



# Ofcom's approach to risk in the assessment of the cost of capital

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*Consultation*

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## Section 1

# Executive Summary

## Introduction

- 1.1 This consultation asks for the views of respondents on a number of issues relating to risk and return, in particular the permissible returns calculated for the companies regulated by Ofcom. It focuses on Ofcom's approach to estimating companies' weighted average cost of capital and the relevance of real options in the assessment of risk associated with new services. These factors can directly affect financial outcomes for firms in the industry, being a key input used by Ofcom in its analysis relating to, for example:
  - setting charge controls and price caps;
  - conducting competition analysis, e.g. predation and margin squeeze tests; and
  - valuing the future cash flows that are associated with, for example, licence applications.
- 1.2 In each of these cases, Ofcom is required to estimate what a reasonable rate of return is, and in each case the financial implication for the firm concerned may be significant. This is a key part of Ofcom's duties in regulating the communications industry. It is a component in Ofcom's calculations in a number of access pricing contexts, where starting charges and/or X factors in "RPI minus X" type regulation are set by Ofcom, for example:
  - the Network Charge Control ("NCC");
  - Wholesale Line Rental ("WLR"); and
  - Partial Private Circuits ("PPCs").
- 1.3 Ofcom's view of a reasonable rate of return is also an important part of its financial analysis in the context of its ex post regulatory duties, e.g. when considering complaints under the Competition Act.
- 1.4 Ofcom's ongoing Strategic Review of the telecommunications sector (referred to as the Telecoms Strategic Review, or "Telecoms Review") is one of the key drivers of Ofcom's decision to review the issues covered in this consultation. In Phase 2 of the Telecoms Review, Ofcom proposed the principle that it should promote a favourable climate for efficient and timely investment and stimulate innovation, in particular by ensuring a consistent and transparent regulatory approach. Ofcom also proposed that regulation should be targeted on ensuring real equality of access to enduring economic bottlenecks, creating the scope for deregulation in other areas.
- 1.5 Taken together, these proposed principles imply that in setting the regulated returns that BT is permitted to make from wholesale access to its network, Ofcom should reflect the varying characteristics of different parts of BT's network. The Telecoms review suggested that three core considerations should affect the regulated return that BT should be permitted to make from providing wholesale access to different parts of its network. There are sometimes trade-offs to be made between these considerations. The considerations are:

- the relative importance of incentives for BT to invest. Where investments are risky, it is important that regulated returns reflect the degree of risk that BT faces at the time that it makes the investment;
  - the scope for investment by competing network providers. If effective competition as a result of investment by competing providers is in prospect, it is important that regulation does not harm such prospects; and
  - the need to protect consumers from excessive charging, for services provided in parts of the network which are enduring economic bottlenecks
- 1.6 As outlined above, Ofcom sets the returns that BT is permitted to make from wholesale access to its network through a number of regulatory instruments, an assessment of BT's cost of capital being a key component of many of these. This consultation discusses how Ofcom might assess the cost of capital of BT and other operators in a manner consistent with the principles proposed in the Telecoms Review.
- 1.7 Some parts of this consultation discuss issues in the context of fixed networks, and are therefore of particular relevance to BT and its direct competitors. Ofcom's intention is that the analytical approach outlined in this consultation will however apply equally to all the sectors that it regulates, including mobile communications and the audio-visual and audio broadcasting industries.
- 1.8 Similarly, the principles outlined in this document, particularly with regard to the equity risk premium, are equally applicable to communications markets in the Kingston Upon Hull area (and hence to Kingston Communications) as they are to the broader UK context (although the size and nature of this market and incumbent are such that there may be other important factors to consider that are not dealt with in this consultation).
- 1.9 Ofcom's proposed views may influence how investors perceive the attractiveness of certain markets and companies, particularly in the context of fixed regulated networks, but also in the case of, for example, cable and mobile networks. Ofcom considers that it has a duty to ensure that regulatory uncertainty does not prove a barrier to investment, and recognises that many investment decisions critical to the evolution of the communications sector will be made in the coming years. By maximising the clarity of its approach in this area, Ofcom aims to ensure regulatory transparency and minimise regulatory risk, thus promoting a favourable climate for efficient and timely investment in addition to promoting competition.

### **Scope of this consultation**

- 1.10 This consultation asks for the views of respondents on a number of specific aspects of Ofcom's proposed policy approach to the cost of capital and other aspects of risk and return. This review is not intended as a comprehensive investigation into all aspects of cost of capital estimation. It does not, for example, discuss a number of issues that are relevant to estimating the cost of capital such as the risk free rate, inflation risk premium, optimal gearing, taxation adjustments, or detailed estimation techniques for the company's beta. Instead, it focuses, and requests the views of stakeholders, on the following specific areas:
- the appropriate approach to estimation of the Equity Risk Premium (ERP) within the Capital Asset Pricing Model (CAPM) framework;
  - the appropriate treatment of variations in risk across different activities and projects in the context of both:

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- o *systematic risk*, i.e. risk that which can not be diversified away; and
- o *specific risk*, i.e. risk specific to a given company or project
- whether and how the value of real options might be incorporated into regulators analysis.

### **Key proposals in this consultation**

1.11 Ofcom makes a number of proposals in this document. The most important of these are discussed in the subsections below.

#### **Ofcom's preferred asset pricing model**

1.12 Ofcom considers that the CAPM remains the most appropriate basis for estimating the cost of capital and will continue to use it as its preferred methodology in most circumstances.

#### **Ofcom's approach to ERP estimation**

1.13 Under the CAPM, the ERP reflects the extra return that investors require in return for investing in equities rather than a risk free asset. It is a market, rather than company-specific, factor. The calculation of a forward-looking ERP entails a significant degree of judgement, and, as will be outlined in Section 3, a wide range of estimates can be derived using commonly-used estimation techniques. Traditionally, Ofcom has considered that the downside risk associated with taking too low a value for the ERP (discouraging discretionary investment) is more detrimental to the interests of consumers than taking too high a value (leading to higher prices to customers) and has tended to the higher end of the possible range. Having reviewed its approach in this area, Ofcom remains of this view, and requests the views of stakeholders on its proposal that values of 4.0% or 4.5% might be appropriate alternatives to 5% as central estimates of the ERP.

#### **Ofcom's approach to modelling variations in systematic risk within the CAPM**

1.14 Regulators in the communications industry, including Ofcom, have traditionally assessed the cost of capital at a company level<sup>1</sup>. However, companies commonly make investment decisions at a project or activity level, and reflect variations in systematic risk between different activities.

1.15 Ofcom believes that, in principle, it may be appropriate to reflect differences in risk within corporate groups in its financial analysis. In the context of systematic risk, this would mean allowing different costs of capital on different projects, since this type of risk is modelled within the CAPM. One way to achieve this in practice would be to vary, or "disaggregate", the beta, the parameter that reflects the systematic risk of a particular company in the CAPM. Analysis carried out on behalf of Ofcom by The Brattle Group in the early part of 2004 indicated a central estimate of 1.3 for the equity

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<sup>1</sup> The terms "firm" and "company" are both used frequently used throughout this document. The latter term is based on a standard economic interpretation of a "firm" as an institution that hires factors of production and that organizes those factors to produce and sell goods and services. In places, Ofcom has used the term, "company" to emphasise that a particular discussion relates to a firm that is owned by two or more shareholders, but the use of this term is not intended to reflect the issues brought about by the legal ownership of a particular form of firm (e.g. the issuing of shares).

beta of BT group. This estimate reflects the, appropriately weighted, average level of systematic risk of all BT activities (which may vary significantly). Ofcom believes that it should consider whether, and if so how, to reflect some of the most important of these variations in systematic risk its financial analysis, whilst ensuring consistency with this overall group beta estimate.

### **Ofcom's initial view on the relevance of real option theory to regulation**

1.16 If the riskiness of a firm's investment is modelled using the CAPM and Net Present Value (NPV) analysis, then, as will be outlined in Section 3, the systematic risk faced by investors is taken into account via an estimate of the firm's Weighted Average Cost of Capital (WACC). Present values should be calculated based on expected cash flows so that the rewards from successful investments are expected to be sufficient to pay for the losses associated with unsuccessful investments. This analysis does not, however, explicitly take into account the extent to which risk can be mitigated by the adoption of certain investment strategies (e.g. investing later in order to "wait and see" how a market develops, or investing early in order to gain a first mover advantage). Ofcom's initial view is that, under certain circumstances, it should take account of such factors by using a real options approach to financial analysis. In particular, Ofcom proposes that, in some cases, the option to wait and see which is surrendered when an investment decision is made may have a value that it is appropriate to take into account in its analysis. In the context of the most important current or near future regulated products, Ofcom's initial view is that the value of these options is likely to be greatest in the cases of:

- next generation access networks; and
- (to a lesser extent) next generation core networks

1.17 Ofcom's initial view is that wait and see options are unlikely to have a significant net value in the case of the other major access products currently offered by BT. As will be discussed in Section 6 of this consultation, any attempt to quantify the value of these options would give rise to a number of methodological issues.

### **Implications of this consultation**

1.18 The overall, i.e. net, financial impact on stakeholders of the proposals in this document are difficult to assess, since, from the perspective of each stakeholder, some implications would be favourable whereas others would be unfavourable:

- other things being equal, the return permitted on all regulated access products would go down owing to the use of a revised ERP;
- the regulated returns permitted on some lower risk investments would go down owing to equity beta disaggregation, whilst the overall company cost of capital calculated under the CAPM would remain the same; and
- the regulated returns allowed for some risky new investments could increase through taking account of the value of real options

1.19 Ofcom believes that these proposals are consistent with its duties relating to the promotion of competition and encouraging efficient investment under the Communications Act and the proposed regulatory principles set out in the Telecoms Review.

## Section 2

# Introduction

## Cost of capital estimation and Ofcom's duties

- 2.1 In carrying out its functions to regulate the communications industry, Ofcom has to, amongst other things, make ex ante decisions over the appropriate level of charges for services in those parts of the sector where enduring bottlenecks that prevent the development of competition exist.
- 2.2 In addition, Ofcom has responsibility for ex post regulation of the sector (under its Communications Act/Competition Act/Enterprise Act powers) to address complaints relating to issues such as excessive or predatory pricing.
- 2.3 Ofcom has to make decisions relating to charges in a way that prevents excessive pricing by dominant firms, but that also allows companies to earn a reasonable return on their investments. A dominant firm's WACC typically forms the basis for calculating charges that permit the earning of a "reasonable" return, i.e. one that is sufficient to reward investors but that does not include monopoly profits.
- 2.4 The cost of capital is also the rate at which firms substitute between present and future value. This means that it is the appropriate discount rate to be used in NPV calculations when comparing company cash-flows over time. NPV calculations are widely used in a range of regulatory contexts, being relevant to both ex ante charge setting and ex post analysis such as margin squeeze tests.
- 2.5 Section 3(1) of the Communications Act ("The Act") sets out Ofcom's principal duty, namely to further the interests of citizens in relation to communications matters; and to further the interests of consumers in relevant markets, where appropriate by promoting competition. Section 3(2), of the Act sets out a number of specific objectives that Ofcom is required to secure in carrying out its functions (focusing on goals that are specific to each of the sectors that Ofcom regulates). Section 3(3) of The Act requires Ofcom to, in all cases, have regard to the principles that regulatory activities should be transparent, accountable, proportionate, targeted, and consistent, and to otherwise reflect "best regulatory practice" as appropriate. Section 3(4) of The Act sets out certain matters to which Ofcom must have regard in performing its duties. Section 4 of The Act sets out Ofcom's duties for fulfilling Community obligations applies to certain functions of Ofcom, notably its functions under Chapter 1 of Part 2 of The Act. In particular, Section 4(3) outlines Ofcom's duty to promote competition.
- 2.6 In the context of Ofcom's approach to risk and return, these duties are of particular importance in those areas where a large element of uncertainty is involved regarding the most appropriate means of estimation, since Ofcom must exercise its judgement in such cases. The key examples from this consultation are the discussion of the equity risk premium, disaggregation of BT's equity beta, and the discussion of the relevance of real options theory to regulation. In these cases, Ofcom is on occasion obliged to rely on a degree of judgement, and in making its decisions will have regard to its duty under The Act.
- 2.7 The matters in Section 3(4) of the Act are of particular relevance here, including the desirability of promoting competition in relevant markets, and the interests of consumers in respect of choice, price, quality of service and value for money, as required by Section 3(5) of the Act.

- 2.8 Ofcom considers that the analysis and arguments outlined in this document are consistent with its obligations under The Act.
- 2.9 Ofcom's view is that a more robust approach to modelling the relationship between risk and return will bring about significant welfare improvements. It has, however, considered its initial views on the issues discussed in this document in the context of its duties under The Act. The discussions of Ofcom's duties under Sections 3 and 4 of the act carried out in relation to each of the specific proposals in sections 4, 5, and 6 of this consultation, when read in conjunction with the rest of this document, represents a Regulatory Impact Assessment (RIA), as defined by section 7 of the Communications Act 2003. Stakeholders should send any comments on this aspect of Ofcom's analysis by the closing date for this consultation. Ofcom will consider all such comments before deciding whether to implement its proposals.
- 2.10 RIAs provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making and are commonly used by other regulators. This is reflected in Section 7 of the Act, which means that generally Ofcom has to carry out RIAs in relation to proposals that would be likely to have a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. In accordance with section 7 of the Act, in producing the RIA in this document Ofcom has had regard to such general guidance as it considers appropriate, including related Cabinet Office guidance.
- 2.11 Ofcom places great importance on providing reasonable stability in relation to the regulatory contract, enabling companies to rely on regulatory guidance about likely future regulatory policy. As regulatory policy changes from time to time, Ofcom will ensure it fully considers the implications for parties affected.
- 2.12 This is particularly important where investment decisions, once made, are not reversible (sunk investments). Unpredictable changes in regulatory policy could have an adverse impact on the incentives for investors to engage in discretionary equity-financed investments. Ofcom therefore believes that it is important that it provides regulatory guidance about the future treatment of past investment to feed into investors' expectations about those investments, and that it commits to appropriate treatment of past investments in order to ensure assets are not expropriated and investors are suitably compensated for unforeseeable policy change.

### **Background to this review**

- 2.13 In the second Consultation Document of the Telecoms Review ([http://www.ofcom.org.uk/consult/condocs/telecoms\\_p2/](http://www.ofcom.org.uk/consult/condocs/telecoms_p2/)), Ofcom proposed seven regulatory principles, suggesting that Ofcom should:
- i. focus regulation on the deepest levels of infrastructure where competition will be effective and sustainable;
  - ii. ensure equality of access at those levels;
  - iii. as soon as competitive conditions allow, withdraw from regulation at other levels;
  - iv. promote a favourable climate for efficient and timely investment and stimulate innovation, in particular by ensuring a consistent and transparent regulatory approach;



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- v. accommodate varying regulatory solutions for different products, and where appropriate different geographies;
  - vi. create scope for market entry that could, over time, remove economic bottlenecks; and
  - vii. in the wider communications value chain, unless there are enduring economic bottlenecks, adopt light touch economic regulation based on competition law (i.e. regulate on an ex post basis) and the promotion of interoperability.
- 2.14 The approach adopted by Ofcom in determining the relationship between risk and return can play a key part in the translation of these proposed principles into regulatory policy.
- 2.15 In addition to its ongoing review of the telecommunications sector, Ofcom will in the coming months be making decisions that will require judgements about the cost of capital in relation to a number of communications markets. For example:
- in the cost of copper review, Ofcom aims to set out a list of principles designed to enable altnets to compete on an equal basis with BT in the provision of services that depend on the access network, in which enduring bottlenecks exist. The level of access charges is a key element of enabling competition in downstream markets; and
  - in the network charge control, Ofcom will consider setting BT's charges for a number of wholesale products, giving consideration to a number of issues including the impact of the introduction of "next generation" technology on BT's cost base.
- 2.16 Some of the issues covered by this consultation will have an impact on these reviews (for example by suggesting that the use of a different ERP or equity beta may be appropriate).
- 2.17 The areas on which this consultation will focus are:
- a brief overview of the theory of risk and return (Section 3);
  - an appropriate value for the equity risk premium (Section 4);
  - a discussion of variations in risk within the firm (Section 5); and
  - a discussion of the significance of real options theory in the context of regulation (Section 6).

## Section 3

# The Theory of Risk and Return

- 3.1 This section provides a brief overview of the models commonly used to estimate the rate of return required by investors, in exchange for bearing different levels of risk. Some aspects of this theory that are particularly relevant to Ofcom's current work are explored in more detail in subsequent sections.

### Why companies reward investors

- 3.2 Investors (shareholders) lend their capital to a firm by purchasing its equity capital. Managers are able to best serve the interests of shareholders by investing in projects that will generate a positive value. Doing so will maximise the current market value of the firm's outstanding shares, and hence shareholder wealth.
- 3.3 The text below describes some of the factors that influence the level of return that is demanded by a firm's shareholders. It uses a simple two-period example for ease of illustration, and assumes that the firm is entirely financed by equity, i.e. it has a gearing level of zero. The example first considers a scenario in which there is no risk, i.e. outcomes are certain, and later on discusses the impact of risk on the returns that are required by investors.

### Rewarding investors where outcomes are certain

- 3.4 Risk, and the role it plays in the level of return required by investors, is the central theme of this document. However, the first factor that determines why investors require a return on their investment is unrelated to risk, exists even in a world of perfect certainty, i.e. where the future can reliably be predicted without error<sup>2</sup>. The so-called "first basic principle of finance" states that a pound today is worth more than a pound tomorrow, because the former can immediately be put to an economically productive use, so money has a time value. Investments are worthwhile only where returns are greater than those that investors could earn by investing in capital market securities rather than the firm. In a two period example, where an initial investment of  $C_0$  taking place "now" is certain to lead to a net cash flow of  $C_1$  in one year's time, the investment's NPV is calculated as:

$$NPV = C_0 + \frac{C_1}{(1+i)}$$

- 3.5 In this example, the discount rate,  $i$ , is determined by the time value of money, i.e. the safe interest rate, and the future cash flow,  $C_1$ , is known with certainty.

### Rewarding investors where outcomes are uncertain/risky

#### *Sources of risk*

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<sup>2</sup> A similar set of principles applies if investors are risk-neutral. Throughout this document, it is assumed, in line with standard theory, that investors are risk-averse.

- 3.6 In practice, future outcomes are not certain (although over very short term horizons they may be close to being completely certain, e.g. tomorrow's state of the world is more predictable than the state of the world in a years' time), i.e. they are subject to risk.
- 3.7 Economic theory has developed different approaches to modelling risk. Most models share a common assumption about how investors make financial decisions. These decisions are based on the concepts of portfolio investing and diversification. Two types of risk are typically identified, commonly termed systematic (market or undiversifiable) risk; and specific (diversifiable or idiosyncratic) risk.
- 3.8 Economists differentiate between these two different types of risk because commonly used portfolio-theory based models assume that investors can, and choose to, hold a diversified portfolio of investments. This means that those risks that are specific to any particular company or product are diversified away by investors. For example, a firm selling ice cream faces significant demand risk because of the possibility that there will be a rainy summer, but investors are able to mitigate this by also investing in firms that sell umbrellas, which will face increased demand under the circumstances that are adverse from the perspective of an ice cream seller. Risks that are specific to a particular company are therefore not priced into investors' required rates of return and hence company cost of capital estimates.
- 3.9 Some risks, however, cannot be diversified away by investors, since, to varying extents, they will have at least some impact on nearly all firms within the economy. Many of the main examples of systematic risks are factors that have an impact on demand, such as fluctuations in GDP growth (such as a recession or boom), oil prices, and interest rates.
- 3.10 As stated above, specific (undiversifiable) risk relates to factors that are unique to a particular product or market, for example:
- despite buoyant growth in consumers' disposable incomes, and hence demand for goods and services in the economy as a whole, a particular new product may fail to become popular, or an existing popular product may cease to become popular; or
  - despite economy-wide productivity gains, the costs associated with a particular industry may increase because of, for example, a shortage of a particular labour or capital input that is indispensable to that industry, leading to increased production costs
- 3.11 Models based on portfolio theory (see below for a description of the most important of these) do not compensate equity investors for bearing specific risks, since investors are assumed to hold diversified portfolios of investments as described above.

*Taking account of risk within the NPV framework*

- 3.12 The formula set out after paragraph 3.4 is also used to calculate NPVs when outcomes are uncertain. It is, however, modified in two ways, since:
- the cash flows in period 1 are no longer known with certainty, and therefore must be estimated. The NPV formula is therefore based on **expected** future cash flows, denoted  $E(C_t)$  in the equation below; and
  - the discount rate,  $r$ , now includes an allowance for bearing systematic risk – so, rather than the risk free interest rate  $i$  used above, the relevant discount rate is the

company weighted average cost of capital, calculated using a portfolio theory based model.

3.13 These two points are reflected in the revised equation below:

$$NPV = C_o + \frac{E(C_1)}{(1+r)}$$

3.14 An important point to note is that, when assessing cash flows on an ex post basis, it should be recognised that there may be a discrepancy between the cash flows that are realised on an ex post basis and those that were expected on an ex ante basis. High cash flows that are realised on an ex post basis may partly reflect a reward for ex ante uncertainty, and, if correctly applied, the NPV framework offers investors a “fair bet”, in which the rewards from successful investments within the portfolio are expected to be sufficient to pay for the losses associated with unsuccessful investments, and additionally to allow an adequate return overall across the diversified set of investments.

*The need for care in using the NPV framework to model risk*

3.15 The NPV approach does not explicitly take into account the impact that the timing of investment may have on the level of risk that is faced by the firm. This issue is discussed in more detail in Section 6, which explains that, when a firm is faced with significant uncertainty, the option to “wait and see” before investing may be valuable, since important additional information relating to the factors that produce uncertainty will become available over time. This additional information is likely to be particularly valuable in mitigating specific risks, since, for example, in the early stages of a particular product’s life cycle, future demand for it may be very hard to predict with any confidence. Later on in the product’s life cycle, it will be possible to forecast the size of the relevant market with greater certainty.

3.16 This means that the ability to defer any investment commitment until such information is available may have significant value. This option must be weighed against, for example, any “first mover” advantage that may be gained by being first to market with a service. These and other related issues are discussed in more detail in Section 6.

### **The reward for bearing systematic risk**

3.17 As outlined in the previous subsection, one of the fundamental principles of finance theory is that the rate of return that investors will require from investing in an asset increases as the investment becomes more risky. This principle is based on the assumption that investors are risk averse, and require compensation for any risk that they choose to bear rather than investing in risk-free assets<sup>3</sup>. It can be argued that this theory has been borne out by historical data for all the world’s major stock markets, which show that returns on different classes of asset do vary in practice, with riskier assets earning higher returns on average. The figure below shows historic returns for the equity market and government bonds. The higher average return to equity over the long term reflects the higher perceived risk associated with this type of asset.

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<sup>3</sup> There are numerous references for the standard textbook treatment of risk and return. These include *Principles of Corporate Finance* by Brealey and Myers (7th Edition 2003), and *The Real Cost of Capital* by Ogier, Rugman and Spicer (2004).

**Figure 1 - Average annual nominal returns (arithmetic mean) from government bonds and equities over the period 1900 to 2003**

<i>Index</i>	<i>Bonds</i>	<i>Equities</i>
<i>UK</i>	<i>6.0%</i>	<i>11.4%</i>
<i>USA</i>	<i>5.2%</i>	<i>11.7%</i>
<i>World</i>	<i>5.0%</i>	<i>10.2%</i>

Source: Dimson, Marsh and Staunton, Global Investment Returns Yearbook 2004, Tables 70 (p. 149), 74 (p. 155), and 78 (p. 161)

- 3.18 The level of compensation required by investors is commonly referred to as the company's cost of equity or debt capital. A company's weighted average cost of capital is simply the weighted average (with weights based on the proportion of its total financing that is accounted for by equity and debt capital respectively) of its cost of equity and cost of debt. The level of a company's cost of capital is equal to the expected return that could be gained from an alternative investment opportunity of equivalent risk that is available in the capital market, i.e. it is an opportunity cost.
- 3.19 In the context of this consultation, Ofcom is only concerned with its approach to determining a company's cost of equity, since it believes that there are currently a number of key issues to be considered in this area. The remainder of this section discusses some of the main determinants of the cost of equity, and how these are modelled in practice.

### **Approaches to modelling systematic risk**

- 3.20 As outlined in the previous subsections, the existence of uncertainty has two implications for calculating the rate of return required by investors. The first of these is that calculations must be based on expected, rather than actual, cash flows. The second is that cash flows must be discounted using a risk adjusted cost of capital.
- 3.21 The models most commonly used to estimate the rate of return that equity investors expect in return for bearing risk (commonly referred to as "asset pricing models") are the CAPM, Arbitrage Pricing Theory (APT), and the Fama-French Three Factor Model. These are briefly described below:
- CAPM – this is a one factor model where systematic risk is a function of the correlation between the returns to the firm and the returns to the stock market. Although it remains the most widely used of the asset pricing models, empirical tests of the CAPM carried out in recent years have in some cases called the robustness into question;
  - APT – while the CAPM explains the difference in risk and return between companies by reference to a single factor, i.e. correlation with the market, the APT assumes that returns are best explained by a number of factors (which will typically include the return on the market portfolio). These typically include pervasive macroeconomic influences such as the volatility of oil prices, interest rates, exchange rates, and so on; and

- Fama-French Three Factor model – this model is, strictly speaking, a special case of the APT, but can also be thought of as an enhancement to the CAPM. Instead of one factor, this model has three: a market factor; a company size factor; and a book/market value factor. It is not easy to provide an underlying economic rationale for why these factors explain returns, but this model has, to some extent, been supported by the results of certain empirical studies.

3.22 Ofcom's preferred approach, in line with the other UK economic regulators and the Competition Commission (CC), is to use the CAPM. This is also consistent with its wide use amongst practitioners. The CAPM has a clear theoretical foundation and its implementation is simple and well established relative to that of other asset pricing models. This was summarised by Wright, Mason and Miles ("WM&M"), 2003, A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK, which concluded:

*In summary: the empirical shortcomings of the CAPM are known. Alternative models to address this issue have their own shortcomings - weak theoretical foundations and empirical challenges. In our view, there is at present no one clear successor to the CAPM for practical cost of capital estimation.*

3.23 It is worth re-iterating that the CAPM, in line with portfolio theory, does not compensate equity investors for bearing unsystematic (company specific) risks. This follows from the fact that, as explained earlier, investors are assumed to hold diversified portfolios of investments, such that specific risks are diversified away, meaning that there is no reward in investors' rates of return for bearing them. The implication of this is that the cash flows to which the WACC should be applied are mean or expected values; they are the mean of a probability distribution of all possible outcomes.

3.24 Under the CAPM methodology, the cost of equity is built up from three main factors. These are:

- the risk free rate;
- the expected market equity risk premium; and
- the value of beta for the company in question.

3.25 The relationship between these factors can be summarised by the following formula (where *RFR* represents the risk free rate and *ERP* refers to the equity risk premium):

$$\text{Cost of equity} = \text{RFR} + (\text{ERP} \times \text{beta})$$

3.26 The risk free rate is simply the expected rate of return on a risk free investment. The expected equity risk premium is the expected return on equities over and above the risk free rate (that is, it is the expected reward for holding equities compared with the reward for holding risk free assets). The value of beta reflects the variability of returns of the equity of the company in question compared with the variability of returns on the equity market.

3.27 Similarly, the cost of debt can be expressed as (where the debt premium is the company specific risk premium for corporate debt above the risk free rate.)

$$\text{Cost of debt} = \text{RFR} + \text{Debt premium},$$

3.28 The WACC takes account of the cost of equity and the cost of debt by weighting each of these by the proportion of equity and debt<sup>4</sup> respectively in a company's financial structures in the following way (where Gearing = Debt / (Debt + Equity)):

$$WACC = (\text{Cost of equity} \times (1 - \text{Gearing})) + \text{Cost of debt} \times \text{Gearing}$$

## Summary

3.29 This section has outlined a number of key principles relating to risk and return, namely that investors require:

- a return that reflects the time value of money; and
- a return that rewards them for bearing systematic risk.

3.30 Sections 4 and 5 discuss a number of issues relating to how the rewards for bearing systematic risk should be calculated, while Section 6 discusses some particular industry risks and explains how they can have implications for the use of NPV analysis within a real options framework.

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<sup>4</sup> This formula assumes that the post-tax cost of debt is used.

## Section 4

# The Equity Risk Premium

### Introduction

- 4.1 Section 3 introduced the concepts of the cost of capital and the cost of equity. Under the CAPM (and other portfolio based approaches) approach to estimating a company's cost of equity, the equity risk premium ("ERP") is a key parameter. In this Section Ofcom discusses the appropriate value for the ERP in a regulatory context, and proposes what it considers to be an appropriate range of values.
- 4.2 The ERP measures the difference between the return from investing in a risk free asset and investing (in a fully diversified manner so as to mitigate company specific risk) in an appropriate market index of risky assets. It is an expected return, the value of which depends on the level of perceived risk associated with the equity market and the level of investors' risk aversion.
- 4.3 Practitioners and academics have carried out a large number of investigations into the value of the ERP, using both quantitative techniques and surveys. These studies have produced a range of widely differing estimates, meaning that, in practice, the UK economic regulators and the CC need to choose a value from within the plausible range implied by these studies, taking into account both subjective judgements and specific policy objectives.

### Alternative estimation methods and estimates

- 4.4 Estimating the ERP is not an end in itself. The key objective of all ERP estimation exercises is to provide a basis for predicting the return that investors will require in the future in return for investing their capital in the equity market. A number of different methods are used in order to measure these forward looking expectations. These may be based on historical investment returns, i.e. an ex-post approach, or alternatively based only on forward-looking considerations, i.e. an ex-ante approach. This Section considers the following estimation methods:
  - *Ex post estimation:*
    - extrapolating historical risk premia;
    - extrapolating adjusted historical risk premia; and
  - *Ex ante estimation:*
    - Using the dividend growth model
    - Surveys of academic and practitioner expectations.
- 4.5 Each of these is discussed in the sections below.



## Ex post estimation: extrapolating historical risk premia

4.6 Historic risk premia are calculated as the difference between the return earned from the equity market and that earned from government bonds. The recent work carried out by Dimson, Marsh and Staunton<sup>5</sup> (“DMS”) is widely regarded as being one of the most authoritative sources of historical estimates. It addresses a number of methodological problems that earlier studies had largely failed to deal with. These include the measurement of total returns over a relatively long time period, the inclusion of a large sample of countries and adjustments for survivorship bias. Figure 2 below summarises the historic risk premia presented by DMS for UK and World<sup>6</sup> equity market indices.

**Figure 2- Risk premia based on asset price data for the period 1900-2003**

	Relative to Bills		Relative to Bonds	
	GM	AM	GM	AM
<b>UK</b>	4.3	6.0	4.0	5.3
<b>World</b>	4.6	6.0	4.0	5.1

Source: Dimson, Marsh and Staunton, Global Investment Returns Yearbook 2004, Tables 70 (p. 149) and 78 (p. 161)

- 4.7 The figure above highlights a number of issues that are relevant to the calculation of the historical risk premium. These are discussed in turn below:
- definition of the safe rate – DMS measured total equity returns, and obtained risk premia by comparing these against a “safe” rate. Two different safe rates are used by DMS, namely “bills”, i.e. short term (less than one year) government debt and “bonds” i.e. longer term government debt. There is a reinvestment risk associated anything other than very short term government debt, meaning that, strictly speaking, longer term government debt is not “risk free”, but the use of gilts as a proxy for a safe rate is a widely accepted convention, and this is the approach taken by Ofcom. Ofcom’s standard approach in identifying a safe rate is to use one with a maturity that corresponds to the time horizon over which the rate of return is to be applied, or alternatively one that reflects the economic life of the relevant assets;
  - arithmetic or geometric mean - the arithmetic mean will be larger than the geometric mean whenever returns vary over time. There remains no firm consensus amongst academics over which method forms a more appropriate basis for a forward looking analysis. This issue is discussed in WM&M, which provides a balanced discussion of the relevant issues, at the end of which the authors express a “weak” preference for using the arithmetic mean.
  - world or country indices – the estimates presented in Figure 2 above show that the UK and World premia are close together, which means that the choice between indices is not currently a key issue. This notwithstanding, the estimation of a World premium may offer advantages over a country specific premium. Firstly, a global

<sup>5</sup> Dimson, Marsh and Staunton, 2002, “Triumph of Optimists: 101 Years of Investment Returns”, ABN AMRO and London Business School; Dimson, Marsh and Staunton, 2003, “Global evidence on the equity risk premium”, Journal of Applied Corporate Finance, 15(4) 27-38; Dimson, Marsh and Staunton, 2004, “Global Investment Returns Yearbook 2004”, ABN AMRO, London Business School.

<sup>6</sup> The World equity market includes 16 countries.

risk premium utilises many more data points than any one country risk premium, enabling more robust estimation. Secondly, a global perspective to the ERP avoids focusing on relatively successful markets such as the US or the UK that may have outperformed expectations over the last century or more. The choice between a domestic or world index depends upon the degree to which capital markets are integrated or segmented and how internationally diversified UK investors are i.e. the extent of the “home bias”. UK investors continue to exhibit a significant “home bias”, meaning that a UK premium may better reflect the expectations of domestic investors.

- 4.8 Based on the above discussion, Ofcom’s view is that some weight should be given to historic premia that are:
- measured relative to bonds;
  - calculated on an arithmetic and geometric basis (with probably a somewhat greater emphasis placed on the former as suggested by WM&M); and
  - calculated with reference to both world and domestic equity markets.
- 4.9 The estimates presented in Figure 2 suggest that it would be appropriate to give weight to historic premia of between 4.0% and 5.0%. Within this range, more weight should probably be attached to values that are towards the higher end of this range, which are calculated on an arithmetic basis. The following sections discuss the results obtained using alternative estimation methods.

### **Ex post estimation: extrapolate adjusted historical risk premia**

- 4.10 Simply extrapolating historic returns in order to estimate the future ERP is a reasonable approach if the average risk premium achieved provides an unbiased estimate of today’s expected ERP. It has been widely argued that this assumption may not be realistic, based on the following two considerations:
- *ex post* historical experience is unlikely to have reflected *ex ante* investor expectations at the time and therefore does not provide an indication of the expected ERP; and
  - the future may not be like the past.

- 4.11 These two arguments are considered in the two subsections below.

#### **Historical experience did not reflect expectations at the time**

- 4.12 DMS have conjectured that the historic risk premia are likely to over-estimate the future ERP, due to the market having outperformed the expectations of investors over the last century i.e. investors could not reasonably have expected to experience such prolonged periods of growth and economic stability, particularly in the US economy. DMS adjust for this apparent out-performance of expectations by making a downward adjustment to historical premia. Ofcom’s view is that it is reasonable to give some weight to such an adjustment.

#### **The future is not like the past**

- 4.13 There are a number of arguments to suggest that changes in the level of risk associated with the equity market may mean that the ERP will be lower in the future than was the case in the past. These include the following:

- Investor confidence has grown leading to a re-rating of equities. DMS observed a step upward change in price/earnings ratios. This means that either investors are expecting faster earnings/dividend growth than in the past and/or are requiring a lower risk premium. By taking into account current forecasts for earning/dividend growth DMS were able to make a downward adjustment to the historic risk premium;
- The risk premium is now associated with a portfolio that is less risky. The equity market is more diversified in terms of the breadth of companies and industries<sup>7</sup>;
- There may be even more reason to view the ERP at the World level. International diversification is now easier with lower transaction costs and cross border listings as well as companies themselves becoming more international;

### Summary on extrapolating adjusted historic risk premia

4.14 Figure 3 below sets out the historic risk premia in DMS (2002), together with corresponding prospective risk premia after the DMS downwards adjustments for out-performance of expectations and the re-rating of equities. DMS set out these adjustments for the premia calculated relative to bills (see above for definition).

**Figure 3- DMS ERP historic and prospective estimates relative to bills for the period 1900 to 2000**

	Historic premia		Prospective (adjusted) premia	
	GM	AM	GM	AM
<b>UK</b>	4.8	6.5	2.4	3.7
<b>World</b>	4.9	6.2	3.0	4.0

Source: Dimson, Marsh and Staunton, 2002, Section 13.7

4.15 Adjusting for out-performance of expectations and the re-rating of equities leads to a downwards adjustment of approximately 2%. DMS have not presented adjusted ERPs relative to bonds and, additionally, they have not updated their adjustments to include the years 2001-2003. In its calculations Ofcom has therefore applied this overall downward adjustment of 2% to the range for the historic ERP of 4% to 5% that is set out in the previous subsection. This implies a range for the adjusted or prospective ERP over bonds of 2% to 3%. Again, Ofcom's inclination is to give more weight to the higher figure, since this has been calculated on an arithmetic basis.

### **Ex ante estimation - estimates not based on historic returns**

4.16 The ERP can be estimated without recourse to the analysis of historical data. Such estimation methods have been used in recent years by, for example the Competition Commission in the UK has recently put weight on such estimates.

4.17 The first alternative method of estimation is based on forecasts of dividend growth. It is possible to calculate an "implied" ERP using current market values and forecasts for earning/dividends. Such an approach is based on rearrangement of a formula relating

<sup>7</sup> See PricewaterhouseCoopers, 2003, "Rates of return for FSA prescribed projections", available on FSA website.

share prices to expected future dividends. It can be shown that the current market value of stocks is determined by the following equation:

$$P_o = \frac{D_1}{r_f + ERP - g}$$

$P_o$  = Current market value

$D_1$  = Dividend in the next period

$r_f$  = Risk-free rate

ERP = Equity risk premium

$g$  = Dividend growth rate

4.18 This can be arranged to give:

$$ERP = \frac{D_1}{P_o} + g - r_f$$

4.19 In this equation,  $D_1$ ,  $P_o$ , and  $r_f$  are known, so the ERP can be estimated once an estimate of  $g$  is obtained.

4.20 The figure below sets out the results from recent studies of this type. An approximate midpoint of this range is about 3.5%, or about 4.0% if only UK figures are used.

**Figure 4 - Implied ERP based on market values and forecasts**

Source	ERP
PwC on behalf of the FSA (2003)	US 3.9% (as at Oct 2002) UK 4.1% (as at Oct 2002)
Fama and French (2002) <sup>8</sup>	US 3.5% (1872-2000, dividend yield model) US 2.6% (1951-2000, dividend yield model) US 4.3% (1951-2000, price earnings model)
Claus and Thomas (2001) <sup>9</sup>	US 3% (1985-1998)

4.21 The second type of ex ante estimation method is based on the use of surveys carried out amongst academics and practitioners, in which participants are directly asked to quantify the returns that they expect from the equity market over a particular time horizon. These expectations may be informed by a wide range of methods, (including ex post estimates) depending on the preferences of each individual participant. The figure below sets out the results from some recent ERP surveys. The views of practitioners (fund managers and financial professionals) appear to be clustered in the range 2% to 4%. The views of academics appear to produce higher estimates, with a range from 3% to 7%.

<sup>8</sup> Fama and French, 2002, "The Equity Premium", Journal of Finance, 57.

<sup>9</sup> Claus and Thomas, 2001, "Equity Premia as Low as Three Percent? Evidence from Analysts' Earnings Forecasts for Domestic and International Stock Markets", Journal of Finance, 56.

Figure 5 - ERP survey results

Source	ERP	Participants/Time horizon
PricewaterhouseCoopers, on behalf of the FSA (2003)	2%-4%	Fund managers/15 years
Graham and Harvey (2003) <sup>10</sup>	3.8%	US CFOs/10 years
Goldman Sachs (2002) <sup>11</sup> Welch (2001a) <sup>12</sup>	3.9% 7% 6%-7%	Global companies Academics/ 10-30 years Academics/ 1-5 years
Welch (2001b) <sup>13</sup>	3%-3.5%	Academics/1 year
Welch (2001b)	5%-5.5%	Academics/30 years
Merrill Lynch (2001)	4%	Fund management professionals
OXERA (1999) <sup>14</sup>	4.8%	FTSE 100 companies

### Regulatory benchmarks

4.22 The UK's economic regulators and competition authorities have adopted a range of measures for the ERP in recent years. They (other than the estimate previously used by Ofcom/Oftel) are consistent with a range of about 2.5% to 5%, as shown in the figure below:

<sup>10</sup> Graham and Harvey, 2003, "Expectations of Equity Risk Premia, Volatility and Asymmetry", Working Paper, Duke University.

<sup>11</sup> GoldmanSachs, 2003, "The ERP: Its Lower than You Think", CEO Confidential, Issue 2002/14.

<sup>12</sup> Welch, 2001a, "Views of Financial Economists on the Equity Premium and on Professional Controversies", Journal of Business, 73.

<sup>13</sup> Welch, 2001b, "The ERP Consensus Forecast Revised", Cowles Foundation Discussion Paper No.1235

<sup>14</sup> OXERA, 1999, "Hurdle Rate Study"

Figure 6 - Regulatory benchmarks

Source/Year	ERP	Context
Ofcom, 2004	5.0%	Various, e.g. Partial Private Circuits charge control, TV licence renewal, mobile termination charges
Ofwat, 2004	4.0%-5.0%	Future water and sewerage charges
Ofgem, 2004	3.5%, based on range of 3.0%-4.0%	Electricity Distribution Charge control Review
CAA, 2003	2.5%-4.5%	Economic Regulation of BAA London Airports (Heathrow, Gatwick and Stansted) 2003 – 2008, decided to use the then-recent Competition Commission range
FSA, 2003	3.0%	Rates of return for prescribed projections
CC, 2002	2.6%-4.6%	Calls to Mobiles. Noted that the extent of uncertainty concerning the downward trend in recent years made a degree of caution appropriate when implementing this decline, in part to help prevent volatility in the short term. It felt that this factor was most appropriately taken account of not by modifying their judgement of the range for the equity risk premium but by increasing the overall level of the WACC by 0.25% in real terms. This adjustment would be consistent with, for example, increasing the upper bound of its range for the ERP from 4.6% to 4.8%, and the midpoint of its range from 3.6% to 3.7% (or alternatively increasing the lower bound of its range from 2.6% to 2.9%).

### Ofcom's objectives in determining the ERP

- 4.23 In determining an appropriate value for the ERP, Ofcom has looked to previous decisions by Oftel/the other legacy regulators, the Competition Commission and other UK utility regulators. However, given the values for the ERP adopted by these regulatory bodies (see the figure above) there is a range of reasonable values that Ofcom could adopt.
- 4.24 The principal issue for Ofcom in choosing an appropriate ERP within the plausible range of estimates is to balance the relative risks of setting a cost of capital that is too high with one that is too low. Ofcom must take into account both the short and long term impacts on consumers and firms.
- 4.25 In following its statutory duties, Ofcom has considered the impact of under- or overstating the level of risk inherent in equity investments (and hence the appropriate ERP).
- 4.26 Excessive rewards may lead to:
- consumers paying prices that are above the competitive level, leading to an overall welfare loss; and
  - investments that are not fully justified by consumer demand being made (and, possibly, investments in other areas that are justified by consumer demand not being made as a result)

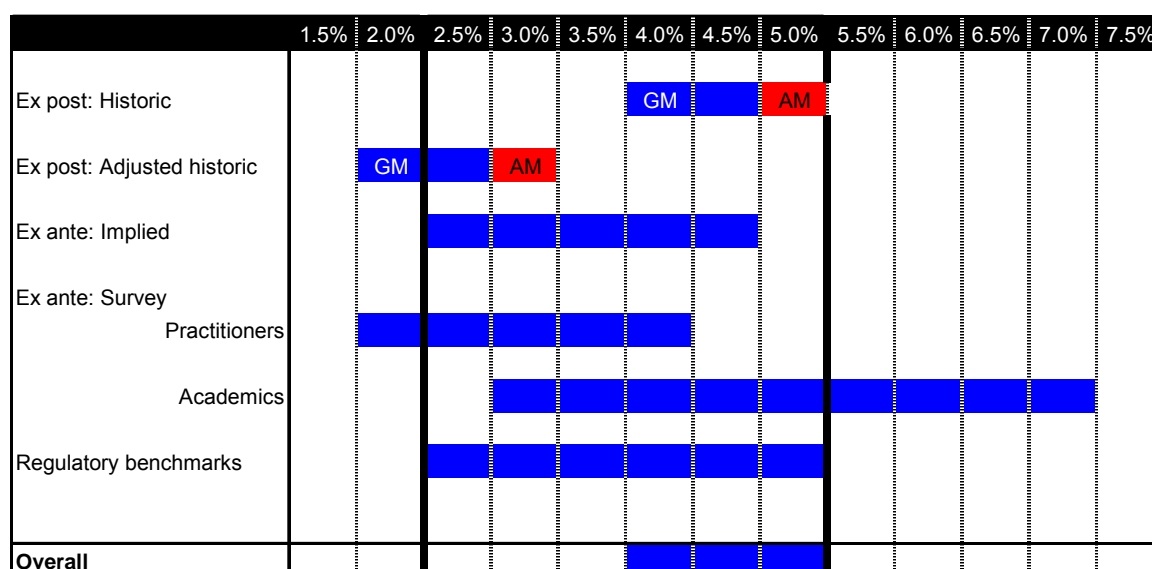
4.27 However, while setting rewards too low will lead to consumers benefiting from lower prices in the short run; it may also lead to discretionary investment being discouraged, meaning that the levels of infrastructure-based competition and innovation are at sub-optimal level.

4.28 Given the duties and objectives outlined above, Ofcom believes that the costs associated with setting too low a cost of capital are greater than those associated with setting it too high. This has been taken into account in the arguments outlined in its discussion of the ERP.

### An appropriate value for the ERP

4.29 The figure below summarises the ERP estimates discussed earlier.

**Figure 7 – Summary of ERP evidence**



4.30 In deciding on an appropriate value for the equity risk premium, Ofcom has taken into account a range of evidence, both historical and forward-looking. As outlined above:

- unadjusted historical estimates point to a range of about 4% to 5%;
- adjusted historical estimates suggest a range of about 2% to 3%;
- forward-looking implied ERPs suggest a range of about 2.5% to 4.5%;
- surveyed practitioners suggest a range of about 2% to 4%, and surveyed academics suggest a wider range of about 3% to 8%, with a central estimate of about 5%. Practitioners may be slightly more conservative than academics in their predictions; and
- prior regulatory experience (excluding the estimates previously used by Ofcom and Oftel) suggests a range of about 2.5% to 5%.

4.31 Overall, this evidence leads to a range of between 2% and 5% (this range is shown in the figure above between the two heavy vertical lines). This suggests that Ofcom's previously used value of 5% is at the very top of end of a plausible range of estimates.

4.32 Given Ofcom's concerns about the risk associated with taking too low a value for the ERP, and the relatively wide range of estimates that are obtained using different

approaches, Ofcom proposes that, as an alternative to its previous estimate of 5%, a figure of either 4.0% or 4.5% would be appropriate and in line with regulatory precedent.

- 4.33 Section 2 of this document provides a brief overview of some of Ofcom's key duties under Sections 3 and 4 of the Communications Act. In proposing the most appropriate values from within this range, Ofcom has, amongst other things, had regard to Section 3(4)(d) of the Communications Act 2003; i.e. to have regard to the desirability of encouraging investment and innovation in relevant markets when exercising its duties. Ofcom's duty to promote competition under Section 4 of The Act is also an important factor to consider. By proposing values that are towards the upper end of a reasonable range, Ofcom has ensured that companies are provided with incentives to invest, and to engage in infrastructure-based competition where this is feasible. However, too high a value could lead to inefficient entry, and to consumers paying prices that are too high. In proposing its range of estimates Ofcom has also had regard to its Section 3(5) requirement in performing its duty to have regard to the interests of consumers in respect of choice, price, quality of service and value for money, and to its Section 4 duties, since setting regulated access charges at a reasonable level will encourage competition at a downstream level.

**Question 1:** *Do you agree that 2% to 5% represents a reasonable range of values for the ERP? Within this range, do you agree that Ofcom should revise its central estimate downwards from 5% to 4.0% or 4.5%? Which of these is the most appropriate?*



## Section 5

# Variations in Risk within the Firm

### Introduction

- 5.1 In the communications industry, firms typically sell a range of wholesale and retail services in markets that may be characterised by widely varying cost and demand conditions. The extent of the systematic and specific risks that apply to firms in such cases will vary considerably across products and services, even where services run over a shared physical infrastructure. For example:
- BT provides a wide range of retail and wholesale activities, including well-established products such as voice call origination and termination, new products such as broadband services, and as yet undeveloped services that will be offered via 21st Century networks;
  - mobile network operators offer a wide range of services, ranging from mature services such as voice call origination and termination to ones that are still emerging, such as 3G data services; and
  - UK media companies are engaged in a wide range of activities in areas such as programming and broadcasting.
- 5.2 This means that it is appropriate to view some large companies such as BT as being a group that consists of a number of firms, or projects, each with its own unique risk profile, that operate together under common ownership.
- 5.3 Ofcom typically undertakes financial analysis (e.g. setting the charges for, or margins between, wholesale services) relating to a **subset** of these large companies. This Section introduces the question of whether Ofcom's financial analysis should reflect variations in risk within a company, and discusses how these variations might be modelled.

### Adjusting the project reward through the cost of capital or cash flows

- 5.4 If projects with different levels of risk are to be rewarded differently, then, in a regulated environment, one (or indeed a combination) of two possible approaches could be used, namely:
- allowing different costs of capital on different projects; and
  - adjusting the cash flows on the projects.
- 5.5 Whilst these approaches can be constructed to be arithmetically equivalent on an ex ante basis, adjusting the cost of capital will affect the discounting of all cash flows to an extent that is dependent solely on their timing. However, applying adjustments directly to cash flows makes it easier to focus on individual elements of risk within a company. Ofcom's initial view is therefore that
- higher or lower systematic risks are most appropriately dealt with by adjusting the project's cost of capital in line with the CAPM framework, using different project/activity betas; and

- where specific risks relate to particular types of uncertainties then they are more appropriately dealt with by adjusting the cash flows to which they relate (e.g. through adding a contingency to investment costs for investment cost risk or reducing expected revenues for demand risk) rather than through general adjustments to the cost of capital, which will affect all the cash flows on the project.
- 5.6 In the context of the assets used to support charge controlled services, it is important to note that many investments will generate cash flows that relate to more than one charge control period. In such cases it will be important to ensure that any higher (or lower) expected rewards are preserved across price reviews and that the timing of the price review does not affect the expected reward from the investment.
- 5.7 Adjusting expected upfront cash flows that fall within the current price control period (e.g. construction costs) does not require any special treatment at future reviews (which may adjust the company WACC), since any higher or lower return would be included in the regulatory asset base. Ofcom would, however, need to consider how to treat contingencies for, e.g. future demand risk and ensure consistency with demand forecasts used in the charge control review.
- 5.8 If the adjustment is through the cost of capital, then investments spanning a number of price control periods would require a separate account to be kept in order to ensure that higher or lower returns are maintained at future controls. This could be formulated as a fixed future return (with the project cost of capital being independent of the determination of the company cost of capital at the future price control review) or a relative future return (with the project cost of capital being a premium or reduction on the company cost of capital).
- 5.9 Either approach is likely to lead to a significant increase in complexity in the regulatory accounts and price control models and to a higher degree of regulatory intrusion.

**Question 2:** *Do respondents think that if projects with different risk profiles are to be rewarded differently, this should be through the cost of capital or the cash flows or should it depend on the types of risks involved? How would such extra (or reduced) rewards be treated in future financial analysis (e.g. at future charge control reviews)?*

## Variations in systematic risk

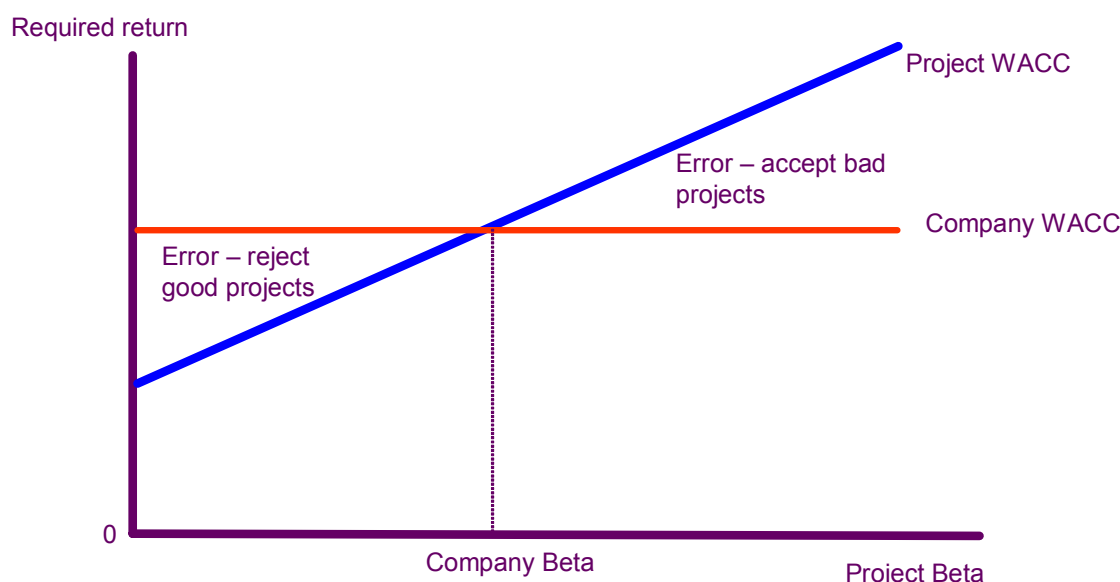
### Introduction

- 5.10 As outlined in Section 3, under the CAPM, differences in specific risks across projects will not feed through into differences in the rate of return required by investors. The same is not, however, true of systematic risk. The rationale for this is that investors require higher returns for bearing higher systematic risk because it cannot be diversified, and this is reflected in the CAPM methodology. This means that it might be appropriate to reflect this in the estimation of the cost of capital by a disaggregation of the calculation in order to reflect different levels of systematic risk across different parts of the company.
- 5.11 If, for all projects, the company WACC and expected cash-flows are used as a basis for investment appraisal or regulated charge setting (rather than the allowed return reflecting the systematic the risk of the particular project), then there is a possibility of suboptimal market decisions being made. Where a significant proportion of investment is discretionary, a company will reject some “good” low risk projects which should be

accepted under a (lower) cost of capital that reflected the systematic risk of the project, and accept some “bad” high risk projects that should be rejected under a cost of capital reflecting the true (higher) systematic risk of the project. This is shown in the figure below, where the two triangular areas represent these two types of error:

- some “good projects” (i.e. ones with an expected return that is above a project – level WACC, were one to be calculated) with an expected return that is below the company WACC will be incorrectly rejected (this is represented by the triangular area below the company WACC and above the “project WACC” line); and
- some “bad projects” (i.e. ones with an expected return that is below a project – level WACC, were one to be calculated) with an expected return that is above the company WACC will be accepted (this is represented by the triangular area above the company WACC and below the project WACC line)

**Figure 8 – mistakes in investment appraisal when using a single company WACC**



5.12 The discussion preceding Figure 8 relates to a firm that is conducting an investment appraisal. However, it is equally applicable in a regulatory context in which the required (or permitted) rate of return is set by a regulator – the use of a single rate here may lead to the same two types of errors shown in the Figure 8. Ofcom’s initial view is therefore that it is appropriate to reward projects with different levels of systematic risk differently in a regulatory context. If this approach were to be pursued in practice, though, it would be necessary to establish a robust process for assessing the differential risks. Ofcom would welcome the views of stakeholders on how to assess these risks and whether it is possible to establish a sufficiently robust methodology to make a disaggregated approach workable.

5.13 The alternative to this approach would be to continue to use a single WACC estimate. The chief merit of the use of a single estimate would be that it requires less use of Ofcom’s judgement. This approach would also be appropriate if the differences in systematic risk relevant to the main regulated products offered by regulated firms were so small as to make no significant difference to WACC estimation, or not possible to incorporate in practical terms. However, as explained in the following subsections, Ofcom’s initial view is that these conditions might not hold, and that a disaggregation

may therefore be appropriate. Ofcom is particularly interested in the views of stakeholders on this issue.

- 5.14 Section 2 of this document provides a brief overview of some of Ofcom's key duties under Sections 3 and 4 of the Communications Act. The discussion of the ERP outlined in Section 4 of this document outlined the importance of Ofcom's Section 3(1), Section 3 (4), Section 3 (5), and Section 4 duties in, where Ofcom's judgement must be used, balancing the short term interests of consumers against the need to avoid discouraging efficient investment. A similar set of considerations applies when deciding whether to reward projects with different systematic risks differently, since an element of judgement is required on Ofcom's part. Departing from the use of a single beta estimate (to the extent that this can be done in a robust fashion) would, by preventing excessive returns being earned with regard to low-risk products, improve consumer welfare with regard to such products, by promoting downstream competition. It will also discourage inefficient investment.
- 5.15 Another key consideration to consider in this context is whether, as is set out in Section 3(3) of the Act, rewarding projects with different levels of systematic risk differently is consistent with regulatory best practice. Ofcom's initial view is that the arguments outlined in the remainder of this Section mean that its approach is consistent with this duty, being in line with widely used financial theory and the approach taken by firms in a commercial context.

**Question 3:** *Do respondents think that projects or business units with different systematic risks should be rewarded differently? If so, is it possible to establish a robust methodology by means of which the systematic risk of these projects could be assessed and the adjustment to the reward determined?*

- 5.16 In the CAPM, systematic risk is measured by a firm's equity beta, which measures the correlation between the returns of an individual firm or activity with those of the market as a whole (and hence, approximately, aggregate demand). The magnitude of an equity beta is determined by the extent to which (see, for example page 237 of Brealey & Myers for a discussion of this in the context of a company's asset beta, which, together with its level of financial leverage, determines its equity beta):
- demand for the relevant product(s) is correlated with market returns, i.e. aggregate demand; and
  - additional units of output have an impact on the firm's profits i.e. the extent of operational leverage – this will tend be greater the higher is the proportion of the firm's costs that are fixed
- 5.17 Ofcom is currently considering whether it is appropriate for its financial analysis to take account of variations in systematic risk across a given firm's range of activities. Within the CAPM framework, this can be achieved via the use of different beta estimates for the firm's different activities. However, it is very difficult to observe disaggregated betas, since projects or company divisions are not traded on the stock market and do not have a share price. One way in which this can be estimated is by identifying companies with risk profiles similar to those of the activity being contemplated, and using the betas of these firms as benchmarks in relation to the activity in question. Ofcom has considered the evidence available with regard to BT.
- 5.18 In practice, developing and agreeing a robust quantified assessment of the riskiness of each investment so as to set the appropriate level of rewards for the activity would be

likely to be a difficult and controversial process, and to increase regulatory involvement in the investment process. Ofcom's view is therefore that only a limited disaggregation is ever likely to be appropriate, focusing only on easily identifiable and substantial parts of the company where levels of systematic risk are likely to vary substantially. This is discussed further later on in this section.

### **Systematic risk and equity beta estimates for BT**

- 5.19 Equity betas reflect the amount of systematic risk that applies to a particular stream of cash flows by measuring the covariance between market returns and those of the company or project.
- 5.20 It is important to note that, since a firm's equity beta is determined by its equity returns, i.e. dividends and share price changes, expectations of future generated cash flows (rather than current cash flows) may play a more significant part in determining the level of a firm's equity beta than current cash flows. These expectations may relate to services that are either not currently offered by the firm, or that do not form a significant part of its product range. For example, the very rapid increase, followed by decline, in Telecoms, Media and Technology ("TMT") share prices associated with the TMT "bubble" at the turn of the millennium was caused primarily by changes in the expectations of investors regarding companies in these sectors, rather than changes to actual cash flows observed at the time. On a related note, equity betas are typically calculated with reference to historical data in order to proxy the relationship between firm and market returns on a forward looking basis.
- 5.21 The overall amount of systematic risk faced by a company is determined by the total systematic risk inherent in each of the activities that it undertakes. To the extent that these differ, it may be desirable to disaggregate a company level beta estimate into distinct components, in order to make sure that financial analysis more closely reflects the level of risk inherent in the activities to which the analysis relates. If, for example, a company, with equity beta  $\beta$ , is made up of two distinct projects, A, and B, with equity beta  $\beta_A$  and  $\beta_B$  respectively, then the firm level equity beta is equal to the weighted average of the equity betas of the two individual projects.

$$\beta = W_A \beta_A + W_B \beta_B$$

- 5.22 The weighting factors  $W_A$  and  $W_B$  should in theory be determined by the relative market or economic values of each project. Since such values are generally not observable in practice, if a beta disaggregation is to be attempted, suitable weights need to be used as a proxy. The best proxy, if available, might be the present values of the future cash flows associated with each project. In cases where such data are not unavailable, other measures could be used, such as the book value of the assets employed in each project. Alternatively, a measure of profitability such as multiples of EBITDA or revenue could be used.
- 5.23 As outlined in Ofcom's *Partial Private Circuits Charge Control - Final Statement*, published 30th September 2004 ([http://www.ofcom.org.uk/consult/condocs/ppc\\_charge\\_control/](http://www.ofcom.org.uk/consult/condocs/ppc_charge_control/), "the PPC charge control"), recent analysis carried out on behalf of Ofcom by The Brattle Group showed that the centre of a reasonable range of estimates of BT Group's equity beta is equal to 1.3. As suggested above, this group figure should be viewed as a weighted average of the equity betas of a number of individual activities.
- 5.24 BT Group incorporates a large number of different activities and products (some of which are regulated) in the UK alone. Of these, a significant proportion relates to

regulated products, and for a subset of these the level or structure of pricing is determined by Ofcom. As outlined above, Ofcom believes that it would be impractical to attempt to break up beta estimates so as to reflect all of the differences between these activities. However, a less wide-ranging delineation may be more appropriate, and could be used to take account of some of the most important variations in systematic risk across BT, subject to the weighted average of the cost of capital for all activities adding up to the company WACC.

- 5.25 In particular, Ofcom's initial view is that it would be appropriate to isolate the special case of wholesale regulatory products that give retail operators access to BT's copper access network. The revenues earned by these assets are primarily related to exchange line services. These may involve significantly less systematic risk than BT group as a whole. This is because they are mature, "essential", products, whose returns are not closely correlated with short-term fluctuations in aggregate demand. If BT's access business were listed as a separate company, it seems very unlikely that investors might view its returns as not being as highly correlated with those of the market as are the returns of BT group as a whole. Ofcom notes that this effect might be partly countered by these services having a relatively high level of operational leverage. However, the revenue effect may outweigh this. This is discussed in the subsections below. Ofcom notes that the stability referred to above relates to BT's wholesale activities, and includes sales to all downstream players including BT.

#### **Assessing the equity beta of BT's copper access network**

- 5.26 In 2004, competing communications providers suggested to Ofcom that the level of risk underpinning some of BT's activities, specifically the services offered over its copper access network, are lower than that facing BT group as a whole. Such a view has some merit at an intuitive level, and Ofcom has consequently undertaken some preliminary analysis with a view to assessing whether this might be the case, and what this might imply for differences in systematic risk and for WACC estimation. This analysis has focused on the following areas:

- benchmarking the equity betas of the UK's largest utility companies;
- benchmarking against the equity betas of US telecoms companies; and
- comparing, based on previously conducted studies, estimates of the income elasticity of demand for access services with that of other telecoms services (calls).

- 5.27 Each of these methods is discussed in the subsections below.

#### *Benchmarking against the betas of UK utilities*

- 5.28 Some of the characteristics of BT's access business, specifically the way in which revenues may not be closely correlated with short-term variations in aggregate demand, are similar to those of utility companies. The products offered by these firms tend to be "essentials", mature products that are characterised by relatively low levels of discretionary spending, so the demand for these products is not strongly correlated with aggregate demand. This means that utility companies tend to have relatively low equity betas, as illustrated in the figure below, which provides estimates for the seven largest (by market capitalisation) utility firms in the UK. Whilst Ofcom considers it unlikely that a beta associated with BT's access business would be as low as some of these estimates, it does seem likely that the BT access beta is below the BT average.

5.29 The degree of systematic risk faced by a firm increases with its level of financial leverage, measured by its gearing ratio, in a manner that is analogous to the impact of operational leverage described above. This means that, in order to make utility equity beta benchmarks comparable with BT's equity beta, it is necessary to ungear the equity betas, i.e. to calculate asset betas, and then re-gear them to a level consistent with Ofcom's estimate of BT's gearing, of 35% on a "debt to debt plus equity" basis<sup>15</sup>. Ofcom has taken the equity beta estimates in the figure below from the London Business School Risk Management Service ("LBS RMS"). As outlined in the PPC charge control, such estimates are not as robust as Ofcom's estimate of BT's equity beta, since they are calculated using monthly data, and use a long (five year) time window. However, their use in a simple benchmarking exercise such as this provides a useful illustration of the principles described above. Ofcom has repeated its analysis using an alternative set of utility equity betas supplied by Thompson financial, and has obtained very similar results in doing so.

**Figure 9- Equity and asset beta benchmarks – UK utilities**

Company	Sector	Equity beta	Market value of equity (£bn)	Book value of debt (£bn)	Gearing ratio [(D/(D+E)]	Asset beta	Equity beta at BT's gearing level (35%)
National Grid Transco	Multi Utility	0.64	14.7	12.6	46%	0.34	0.53
Centrica	Gas dist	0.84	8.7	0.1	1%	0.83	1.28
Scottish power	Electric	0.44	7.4	3.7	34%	0.29	0.45
Scottish & Southern Energy	Multi Utility	0.12	7.1	1.4	17%	0.10	0.15
United Utilities	Multi Utility	0.35	3.5	3.4	50%	0.18	0.27
Severn Trent	Water	0.42	3.3	2.7	45%	0.23	0.35
Kelda Group	Water	0.38	2.2	1.7	44%	0.21	0.33

Source Thompson financial, LBS Risk Management Service

5.30 The simple average of the adjusted equity betas in the final column of the figure above is 0.48. If they are weighted according to the market capitalisation of firms, the average is 0.56. A common approach when analysing equity betas is to take the median value. Such an approach means that less weight is put on "outliers" (such as the estimate for Centrica in the figure above). The median of the figures in the figure above is 0.35.

<sup>15</sup> In performing this exercise, Ofcom has assumed that the beta of debt is zero, and has hence used the following formula in re-gearing an equity beta with a particular gearing level ("1") to another gearing level ("2"):

$$\beta_2 = \beta_1 \times \frac{1 - \text{Gearing}_1}{1 - \text{Gearing}_2}$$

- 5.31 On a standalone basis, the above analysis does not point to any particular beta value for BT's copper access network. However, in conjunction with the evidence set out below, it does, in Ofcom's view, suggest that the "BT group" estimate of 1.3 may not be appropriate in the context of BT's copper access network.

*Benchmarking against the betas of US telecoms companies*

- 5.32 The most accurate basis upon which the beta of an "access only" firm could be inferred would be by benchmarking the equity betas of telecoms companies that only offered access services. However, Ofcom is not aware of any such companies currently in operation, either in the UK or overseas. In the previous subsection, the betas of UK utility companies were used as a possible proxy given the similarities that exist between these types of firms. An alternative to this approach would be to analyse beta estimates for Local Exchange Carriers ("LECs") in the USA. US LECs are in some ways closer to an "access only" firm than BT because their activities only cover their own local access transport areas, and as such do not offer a number of non-access services, such as long distance and international calls, that a fully national operator like BT does. It seems likely that the systematic risk profile of US LECs will be closer to that of BT than will that of the utility companies. Additionally, analysis of data from the US makes it possible to directly compare betas that include a significant "access" portion with those of firms that focus on other activities.
- 5.33 This type of benchmarking is not without its limitations, since, as noted above, the US LECs do offer some call services (although local calls are frequently offered at very low rates, and may in some cases be bundled together with access services) and, significantly, many offer mobile services (it should be noted that this would not tend to bias beta estimates downwards since access betas for mobile networks are typically at least as high as those for fixed networks). Additionally, almost all of the biggest US LECs operate as part of a parent group that typically includes at least some holdings relating to long distance services. Bearing these factors in mind, Ofcom has benchmarked the equity betas of the following companies (based on data from the FCC's Statistics of Common Carriers, year to end December 2003). The activities of one or more LECs (as opposed to long distance operations) accounts for at least 90% of the annual revenues of all of these groups:
- BellSouth Corporation
  - SBC Communications; and
  - Verizon Communications
- 5.34 No other US telecoms companies were added to the sample because, of the other major industry players, long distance operations make up a significant proportion of their total revenue, meaning that they are less useful for attempting to isolate any unique features of "access" operations. Ofcom has obtained its benchmark betas from Thompson financial, so caveats similar to those outlined in the discussion of LBS RMS betas above apply.



Figure 10 - Equity and asset beta benchmarks – US telecoms companies

Company	Equity beta	Market value of equity (US \$ bn)	Book value of debt (US \$ bn)	Gearing ratio [(D/(D+E)]	Asset beta	Equity beta at BT's gearing level (35%)
Bell South	0.69	51	10	17%	0.57	0.88
SBC Communications	0.56	86	13	13%	0.49	0.75
Verizon Communications	0.72	113	43	27%	0.53	0.81

Source Thompson financial (all data). Betas are measured against US equity market indices.

- 5.35 The simple average of the adjusted equity betas in the figure above is 0.81. The median value is also equal to 0.81, as is the mean when observations are weighted according to market capitalisation.
- 5.36 This analysis shows that a sample of US telecoms companies, for which the access component of revenues is more important than it is for BT group, tend to have betas that are below 1.0. While some caution should be exercised in interpreting the absolute values of the equity betas in the table above, it is interesting to compare these values with ones relating to long distance carriers in the US. The two biggest long distance carriers in the US are AT&T and Sprint Communications. The simple average of the equity betas of these two operators, when re-gearing to BT's gearing level, is equal to 1.3, and equal to 1.45 when weighted by market capitalisation, the value for the larger company, Sprint, being higher at 1.63 compared to 1.02 for AT&T). This lends support to the idea that betas relating to long-distance activities are higher than those relating to access products.
- 5.37 The above arguments add weight to the suggestion that the "BT group" equity beta estimate of 1.3 may not be appropriate in the context of BT's copper access network, and that the true equity beta of this part of BT's operations may be lower.

*Estimates of income elasticity of demand – access versus calls services*

- 5.38 As explained above, Ofcom's view is that access services may have a low equity beta, because the demand for such services is not closely correlated with aggregate demand. This view is supported by the available academic evidence. For example, *The Future of the Telecommunications Industry: Forecasting and Demand* by David G. Loomis and Lester D. Taylor (Eds.) and *Telecommunications Demand in Theory and Practice* by Taylor, L. D. (1994), summarise a number of academic articles relating to forecasting the demand for telecommunications services. In these books, a large number of studies carried out over three decades in North America and Europe showed that, on average, the income elasticity of demand for access is significantly lower than the corresponding elasticities for various call types. In these studies, "income" is typically measured by, in the case of business lines, GDP, and, in the case

of residential lines, a closely related measure such as average personal disposable income.

*Summary and implications for betas for other BT activities*

5.39 The analysis outlined in the previous subsections shows that:

- both UK utility firms and US local exchange carriers, which have a number of things in common with BT's copper access business, tend to, when differences in financial leverage are corrected for, have equity betas that are lower than 1;
- US telecoms companies that focus on local and access services have lower equity betas than long-distance operators; and
- access services tend to have lower income elasticities of demand than call services.

5.40 In light of these factors, Ofcom believes that it might be appropriate to depart from its equity beta estimate of 1.3 for BT group in relation to BT's access business, since a value that is below the group average might better reflect the risks facing this part of BT's business. Being unable to observe directly an exact value for any of BT's activities, Ofcom is obliged to rely on judgement to some extent. One method of establishing the reasonable limits of the range in which the access beta might lie is to consider the implication of various estimates of BT's access beta for the rest of BT's business. In doing this, Ofcom has assumed that BT's other regulated wholesale products have an equity beta equal to the group average, i.e. 1.3<sup>16</sup>, and considered what different access betas imply for the beta of the rest of BT's business. These implied values depend on the weights applied to each beta. As explained above, if such values were observable, these equity betas would be weighted according to market value. Ofcom has used the book value of assets in order to proxy this, based on BT's regulatory accounts for the year 2003/04. This is shown in the figure below (the table's second row shows the weighting placed on each part of BT's business in bold type).

**Figure 11 - Range of plausible equity beta estimates for BT (weights calculated based on CCA MCE for 2003/04)**

<b>Copper access beta</b>	<b>"Other regulated" beta</b>	<b>Rest beta</b>
40%	30%	30%
0.50	1.30	2.34
0.60	1.30	2.21
0.70	1.30	2.08
0.80	1.30	1.95
0.90	1.30	1.82
1.00	1.30	1.69
1.10	1.30	1.56
1.20	1.30	1.43
1.30	1.30	1.30

<sup>16</sup> An alternative approach would be to split BT's activities into two or indeed more than three, categories/

A degree of judgement is required in selecting an appropriate set of beta estimates based on a Figure such as the one above. Ofcom's view is that a beta of much less than 1 for BT's copper access business would not be plausible, since it would imply unreasonably high beta estimates for other parts of BT's business. Ofcom is therefore proposing that, based on the information currently available to it, that an estimate in the range of 0.9 to 1.2 would, in Ofcom's view, be plausible.

**Question 4:** *Do respondents agree that it is appropriate for Ofcom to disaggregate its estimate of BT's equity beta, and in particular to estimate a distinct equity beta for BT's copper access network?*

**Question 5:** *Do respondents agree with Ofcom's approach to assessing possible values for the equity beta of BT's copper access network, and its suggested range of values?*

### **Variations in specific risk - biases in cash flow forecasting**

5.41 In theory, investors should be indifferent to the level of specific risk involved in a particular project, since this can be diversified away. Thus, all that is required is an estimate of the mean expected cash flows of a project – the diversification assumption means that other outcomes, and the variance of the outcomes caused by specific risk, can be ignored. In practice, however, it is often very difficult to estimate the mean or expected costs for projects with large elements of specific risk (since this involves identifying and quantifying all the possible outcomes and then weighting them by their probability). It may be the case that the unquantified downside project risks (of failure) are higher than the unquantified upside risks (of succeeding beyond the initial expectations), leading to initial appraisals of projects underestimating the expected or actual project costs. There is also often an element of "optimism bias" inherent in estimates of the costs of large investment projects (See HM Treasury's "Green Book" on appraisal and evaluation in a government, [http://www.hm-treasury.gov.uk/economic\\_data\\_and\\_tools/greenbook/data\\_greenbook\\_index.cfm](http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_index.cfm) for details). This is often addressed in firms' project authorisation processes by adding a contingency to the costs or setting a higher hurdle rate than the true cost of capital.

**Question 6:** *Do respondents agree that initial appraisals of projects with high specific risk tend to underestimate the true expected costs of the project? If so, how should the true expected cost of the project be assessed and any adjustment to the required reward determined.*

## Section 6

# Taking Account of Real Options

## Introduction

- 6.1 Section 5 proposed a mechanism for taking account, within the CAPM framework, of the variations in systematic risk across various BT activities. Section 6 considers a set of circumstances under which the “traditional” or standard use of the CAPM and NPV frameworks may not provide a sufficient basis for modelling risk in all cases.
- 6.2 As will be seen below, specific, i.e. non-diversifiable, risks are important to this discussion. For this reason, this Introduction begins with a description of some of the most common types of specific risk, before going on to explain their relevance in the context of a real options framework.

## Types of specific risk

### *Demand risk*

- 6.3 In some instances, an investment will not be profitable unless demand expands significantly from its current level. This is most likely to be relevant to investments that are made with a view to supporting new applications that are not currently available. A telecoms example might be very high bandwidth services supplied to residential customers. The success of such an investment will depend upon significant growth in new end user applications that are currently not available to customers. This future demand is very uncertain, and is thus a source of risk with respect to this type of investment.
- 6.4 To some extent, similar uncertainty exists regarding a number of new products in the communications industry. In general, investments involving new services and new markets have a higher risk of failure than investments involving existing services and existing markets. New technology investments, that are intended to bring new services to new markets increase these risks. For example, investment in next generation core networks can be viewed as delivering existing services (voice and data traffic) into existing markets, using a potentially risky technology. On the other hand, next generation access network investment, represents, in addition to a technology risk, a demand risk, since its success relies on new services (high bandwidth broadband) in unknown markets.

### *Technology risk*

- 6.5 Technology risk relates to those elements of risk that are uniquely or largely related to investment in the development and commercialisation of new technologies and the services based upon them. Investment in next generation broadband access, for example, has risks in common with all large infrastructure investments, such as the building of an electricity transmission grid, but has other risks which are uniquely related to the new technologies on which such a network would be based and the new products and services it would support.
- 6.6 Some of the most important examples of technology risk are briefly described below.

## **Technology Feasibility**

- 6.7 New technologies do not always work. While firms put development processes in place in order to try and minimise the risk of failure at launch, the exploratory nature of technology development makes some failures inevitable. At the point at which the investment decision must be made, i.e. at the beginning of the process, the risk of failure may be significant. For example an Economist article dated 25th November 2004 titled Managing Complexity, stated:

*A study earlier this year by the Standish Group, a technology consultancy, estimated that 30% of all software projects are cancelled, nearly half come in over budget, 60% are considered failures by the organisations that initiated them, and nine out of ten come in late.*

## **Technology Standards**

New technology is often realised via standards developed over time by international bodies such as the International Telecommunications Union (ITU). Examples include:

- internet protocol, i.e. IP;
  - third generation mobile networks, i.e. 3G
  - High Definition Television (HDTV); and
  - WiMax, which enables wireless networking between these computers
- 6.8 Technologies such as these have given and will give rise to new products, meeting new and evolving customer needs. However investment decisions must often be made at a time when standards are not fully defined. For example, the £22billion investment in UK 3G licences was made before 3G standards were stable. Standards may also compete - examples of this include the competition between, in the context of electricity, AC (Westinghouse) and DC (Edison) in the early part of the last century, and, in the context of home video recorders, between VHS and Betamax in the 1980s. As a final example, there are currently two different standards under development for HDTV, and it is as yet uncertain which of these will go on to become an industry standard, or indeed whether a third standard will emerge. A further source of technology risk is therefore the possibility that an investment will prove to have been in a “wrong” standard, i.e. not the one that is adopted as the common standard.

## **Technology evolution**

- 6.9 A third example of technology risk relates to the “evolution” of technology. Over time, most if not all investments are eventually rendered obsolete. This is particularly relevant to high technology products where new “generations” of product with significantly greater functionality than the previous version are developed on a frequent basis (e.g. video games consoles). The effective operational life of the investment (and therefore the period over which companies need to recover their initial investment) may be significantly curtailed by future technological advances the timing of which may be very difficult to predict.

## **The importance of timing strategies**

- 6.10 The traditional NPV framework reflects an assumption that investment takes place immediately, and does not model the value that might be associated with the choice of using different timing strategies. For example, if certain extra information relating to the

chances of a project succeeding becomes available over time, then there may be a significant value associated with postponement. Traditional NPV analysis will often ignore or mis-price this real option value, which is discussed in more detail in the remainder of this section.

In financial economics, “real option” is the term given to a possibility to modify a project at a future point (e.g. see Chapter 22 of Brealey & Myers for an introductory level discussion). This concept is relevant to investment decisions made under uncertainty that may either create or destroy real options. For example:

- In making an investment, a firm will forego the option to defer investment and “wait and see” how demand for the new product will evolve. This option may have a significant value in cases where:
  - there is significant uncertainty regarding the return on the investment (e.g. because demand for the products it will support is as yet unknown), that can be substantially mitigated by delaying the investment for a certain amount of time; and
  - the investment is irreversible (i.e. it cannot be sold on “second hand” by the firm or put to another use)
- It may not be possible for a firm to enter, or compete effectively within, a market unless it already has a related presence – meaning that entering a market (e.g. by investing in marketing spend to create a brand) may confer real options on a firm

In 2004, BT made a submission to Ofcom relating to this first type of real option. Many of the arguments submitted by BT are included in an article written by Robert Pindyck of MIT, titled *Mandatory Unbundling And Irreversible Investment In Telecom Networks*. This article argues that the significance of giving up “wait and see options” needs to be taken into account if regulated charges are to be set at efficient levels. The primary purpose of the discussion of real options contained in this consultation is to outline Ofcom’s initial views on the importance of wait and see options in the context of regulated access products. The remainder of this Section covers the following:

- a brief outline of some of the main types of real option that are likely to be relevant in the context of the communications industry; and
- a more detailed discussion of the circumstances under which, as advocated by BT, regulated access charges should reflect the value of wait and see options.
- 

### **Types of real options and factors that may affect their value**

6.11 Both systematic and specific risks are important in a discussion of real options. This is because, over time, additional information becomes available regarding both company specific and economy-wide factors. However, Ofcom’s view is that the specific risks listed at the beginning of Section 6 are likely to be of particular importance, since (some of) these risks, such as risk relating to the uptake of a new product, are particularly likely to be mitigated by waiting for additional information, whereas the uncertainty resulting from systematic risks will always be present on a forward-looking basis and therefore remain broadly constant over time. Specific risks can therefore give rise to a number of different types of real option having a significant value. Making use of some of these options (e.g. deciding to wait and see, or to pilot a new product) can significantly reduce the impact of demand and technology risk.

6.12 Some of the most important real options are described in the text below.

### **Wait and see (also known as “defer”)**

6.13 Investment can be deferred for a period of time, enabling the firm to learn from the investments of others and put capital to other uses.

6.14 If an investment can be reversed (e.g. equipment re-sold to other companies), then the value of wait and see options will not be significant. This is because the downside of a costly investment yielding a low return is effectively ruled out by the opportunity to reverse the investment. In the telecommunications industry, most investment is likely to be irreversible.

6.15 This type of real option is the focus of the remainder of this Section, since BT has suggested to Ofcom that they may be of some importance in the context of setting access charges.

### **Stage**

6.16 Risk may be mitigated to some extent if the investment can be made in stages, during which the firm will be able to improve its ability to forecast demand and “operationalise” the technology. This might apply, for example to network roll-out that is carried out on an incremental basis, being staged to cover first one geographic area and then another.

### **Pilot**

6.17 In some cases, investment can be made in a prototype or pilot product version, whereby expected payoffs and costs are limited, and can be scaled up if successful.

### **Future Growth**

6.18 Investment in a technology now may create future investment options. For example:

- Palm’s initial investment in an unsuccessful Personal Digital Assistant (PDA), called the Zoomer, enabled it to develop the technology which resulted in the Palm Pilot; and
- in a telecoms context, investment in current generation broadband access may bring with it the option to invest in future generation broadband access.

## **A more detailed discussion of wait and see options**

### **Introduction**

This discussion follows on from the submission made by BT that is referred to above.

6.19 The intuition behind the basic “wait and see option” case referred to in the introduction is set out in some detail in the article by Robert Pindyck that is referred to above. A very brief summary is provided below.

Suppose that:

- a firm is considering whether or not to make an irreversible investment that can only be used to support a new application. There is a significant amount of uncertainty regarding demand for the new application by end users.
  - if the firm decides to make the investment now, the (expected) NPV is £10m. This NPV is based on:
    - a 50% chance that there will be no demand for the new application, meaning that the investment will be wasted, and the project's NPV will be -£20m; and
    - a 50% chance that there will be a significant demand for the new application, meaning that the investment is successful and that the project's NPV will be £40m.
  - if, as an alternative, the firm is able to wait and see whether there will be a demand for the new application, then the expected NPV will be £20m, higher than the £10m in the example above, since the firm is able to ensure that it invests only in the second scenario and is therefore able to avoid the losses associated with the first, i.e.:
    - if there is no demand for the new application (which will be the case with probability 50%), the firm will not make the investment, yielding an NPV of zero; and
    - If there is a significant demand for the new application, the investment will be made, yielding an NPV of £40m (although in practice this figure might be lower than the NPV in a "invest immediately and be successful" state of nature figure of £40m quoted above due to the delay in implementation).
- 6.20 The wait and see option has a value, equal in this case to the difference between the return that the firm would expect on the investment if it invests now compared with the expected NPV if it delays – i.e. £10m in this example. The value of the real option in the above example is expressed in absolute, rather than percentage terms.
- 6.21 If the firm in question is a regulated incumbent and a regulator mandates that the incumbent grant access to the investment to its competitors, then access prices are usually set so as to reflect the costs incurred by the incumbent (including an opportunity cost of capital). BT has suggested that cost estimates should be calculated to include the value of the real options that have been surrendered by the incumbent in investing now. BT argues that, if access prices do not reflect the incumbent's full cost, the incumbent will delay its investment until there is more certainty regarding demand conditions. This will be inefficient if consumers' willingness to pay to get the new services now is sufficient to cover the option value.
- 6.22 A large incumbent communications provider like BT invests significant sums of money on its network every year (e.g. BT's total level of capital expenditure for 2003/04 was equal to over £2.5bn). This capital expenditure is spent on a wide range of both new and replacement assets, which are used to support end user services that are characterised by varying degrees of demand uncertainty. This means that there are varying degrees to which real options are relevant to these services. The following subsections discuss the circumstances in which wait and see options are likely to be more or less relevant in the context of access pricing.
- 6.23 There are a number of important factors to consider that may have a significant bearing on the value of wait and see options. Some of the most important of these are considered in turn below.



## **Competitor specific investments and stranded assets**

- 6.24 In certain cases, principally where the technology involved is well-established, a regulator will mandate that an incumbent make a particular investment that is in some sense specific to one of its competitors. In these cases, the value of wait and see options may be substantial. For example, where BT makes a specific investment in order to install a PPC tail circuit on behalf of an altnet, it faces a risk that the altnet will decide to cancel its PPC order within a relatively short period of time. Under such circumstances, the asset may become stranded since it may not have an alternative use to BT. It is important to note, however, that investments of this type are relatively rare in the context of BT, since it is usually able to provide services without undertaking substantial specific additional investment. In addition, to the extent that such risks do exist, BT is able to pool them, and mitigate them by the nature of the contracts it writes with customers.
- 6.25 It is also worth noting that altnets may face a risk of stranding in cases where they invest in order to build out to BT's network because of a need to interconnect for the purpose of buying a particular wholesale service. If, following this investment, demand for the product in question declines then the return on the altnet's investment will not be in line with its expectations.

## **The availability of alternate investment strategies**

- 6.26 The value of wait and see options is likely to be higher in cases where a number of investment strategies available are available to the firm. For example, if the firm might be able to serve future demand without making an investment (perhaps with a lower service quality), then its wait and see options are likely to be more valuable.

## **Quantifying the value of wait and see options**

- 6.27 There are a number of ways in which access pricing and other obligations could be amended to take account of real options. The most obvious such amendment would be a series of adjustments to access prices to include the value of options foregone. However, calculating the value of real options is likely to be very difficult in practice. Merton, Brennan and Schwarz (and others) have adapted the work done by Black and Scholes in order to set out a framework for valuing options in the context of a wide range of assets (the "Black-Scholes Formula"). It is usually difficult to value real options in the absence of good estimates of the relevant parameters and a market in the underlying asset that would ensure the type of "riskiness arbitrage" implied by Black and Scholes. BT has cited work such as that done by Hausman in *Valuing the Effect of Regulation on New Services in Telecommunications*, Brookings Papers on Economic Activity, 1997), and also further work by Dobbs, that may go some way towards addressing this issue, but at present this is an area in which best practice has not yet been determined.

## **Investment creating options for the investor**

- 6.28 Pindyck's article, and BT's recent submission to Ofcom focused on the value of wait and see options, focusing on the incentives that, absent regulatory intervention, give an incumbent incentives to delay investment.

There may, however, be a number of advantages of investing early to a firm. These are:

- *Options to expand* – as outlined above, in some cases it not be possible for a firm to enter or compete effectively within a market unless it already has a related presence. Investing therefore, confers real options on the firm, rather than (or possibly in addition to) using them up.
- *First mover advantage* – if a firm enters a market quickly, this may confer an advantage on it over other firms. For example, if a market is growing quickly, investing early may enable a firm to capture a large market share quickly.

6.29 Ofcom's view is that these factors would need to be taken fully into account if the value of other types of real options were to be taken into account. Whilst the value of wait and see options that are given up when investments are made may be significant, for a balanced view to be taken it is important to consider their net value, taking into account the value of any other relevant options that may be gained by the incumbent.

### **Investments that create options for competitors**

6.30 Pindyck's article discusses a type of real option whereby an investment made by an incumbent effectively means that its competitors (altnets) are given real options, and argues that the payments made by altnets should reflect the value of these. A key example focuses on the case where both an incumbent and its competitors are all considering whether to invest in a technology or "wait and see". In such a case, if the incumbent makes the investment and access is mandated, then a real option has effectively been given to the altnets. This is because, relative to a situation in which the incumbent has not made the investment, it now has more choices available to it in deciding whether to build competing infrastructure or buy access from the incumbent.

There are two parties involved in the transactions described above, namely the incumbent's wholesale business and the altnet's retail business. There are therefore a number of real options to consider, namely (the loss of potential monopoly profit at the retail level for the incumbent would not normally be a key consideration for a regulator):

- options to wait and see that are given up by the incumbent (as discussed elsewhere in this section); and
- options to build or wait and see that are conferred on the altnet.

6.31 The second of the two types of real option in the bullet points above relates to the benefits flowing to altnets and their consequent willingness to pay, rather than the incumbent's costs. Basing access prices on the benefits to altnets, rather than the costs of the incumbent, is an alternative approach that has some merits. Ofcom does not believe, however, that it is consistent with the promotion of competition.

### **Wait and see options and BT's access products**

6.32 Based on the arguments outlined in the previous sections, Ofcom has undertaken a preliminary analysis of the extent to which wait and see options are relevant to BT's main regulated access products. This analysis is outlined below – Ofcom is very interested in the views of stakeholders with regard to these issues.

For each of these access products, Ofcom sketches out the following key considerations, which attempt to assess the net value of surrendered wait and see options, having taken the value of other options into account:

- the extent to which BT is giving up wait & see options by making investments (i.e. whether demand is uncertain and irreversible, and whether there is a risk of technological failure);
- the extent to which this is mitigated by BT still having other important options (i.e. to stage or pilot the investment); and
- whether investment confers other benefits (e.g. first mover advantage, options to expand).

- 6.33 Considering the above factors means that, in some such instances, wait and see options will have a limited **net** value, particularly in the case of well established products. For example, BT's existing copper network was rolled out a number of decades ago. This means that the primary type of investment to consider in the context of the cost of copper is maintenance and replacement driven. This type of investment is staged in that it is made on a case-by-case basis in response to known demand. In such a case, based on the criteria established in the previous section, Ofcom's proposed view is that wait and see options will have a limited value.
- 6.34 At the other extreme, investment in next generation networks has yet to take place, there is considerable uncertainty over demand (particularly in the case of next generation access, the demand for which is dependent on new and as yet undetermined applications), and, particularly in the case of NGN access, over technology. Although it is theoretically possible to pilot an investment in NGN – there are examples of Fibre to the Home access networks in Sweden and Amsterdam - bandwagon effects<sup>17</sup>, combined with scale economies, mean that such pilots are unlikely to provide a reliable indicator of future market performance. However, particularly in the case of Next Generation Access, investment will confer a significant first mover advantage, making entry by other firms less likely.
- 6.35 The rows in the figure below correspond to the determinants of the value of wait and see options that are outlined above. The symbols (ticks and crosses) used in each cell of the figure indicate the extent to which each determinant is relevant to each access product. For example, in the first row, three "ticks" in the right hand column mean that the assertion, "there is a significant amount of demand uncertainty" in relation to next generation access networks strongly appears to be correct and important. Similarly, in the left hand column of the top row, two "crosses" indicates that the assertion, while relevant, is incorrect in the case of BT's copper access network. Cells that have been left blank or with question marks in indicate that it is difficult to assess how relevant or correct an assertion is to a particular type of wholesale product.

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<sup>17</sup> The process by which the introduction of new services associated with a particular platform (e.g. new software titles brought out for a video games platform), increases the popularity of the platform, which in turn provides a greater incentive for the introduction of new services.

Figure 12 - Wait and see options and some important BT access products

	Copper access network	NCC	PPCs	Next generation – core	Next generation - access
Significant amount of demand uncertainty (e.g. return on investment is dependent on demand growth)?	x x	x x	x	x	✓ ✓ ✓
Investment cannot be staged, reversed, or piloted?	x	x	x	✓	✓ ✓
Significant technology risk?	x x	x x	x x	✓	✓ ✓ ✓
Risk of stranding due to investment being competitor specific	x	x	✓	x	x
Are other investment strategies available? (e.g. new demand can be served using existing network)				✓	x?
No chance that loss of wait and see will be mitigated by gaining a first mover advantage?				x	x x x

As summarised in Figure 12 above, Ofcom proposes that the value of wait and see options is likely to be:

- significant in the case of next generation access networks;
- relevant to a degree in the case of next generation core networks; and
- small in other cases

## **Ofcom's initial views on Real Options**

In the above section, Ofcom outlines its initial view on the relevance of real options theory to BT's access pricing. Ofcom's initial view is that it should consider ways in which to estimate the value of wait and see options in the context of:

- BT's next generation access networks; and
- (to a lesser extent) next generation core networks

6.36 Ofcom is not of the view that the value of wait and see options is significant in the case of the other major access products **currently** offered by BT. However, an approach such as the one described above outlines Ofcom's initial view on the importance of these options in the context of future regulated products.

6.37 Section 2 of this document provides a brief overview of some of Ofcom's key duties under Sections 3 and 4 of the Communications Act. A number of these duties are important factors to bear in mind when considering the issue of real options. Section 3 (4) requires Ofcom to have regard to the desirability of encouraging investment and innovation and the availability and use of high speed data services. This is of particular relevance to a discussion of real options and regulation, particularly in the case of next generation networks, since, to a greater extent that is true of more established technologies, efficient investment may be delayed if the value of these is not taken into account by Ofcom.

To the extent that there may be a conflict between the above and Ofcom's principal objective under Section 3 (1) of The Act (namely to further the interests of citizens and consumers, where appropriate by promoting competition), Ofcom's initial view is that the discussion it has outlined above strikes an appropriate balance between these two objectives, and is interested in the views of stakeholders on this.

**Question 7:** *Do respondents agree with Ofcom's suggested assessment of the likely circumstances under which real option theory will be applicable in the context of regulation?*

**Question 8:** *Do respondents have any views on how the value of real options might be taken into account in practice in a regulatory context?*