-honoured academic convention of defining the current price of a share using an *ex-div* valuation.

2.2 The Capitalisation of Dividends and Earnings

Irrespective of whether shares are traded *cum-div or ex-div*, their present values can be modelled in a *variety* of ways using discounted revenue theory. Each depends on a definition of future periodic income (either a dividend or earnings stream) and an appropriate discount rate (either a dividend or earnings yield) also termed the equity capitalisation rate.

For example, given a forecast of periodic future dividends (D_t) and a shareholder's desired rate of return (K_e) based on current dividend yields for similar companies of equivalent risk:

The present *ex-div* value (P_0) of a share held for a *given* number of years (n) should equal the discounted sum of future dividends (D_t) plus its eventual *ex-div* sale price (P_n) using the current dividend yield (K_e) as a capitalisation rate.

Expressed algebraically:

$$(5) \quad P_0 = [(D_1 / 1 + K_e) + (D_2 / 1 + K_e)^2 + \ldots.. + (D_n / 1 + K_e)^n] + (P_n / 1 + K_e)^n$$

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Rewritten and simplified this defines the *finite-period dividend valuation model:*

$$(6) \quad P_0 = \sum_{t=1}^{n} D_t / (1+K_e)^t + P_n / (1 + K_e)^n$$

Likewise, given a forecast for periodic future earnings (E_t) and a desired return (K_e) based on current earnings yields of equivalent risk:

The present *ex-div* value (P_0) of a share held for a *given* number of years (n) equals the sum of future earnings (E_t) plus its eventual *ex-div* sale price (P_n) all discounted at the current earnings yield (K_e).

Algebraically, this defines the *finite-period earnings valuation model:*

$$(7) \quad P_0 = \sum_{t=1}^{n} E_t / (1+K_e)^t + P_n / (1 + K_e)^n$$

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Activity 2

A logical approach to financial analysis is to make *simplifying* assumptions that rationalise its *complexity*. A classic example is the derivation of a series of dividend and earnings valuations, other than the *finite* model. Some are more sophisticated than others, but their common purpose is to enable investors to assess a share's performance under a variety of conditions.

To illustrate the point, briefly summarise the theoretical assumptions and definitions for the following models based on your reading of *SFM* (Chapter Five) or any other source material.

The *single-period* dividend valuation
The *general* dividend valuation
The *constant* dividend valuation

Then give some thought to which of these models underpins the data contained in stock exchange listings published by the financial press worldwide.

We know that the *finite-period* dividend valuation model assumes that a share is held for a given number of years (n). So, today's *ex div* value equals a series of expected year-end dividends (D_t) plus the expected *ex-div* price at the end of the entire period (P_n), all discounted at an appropriate dividend yield (K_e) for shares in that risk class. Adapting this formulation we can therefore define:

- The *single-period* dividend valuation model

Assume you hold a share for one period (say a year) at the end of which a dividend is paid. Its current *ex div* value is given by the expected year-end dividend (D_1) plus an *ex-div* price (P_1) discounted at an appropriate dividend yield (K_e).

- The *general* dividend valuation model

If a share is held indefinitely, its current *ex div* value is given by the summation of an infinite series of year-end dividends (D*t*) discounted at an appropriate dividend yield (K_e). Because the share is never sold, there is no final *ex-div* term in the equation.

- The *constant* dividend valuation model

If the annual dividend (D_t) not only tends to infinity but also remains constant, and the current yield (K_e) doesn't change, then the *general* dividend model further simplifies to the *capitalisation of a perpetual annuity*.

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2.3 The Capitalisation of Current Maintainable Yield

Your answers to Activity 2 not only reveal the impact of different assumptions on a share's theoretical present value, but why basic price and yield data contained in stock exchanges listings published by the financial press favour the *constant* valuation model, rather than any other.

Think about it. The derivation and analyses of current share prices based on future estimates of dividends, *ex-div* prices and appropriate discount rates for billions of market participants, even over a single period is an impossible task. To avoid any weakness in forecasting characterised by uncertainty and to provide a *benchmark* valuation for the greatest possible number, stock exchange listings therefore assume that shares are held in *perpetuity* and the latest reported dividend per share will remain *constant* over time. This still allows individual investors with other preferences, or information to the contrary, to model more complex assumptions for comparison. There is also the added commercial advantage that by using the simplest metrics, a newspaper's stock exchange listings should have universal appeal for the widest possible readership.

Turning to the mathematics, given your knowledge of discounted revenue theory based the *capitalisation of a perpetual annuity* (where $PV = C_t / r$) share price listings define a current *ex- div* price (P_0) using the *constant* dividend valuation model as follows:

(8) $$P_0 = D_1 / K_e$$

Next year's dividend (D_1) and those thereafter are represented by the latest reported dividend (*i.e.* a constant). Rearranging terms, (K_e) the shareholders desired rate of return (equity capitalisation rate) is also a constant represented by the current yield, which is assumed to be *maintainable* indefinitely.

(9) $$K_e = D_1 / P_0$$

2.4 The Capitalisation of Earnings

For the purpose of exposition, so far we have focussed on dividend income as a determinant of price and value, with only passing reference to earnings. But what about shareholders interested in their *total* periodic returns (dividends plus retentions) from corporate investment? They need to capitalise a post-tax earnings stream (E_t) such as *earnings per share* (EPS) and analyse its yield (K_e). No problem: the *structure* of the valuation models summarised in Activity 2 remains the same but E_t is substituted for D_t and K_e now represents an earnings yield, rather than a dividend yield. Thus, we can define a parallel series of equations using:

The *single-period*, earnings valuation model
The *finite-period*, earnings valuation model
The *general* earnings valuation model
The *constant* earnings valuation model

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Turning to stock exchange listings and the financial press, we also observe that for simplicity the publication of earnings data is still based on the *capitalisation of a perpetual annuity*.

(10) $P_0 = E_1 / K_e$

Next year's earnings (E_1) and those thereafter are represented by the latest reported profit (*i.e.* a constant). Rearranging terms, (K_e) the shareholders desired rate of return (equity capitalisation rate) is also a constant represented by the current earnings yield, which is assumed to be *maintainable* indefinitely.

(11) $K_e = E_1 / P_0$

Review Activity

Having downloaded this text and others in the *bookboon* series, it is reasonable to assume that you can already interpret a set of published financial accounts, if not share price data. To test your level of understanding for future reference, select a newspaper of your choice and a number of companies from its stock exchange listings. Then use the data to explain:

- The mathematical relationship between a company's dividend and earnings yields and why the two may differ.
- The definition of earnings yields published in the financial press.

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Our discussion of efficient markets in Chapter One explained why a company's shares cannot sell for different prices at a particular point in time. So, it follows that:

(12) $P_0 = D_1 / K_e = E_1 / K_e$

And if a company adopts a policy of full distribution (whereby $D_1 = E_1$) then the equity capitalisation rates for dividends and earnings, using a current maintainable yield (K_e) must also be identical.

(13) $K_e = D_1 / P_0 = K_e = E_1 / P_0$

But what of the more usual situation, where a company retains a proportion of earnings for reinvestment?

Given P_0 (but $D_1 < E_1$) the respective equity capitalisation rates (K_e) now differ.

(14) $K_e = D_1 / P_0 < K_e = E_1 / P_0$

Not only is the dividend yield lower than the earnings yield but as we shall explore in Chapter Three, there is a *behavioural* explanation for relationship between the two. For the moment, suffice it to say that there is also an underlying mathematical relationship. For example, if a company's current share price, latest reported dividend and earnings per share are $100, $10 and $20 respectively, then because earnings *cover* dividends twice (again, more of which later) the dividend yield is half the earnings yield (10 and 20 percent respectively).

This difference in yields is not a problem for investors who know what they are looking for. Some will prefer their return as current income (dividends and perhaps the sale of shares). Some will look to earnings that incorporate retentions (future dividends plus capital gains). Most will hedge their bets by combining the two in share portfolios that minimise risk. So, their respective returns will differ according to their risk-return profile. Which is why share price listings in newspapers worldwide focus on dividends *and* earnings, as well as the *interrelationship* between the two measured by dividend cover.

Moving on to the second question posed by our Review Activity, if you are at all familiar with share price listings published in the financial press, you will be aware of a *convention* that also enables investors to avoid any confusion between dividend and earnings yields when analysing a share's performance.

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Given the current earnings yield:

(11) $K_e = E_1 / P_0$

The equation's terms can be rearranged to produce its *reciprocal*, the price-earnings (P/E) ratio.

(15) $P/E = P_0 / E_1 = 1/K_e$

Unlike the earnings yield, which is a *percentage* return, the P/E ratio is a *real* number that analyses price as a *multiple* of earnings. On the assumption that a firm's current post tax profits are maintainable indefinitely, the ratio therefore provides an alternative method whereby a company's distributable earnings can be capitalised to establish a share's value.

Because the two measures are reciprocals whose product always equals one, the interpretation of the P/E is that the *lower* the figure, the *higher* the earnings yield and *vice versa*. And because investors are dealing with an *absolute* P/E value and not a *percentage* yield, there is no possibility of confusing a share's dividend and earnings performance when reading share price listings, articles or commentaries from the press and media, analyst reports, or internet downloads.

Finally, having noted that low valuation multipliers correspond to high returns and that a number multiplied by its reciprocal equals one, use Table 2.1 to confirm a *perfect inverse* relationship between a share's P/E and its earnings yield. Not only will this exercise be useful for future reference throughout this text, but future reading of the financial press should also fall into place.

P/E	=	P_0 / E_1	=	1/Ke	50	40	20	15	12	10	8	5	2
Yield	=	E_1 / P_0	=	Ke	2	2.5	5	6.66	8.33	10	12.5	20	50

Table 2.1: The Relationship between the P/E Ratio and Earnings Yields

Summary and Conclusions

This Chapter has outlined the fundamental relationships between share valuation models and the derivation of the cost of equity capital for the purpose of analysing stock market returns.

We set the scene by explaining the derivation of basic share valuation models using discounted revenue theory, with particular reference to the capitalisation of a perpetual annuity. We noted that corresponding equity valuations based on current dividend and earnings should be financially equivalent.

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The relationship between an *ex-div* dividend and earnings valuation revealed why a few select metrics (based on price, dividend yield and the P/E ratio) published in the financial press encapsulate a company's stock market performance and provide a guide to future investment.

As we shall discover in later chapters, a share's intrinsic value (price) is only meaningful if we consider other data about a company and then place it in context. For example, given a company's latest reported dividend and profit figures, investors can use existing dividend yields and P/E ratios to place a comparative value on that company's shares. These can then be compared with its actual value (current market price) to establish whether the company is either undervalued, equitable, or overvalued, relative to the market for similar shares of equivalent risk. Needless to say, undervalued, rational investors buy, equitable they hold, overvalued they sell.

Selected References

Hill, R.A., *Strategic Financial Management:* Chapters Two and Five, *bookboon.com* (2008).

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