

# Autoridade Nacional de Comunicações (“Anacom”)

Assessment of the cost of capital analysis of Portugal  
Telecom Comunicações

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# 1. Executive summary

## 1.1 Context and our role

Autoridade Nacional de Comunicações (“Anacom”), as part of its regulatory duties, is required to review the approach of Portugal Telecom Comunicações (“PTC”) to calculating its cost of capital.

In this context, PricewaterhouseCoopers SROC (“PwC”) has been commissioned by Anacom to provide an assessment of PTC’s weighted average cost of capital (“WACC”) for regulatory purposes. Our work has been divided into two phases. The first phase consisted of:

- a review of PTC’s current methodology in estimating its WACC;
- an analysis of the regulatory precedents across a selection of Western European countries; and
- a description of PwC’s recommendations and rationale for alternative methodologies when appropriate;

Phase two of the work consisted on calculating indicative estimates for PTC’s WACC and the underlying parameters.

## 1.2 Conclusions and recommendations

The tables below provide a summary of PTC’s approach to calculating its WACC and PwC’s recommendations.

Table 1: Summary of PTC's approach to WACC and PwC's recommendations

Assumption	PTC's approach	PwC's recommendation
Conceptual framework for calculating the cost of equity	Capital Asset Pricing Model ("CAPM")	CAPM
Conceptual framework for calculating the cost of debt	Estimated directly from accounting information. For 2005-07, the cost of debt is equal to the weighted average of the interest rate on medium and long term debt and liabilities related to employee benefits.	Estimated by adding the market based debt margin to the risk-free rate.
Risk-free rate	Average monthly yields on 10 year Portuguese government bonds calculated over a 12 month period.	Average yields on 10 year Portuguese government bonds, calculated over a 1 to 2 year period.
Equity Beta	Bloomberg estimates (regression analysis of PT returns against the Portuguese stock exchange index).	Bloomberg equity betas based on suitable comparators and regulatory precedents.
EMRP	Bloomberg estimates (forward-looking, based on Dividend Growth Model).	Range of sources including ex-post and ex-ante estimates, regulatory precedents and recent views to take account of the current turmoil in financial markets.
Debt premium	Accounting information on medium to long term debt and responsibilities with employee benefits.	Yields on comparable corporate bonds with 10 year maturity, considering an average over a 1 to 2 year period.
Gearing	Actual gearing	Optimal gearing based on comparator analysis and regulatory precedents.
Tax	Pre-tax WACC	Vanilla or pre-tax WACC

Source: PwC analysis

Table 2: Summary of estimates of PTC's WACC and sensitivity analysis

Cost of Capital	Low Range WACC	Midpoint WACC	High Range WACC
Risk-free interest rate	4,47%	4,50%	4,52%
Debt Premium	0,96%	1,47%	1,98%
Debt Rate	5,44%	5,97%	6,50%
Beta	0,76	0,89	1,02
EMRP	5,42%	5,58%	5,75%
Gearing	45,26%	37,51%	29,77%
Tax rate	26,50%	26,92%	27,34%
Cost of equity	8,64%	9,49%	10,39%
Vanilla WACC	7%	8%	9%
Pre-tax WACC	9%	10%	12%
Post-tax WACC	7%	8%	9%

Input	Change in Input	Change in WACC
Risk-free interest rate	10bp	0,15%
Debt Premium	10bp	0,06%
Beta	0,10	0,50%
EMRP	10bp	0,10%
Gearing	10,00%	0,72%
Tax rate	1,00%	0,14%

## 2. Introduction

### 2.1 Context and our role

As part of its regulatory duties, Autoridade Nacional de Comunicações (“Anacom”), the telecommunications regulator in Portugal, is required to review the weighted average cost of capital (“WACC”) calculations undertaken by Portugal Telecom Comunicações (“PTC”). The WACC is used for a number of regulatory purposes such as setting price controls and regulatory accounting and it is the most common approach to calculating the cost of capital by regulators worldwide.

Our examination of the regulatory precedents is based on the two most recent decisions made by each of the telecommunications regulators across seven European countries and the energy regulator in Portugal, as set out in the table below.

Table 3: Selected sample of European regulators

Country	Regulator
Belgium	Institut Belge des services Postaux et des Télécommunications (“IBPT”)
France	Autorité de Régulation des Communications Électroniques et des Postes (“Arcep”)
Ireland	Commission for Communications Regulations (“ComReg”)
Italy	Autorità per le Garanzie nelle Comunicazioni (“Agcom”)
Norway	Norwegian Post and Telecommunications Authority (“NPT”)
Spain	Comisión del Mercado de las Telecomunicaciones (“CMT”)
UK	Office of Communications (“Ofcom”) (formerly known as Office of Telecommunications (“OfTel”))
Portugal	Energy Services Regulatory Authority (“ERSE”)

Source: PwC analysis

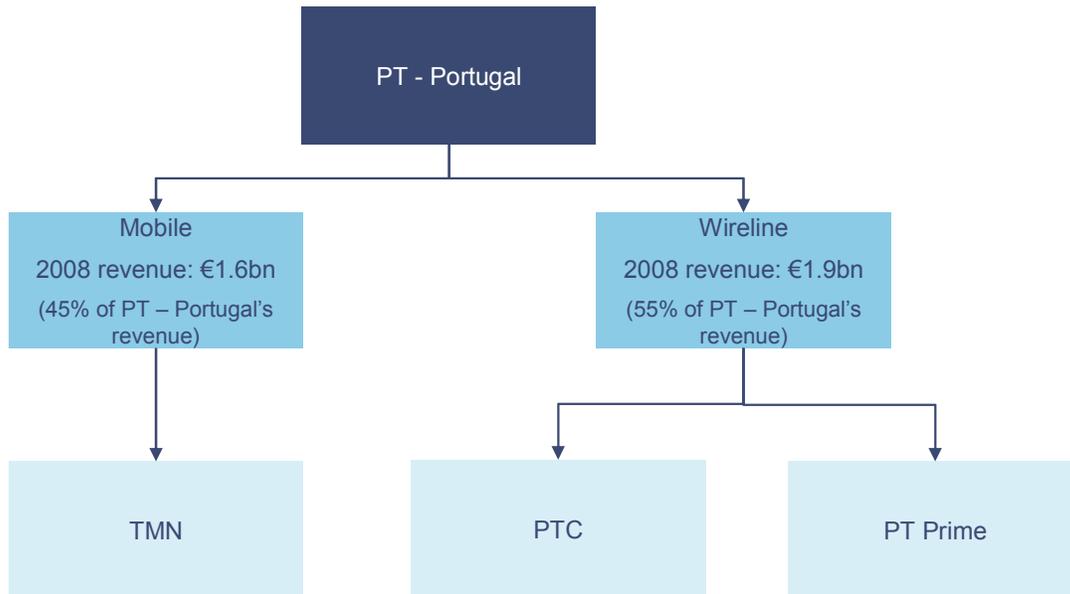
For each decision, we examined the estimates used and their underlying assumptions. Further details of the regulatory decisions that have been reviewed are provided in Appendix I.

### 2.2 Background on Portugal Telecom

Portugal Telecom (“PT”) is the incumbent provider of telecommunications and multimedia services in Portugal. The company’s services include fixed, mobile, multimedia and data communications, information systems, investigation and development, satellite communication, e-business and directories services. PT also has operations in Brazil, Angola and other African countries.

The figure below sets out PT's corporate structure for its business operating within Portugal.

Figure 1: PT's corporate structure in Portugal



Source: PT's financial statements and PwC analysis

PT Portugal consists of two main businesses: Mobile and Wireline. The Wireline business is comprised of two subsidiaries:

- **PTC:** holds and operates the fixed line network and provides fixed line telephone services, wholesale services, directories and sales of telecommunications equipment within Portugal; and
- **PT Prime:** offers data and corporate services using information technology, telecommunications, internet and outsourcing.

PT provides mobile services in Portugal through a wholly owned subsidiary called TMN.

This report focuses on the cost of capital for PTC.

## 2.3 Structure of the report

The remainder of this report is organised as follows:

Section 3 sets out the alternative methodologies for calculating the WACC;

Section 4 reviews PTC's and European regulators' cost of equity calculations and sets out PwC's recommendations;

Section 5 reviews PTC's and European regulators' cost of debt calculations and sets out PwC's approach;

Section 6 reviews PTC's and European regulators' approach to estimation of gearing and sets out PwC's recommendations;

Section 7 discusses issues related to the remuneration of tax; and

Section 8 contains our conclusions.

## 3. Conceptual framework

### 3.1 Cost of capital

The cost of capital represents the minimum rate of return a company should earn on its invested capital in order to provide sufficient returns to the investors who are financing the business. It follows that it is the minimum return a regulator should allow in determining the prices of regulated activities.

The cost of capital can be applied in a wide range of regulatory situations. These include:

- Determining interconnection rates, access and wholesale prices — this is done by incorporating the cost of capital into cost-based pricing models;
- Price control reviews and rate applications — determining retail prices which incorporate a minimum return to enable the company to finance its regulated activities; and
- Discounting regulated cash flows to present values.

The cost of capital presented in this report should be used for these general regulatory purposes, in relation to the regulated activities that require the use of PTC's fixed-line infrastructure assets. Since the cost of capital used in any particular situation should reflect the risks of the activity undertaken<sup>1</sup>, as the cost of capital methodology we comment on is intended to be appropriate for fixed-line activities, if any regulated activity has a markedly different risk profile to the fixed telephony business then a different cost of capital should be used.

Furthermore, the cost of capital does vary over time and therefore should be reviewed on a timely basis.

The cost of capital itself requires the calculation of three components:

- The **cost of equity**, being the rate of return equity investors would expect on an investment with the relevant risk profile;
- The **cost of debt**, being the interest rate debt providers would charge for providing debt to such an investment; and
- The **gearing ratio**, being the relative proportions of debt and equity used to finance the investment.

To calculate the WACC, the cost of equity and cost of debt are weighted together using the proportion of total investment funding accounted for by each as the weights. The WACC is the measure of the minimum expected return providers of both forms of capital require in order to be incentivised to invest capital in a business. The WACC therefore represents the minimum rate of return a company should expect to achieve from its overall activities to satisfy its various capital providers and it is the most commonly used methodology.

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<sup>1</sup> See, for example, Brealey and Myers "Principles of Corporate Finance", 7th Edition.

In particular, the WACC is calculated as follows:

$$WACC = K_d \times G + K_e (1-G)$$

Where:

*K<sub>e</sub>* is the cost of equity

*K<sub>d</sub>* is the cost of debt

*G* is the level of gearing

## 3.2 Cost of equity

### 3.2.1 Capital asset pricing model

The methodology used most often in estimating the cost of equity is the Capital Asset Pricing Model (“CAPM”). This assumes that equity investors require their investment to yield at least the return available on risk-free instruments. Added to this risk-free rate of return, equity investors expect a premium for the risk involved in an equity investment. This premium is equal to the general equity market risk premium (“EMRP”) multiplied by the equity beta.

The EMRP represents the additional expected return investors require to compensate them for the additional risk associated with investing funds into equities rather than risk-free instruments. The equity beta is a measure of the riskiness of a particular equity investment relative to the average equity investment. In particular, it is a measure of the degree of “systematic risk” for a particular investment. A key aspect of the CAPM framework is that it distinguishes between specific risks and systematic risks, as follows:

- **Specific risks** are those risks which are specific to a company or project. They can be “diversified away” by holding a well diversified portfolio of investments in which, on average, investments which perform badly due to specific risk factors can be expected to be offset by investments which perform well for specific risk reasons and vice versa; and
- **Systematic risk** refers to risk factors which affect all equity investments simultaneously in the same direction to a greater or lesser extent, and hence cannot be diversified away. Movements in economy wide factors such as changes in the GDP growth rate, interest rates, savings rates and inflation contribute to systematic risk.

Since equity investors can diversify away specific risks, they do not affect required returns, and hence under the CAPM framework are not reflected in the cost of equity. Hence expected equity returns reflect only systematic risk exposure. However it is important to note that specific risk should be reflected in the calculation of the expected cash flows from any business or project being evaluated.

To summarise, under the CAPM framework, the cost of equity is defined as follows:

$$K_e = R_f + \beta * [EMRP]$$

Where:

$K_e$  is the cost of equity

$R_f$  is the risk-free rate

$\beta$  is the equity beta

EMRP is the equity risk premium ( $R_m - R_f$ ), where  $R_m$  is the equity market return.

### 3.2.2 Alternative methodologies

The cost of equity can be estimated using a number of alternative methods. These include:

- the Dividend Growth Model,
- the Fama French Three-Factor model; and
- the Arbitrage Pricing Theory.

We discuss each of these in turn below.

#### The Dividend Growth model

The Dividend Growth Model (“DGM”) is a forward-looking model that assumes that the current share price of a quoted business is equal to the present value of all future expected dividend payments. Therefore, given the current market price and future growth rate expectations, the cost of equity implicit in the share price can be determined as follows:

$$K_e = (D_0 * (1+g) / P_0) + g$$

Where:

$K_e$  is the post-tax cost of equity

$D_0$  is the current dividend

$g$  is the dividend growth rate (assumed to be constant)

$P_0$  is the current share price

For unlisted companies such as PTC where the current market price is not directly observable, the DGM can be applied by inferring the market price (of the unlisted company) based on an assessment of comparators’ market value.

The main limitation of the DGM is that it relies on constant dividend growth forecasts. Forecast growth rates are problematic because, at best, they are short-term estimates provided by the business itself, or are estimated by equity analysts. Both of these can be subject to bias and error.

The DGM is seldom used as the primary method of estimating the cost of equity, but instead is sometimes used as a useful check on the cost of equity derived from the CAPM.

### Fama French Three-Factor Model

Some academic tests of the CAPM have shown that the explanatory power of CAPM does not always perform well. The most prominent contradiction is the “*size effect*” discovered by Banz (1981)<sup>2</sup>, who found that the average returns of smaller US companies appeared high relative to the returns implied by the CAPM framework. This was further investigated by Fama and French (1993)<sup>3</sup>, who found that two variables, size and book-to-market value, capture most of the variation in stock returns not captured by the CAPM framework. Fama and French proposed the Fama French three-factor model (“FFTM”) that attempts to adapt the conventional CAPM by adding additional explanatory variables for size and book-to-market value. In particular, under the FFTM:

$$K_e = \beta_1 * EMRP + s_i * E(\text{size}) + h_i * E(\text{book/market})$$

Where:

*EMRP* is the equity market risk premium

$\beta_1$  is the sensitivity of security *i* to the EMRP

*E(size)* is the extra return expected for small capitalisation companies

*s<sub>i</sub>* is the sensitivity of security *i* to *E(size)*

*E(book/market)* is the extra return expected for companies with high book-to-market ratios

*h<sub>i</sub>* is the sensitivity of security *i* to *E(book/market)*

The FFTM is usually considered when estimating the cost of capital for small or distressed firms. As the model is really an adaptation of the CAPM, for non-distressed firms the most common practice is to extend the CAPM to a two-factor model in which a small company risk premium is added to the conventional CAPM model.

This is shown below:

$$K_e = R_f + \beta * EMRP + S$$

Where:

*R<sub>f</sub>* is the risk-free rate

$\beta$  is the equity beta

*S* is equal to the small company premium

### Arbitrage Pricing Theory

The Arbitrage Pricing Theory (“APT”) extends the three-factor model even further to an unlimited number of explanatory variables and beta coefficients:

<sup>2</sup> Banz, Rolf W. (1981) “The relationship between return and market value of common stocks”, March, Journal of Financial Economics.

<sup>3</sup> Fama, E., French, K., (1993) “Common risk factors in the returns on stocks and bonds”, Journal of Financial Economics.

$$K_e = R_f + \beta_1 * E_1 + \beta_2 * E_2 + \beta_3 * E_3 \dots + \dots \beta_n * E_n$$

Where:

$R_f$  is the risk-free rate

$\beta_i$  is the sensitivity of the security  $i$  to each of the  $n$  risk factors

$E_i$  is the expected risk premium associated with each unit of risk for factors 1 to  $n$

In practice, the individual APT variables and associated betas can be seen as a decomposition of the single beta factor of the CAPM. So, for example, although APT theory does not tell us what the APT factors are, typically they are related to systematic macroeconomic variables such as the level of GDP, inflation and interest rates.

Table below summarizes PwC's assessment of the alternative methodologies for calculating the cost of equity.

Table 4: Evaluation of CAPM and alternative methodologies for estimating the cost of equity

Methodology	Explanation	Advantage	Disadvantage
<b>CAPM</b>	The intuition behind CAPM is that investors are only rewarded for carrying non-diversifiable risk (also known as systematic or market risk).	Widely used and applied in valuations.	Empirical tests have found that beta may not be the only variable that has explanatory power.
<b>Dividend Growth Model</b>	The DGM is a simple forward-looking model that assumes that current share prices are equal to the present value of all future dividend payments.	Simple to compute.	Relies on accurate growth forecasts which may be biased. Cost of equity estimates tend to be highly volatile.
<b>Fama French Three- Factor Model</b>	Some academic tests of CAPM have shown that there may be some misspecification with regard to size and book-to-market value.  The Fama French Three-Factor Model attempts to compensate for the perceived misspecification.	Has achieved some empirical support.	In practice, this model is not widely used in its pure form but practitioners may increase the cost of equity in a judgemental way to reflect greater perceived risk for a small company.
<b>Arbitrage Pricing Theory</b>	The principle behind APT is similar to CAPM: investors get incremental reward for incremental (non-diversifiable) risk.	Theory is sound and intuitively appealing.	APT is rarely used because of problems with data availability and remains more of a conceptual academic model than a practitioners' tool.

Source: PwC's analysis

### 3.2.3 Review of PTC's approach and regulatory precedents

The table below sets out PTC's cost of equity calculation. From this, it is evident that PTC has used the CAPM framework to calculate its cost of equity.

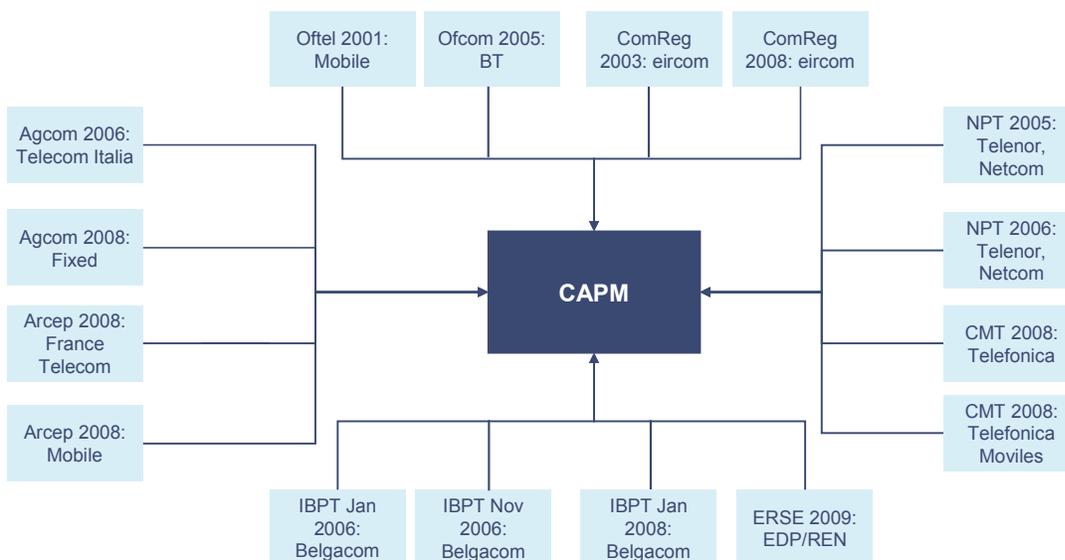
Table 5: PTC's cost of equity calculations (2004-2007)

	2004	2005	2006	2007
Risk-free rate (%)	4.2	3.5	3.9	4.4
Equity beta	1.2	1.2	1.2	1.2
EMRP (%)	6.5	6.7	5.8	7.0
Cost of equity (%)	11.9	11.4	10.6	12.5

Source: PTC's regulatory submissions

Our regulatory database shows that all of the regulators which we sampled have also used the CAPM in recent years.

Figure 2: Regulatory precedents - conceptual framework for calculating the cost of equity



Source: PwC analysis of European regulators. Further details are provided in Appendix I

### 3.2.4 PwC's recommendations

PwC's assessment of the three alternative frameworks in the context of estimating PTC's cost of equity are as follows:

- The DGM is seldom used as the primary method of estimating the cost of capital, but instead is sometimes used as a useful check on the cost of equity derived from CAPM. Its usefulness as a cross check depends on the accuracy of dividend growth forecasts and the volatility of share prices (or market value);
- As PTC is a large firm, the use of a small company risk premium is not relevant in this case and therefore this limits the usefulness of the FFTM; and

- The multi-factor APT model has not been widely adopted and is generally considered more of a conceptual academic model than a practical one mainly because of problems with data availability. PwC's analysis of the regulatory precedents indicates that no regulator across the seven European countries has used APT.

We consider CAPM to be the most appropriate framework for calculating PTC's cost of equity, as it is the most widely used and accepted of the techniques.

### 3.3 Cost of debt

The cost of debt is the return required by debt providers for lending to a business. It is typically calculated as:

$$K_d = R_f + DM$$

Where:

*K<sub>d</sub>* is the pre-tax cost of debt

*R<sub>f</sub>* is the risk-free rate

*DM* is the corporate debt margin

The debt margin is the additional return over the risk-free rate required by investors to hold debt rather than risk-free assets. The debt margin reflects the perceived credit quality of the borrower and the likelihood of default. It depends on a number of factors such as the capital structure of the firm, the cyclicity of earnings and operational leverage, and the quality of management.

There are three main ways in which the debt margin can be estimated:

- If a company issues tradable debt then the market cost of debt and the debt margin can be measured directly by looking at the yield to maturity on the company's own traded bonds;
- Alternatively, if the company has no tradable debt, the cost of debt can be measured by looking at the yield on debt issued by appropriate comparators in the market. In other words, the debt margin can be estimated by benchmarking the cost of debt to a suitable set of comparators; and
- The cost of debt can also be based on the benchmark yield for bonds with a similar credit rating. If the credit rating is unknown, it may be possible to derive a synthetic rating based on interest expense coverage, which is a determinant of credit ratings, or alternatively the credit rating of similar comparators could be used.

It should be noted that whilst this is the conventional approach to calculating the cost of debt, in strict theoretical terms it is incorrect. Consistent with the cost of equity, in principle what is required for the calculation of WACC is the expected cost of debt. The conventional calculation gives an estimate of the promised cost of debt – i.e. what a firm promises to pay its debt providers assuming that it is able to service its debt. The difference between this promised cost of debt and the expected cost of debt therefore reflects the probability that the firm will default on its debt. Where the cost of debt is being calculated for a going concern (as is generally the case in regulatory contexts) the probability of default can be ignored, and hence the conventional approach is to include the promised cost of debt in the WACC calculation.

#### 3.3.1 PTC's review and regulatory precedents

The table below sets out PTC's cost of debt calculations.

For 2004, PTC calculates its cost of debt as the actual interest rate<sup>4</sup> on inter-company loans from the parent, PT. Inter-company loans typically do not reflect what an independent, market based rate of interest would be.

For 2005, PTC calculates its cost of debt as the weighted average of the actual interest rates on liabilities related to employee benefits and those on medium and long term debt. The liabilities related to employee benefits are not a source of funds for the business, and therefore any interest expense on such liabilities should not be considered when calculating cost of debt.

For 2006-07, PTC calculates its cost of debt as the weighted average of the forward looking market based interest rate on medium and long term debt and the actual interest rate on liabilities related to employee benefits. The market based interest rate used for medium and long term debt for these years is equal to 3 months Euribor plus **[Informação confidencial (IC)]** for 2007.

Table 6: PTC's cost of debt calculations (2004-2007)

Criteria	2004	2005	2006	2007
Liabilities related to employee benefits (€ M)	[IC]	-	-	-
Interest rate on liabilities related to employee benefits (%)	-	-	-	-
Type of interest rate	-	-	-	-
Medium and long term debt (€ M)	-	-	-	-
Interest rate on debt (%)	-	-	-	-
Type of interest rate	-	-	-	-
Cost of debt (%)	-	-	-	[FIC]

Source: PTC regulatory submissions

[IC] – Início de informação confidencial, [FIC] – Fim de informação confidencial

The majority of the European regulators reviewed estimate the cost debt as the sum of the risk-free rate and the debt premium. The table below sets out the methodologies used for estimating the debt premium.

<sup>4</sup> Actual interest is calculated on the basis of the ratio of interest expense to the book value of the liability.

Figure 3: Regulatory precedents - methods for calculating debt premium

Regulator (Year)	Country	Companies	Debt premium (%)	Debt instrument of company under review	Debt instruments of comparators	Regulatory precedents
ComReg (2008)	Ireland	eircom	1.9			
Agcom (2006)	Italy	Telecom Italia	0.8			
Agcom (2008)	Italy	BT Italia,	2.4			
Agcom (2008)	Italy	Fastweb	2.2			
Agcom (2008)	Italy	Tele2	1.0			
Agcom (2008)	Italy	Tiscali	1.8			
CMT (2008)	Spain	Telefónica Móviles	0.9			
CMT (2008)	Spain	Telefónica	0.9			
Oftel (2001)	UK	Vodafone, BT Cellnet, One2One, Orange	1.0 – 1.8			
Ofcom (2005)	UK	British Telecom	1.0			
Anacom (2005)	Portugal	PTC	[IC]			
Anacom (2006)	Portugal	PTC	[IC]			
Anacom (2007)	Portugal	PTC	[IC]			
ERSE (2009)	Portugal	EDP Distribuição	0.8 – 1.0			
ERSE (2009)	Portugal	REN	0.5 – 0.9			

Key

Considered

Source: PwC analysis. Further details are provided in Appendix I

The evidence suggests that the majority of regulators refer to the bond yield of the company under consideration or its comparators for the purpose of estimating the cost of debt.

### 3.3.2 PwC's - recommendations

The most direct measure of PTC's forward looking debt margin would be the credit spread on its tradable bonds, where this would be calculated as the difference between PTC's corporate bond yield and the appropriate risk-free rate<sup>5</sup>. However PTC does not have any active bonds.

PwC's recommended approach is therefore to estimate PTC's debt margin through calculations based on the tradable debt of comparator companies with a similar credit rating.

PTC's actual cost of debt should also be taken into consideration to determine whether it is under any particular funding issues which result in a higher cost of debt than that observed in the market. However it should be noted that the regulator's objective is to remunerate PTC for its efficient cost of debt, and therefore PTC should not be compensated for any difference between its actual cost of debt and the market cost of debt where this has arisen as a result of poor management and investment decisions.

PwC's recommended approach is to estimate PTC's debt margin by reference to the tradable debt of comparator companies with a similar credit rating.

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<sup>5</sup> Note that this would assume that PTC's bonds are liquid financial instruments and of a suitable maturity.

## 4. Cost of equity inputs

### 4.1 Risk-free rate

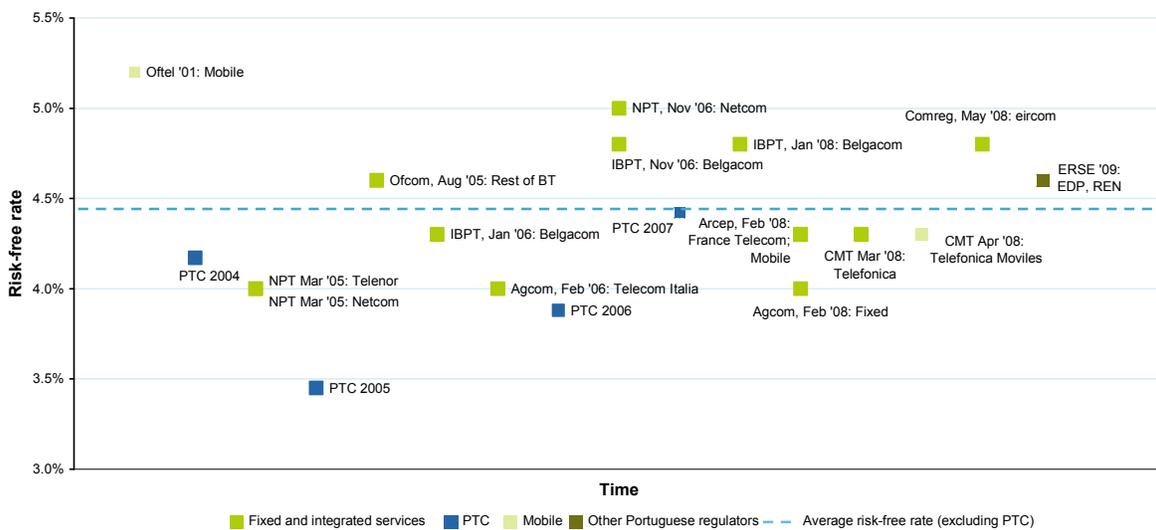
The risk-free rate is the rate of return that can be earned on a risk-free investment i.e. an investment that guarantees a fixed return on investment, with no possibility whatsoever of any variation in the level of returns. Whilst there are no investments that are absolutely risk-free, it is conventional practice to determine the risk-free rate by examining the yield on “safe”, liquid financial instruments that are considered to have negligible default risk. To determine the nominal risk-free rate the yield on treasury bills and government bonds are used, whilst the real risk-free rate can be measured using index-linked government bonds, if these are available.

#### 4.1.1 PTC’s approach and regulatory precedents

Over the last four years PTC has used nominal risk-free rates ranging from 3.5% to 4.4% in calculating its WACC. These were based on the average monthly yields on 10 year Portuguese government bonds calculated on a yearly basis.

Figure 4 below illustrates the range of nominal risk-free rates used by European regulators<sup>6</sup> in their last two cost of capital decisions. Most of them have used a nominal risk-free rate ranging between 4% and 5% in these decisions.

Figure 4: Regulatory precedents - nominal risk-free rate



Note: In cases where a range is given, we have used the midpoint in our approximation

Source: PwC analysis. Further details are provided in Appendix I

A relevant issue in relation to the risk-free rate is the choice of maturity for the financial instrument selected. Figure 5 below provides a summary of the financial instruments that were used by regulators in formulating their views on the risk-free rate.

<sup>6</sup> Ofcom is less useful as a comparator for the risk-free rate as it is outside of the Eurozone.

Figure 5: Regulatory precedents - maturity of government bonds used to infer the risk-free rate

Regulator	Country	Companies	Value (%)	Financial instrument considered	Years to Maturity			
					4	5	10	20
IBPT (Jan 2006)	Belgium	Belgacom	4.3	US government bonds				
IBPT (Nov 2006)	Belgium	Belgacom	4.8	US government bonds				
IBPT (2008)	Belgium	Belgacom	4.8	US government bonds				
Arcep (2008)	France	France Telecom	4.3	French government bonds				
Arcep (2008)	France	Orange France, SFR, Bouygues Telecom, Orange Caraibe, SRR.	4.3	French government bonds				
ComReg (2008)	Ireland	eircom	4.8	Irish and German government bonds				
Agcom (2006)	Italy	Telecom Italia	4.0	Italian government bonds				
Agcom (2008)	Italy	BT Italia, Fastweb, Tele2, Tiscali	4.0	Italian government bonds				
NPT (2005)	Norway	Netcom/Telenor	4.0	Norwegian government bills				
NPT (2006)	Norway	Netcom/Telenor	5.0	Norwegian government bills				
CMT (2008)	Spain	Telefónica, Telefónica Móviles	4.3	Spanish government bonds				
Oftel (2001)	UK	Vodafone, BT Cellnet, One2One, Orange	5.2	UK government bonds				
Ofcom (2005)	UK	BT	4.6	UK government bonds				
Anacom (2004)	Portugal	Portugal Telecom	4.2	Portuguese government bonds				
Anacom (2005)	Portugal	Portugal Telecom	3.5	Portuguese government bonds				
Anacom (2006)	Portugal	Portugal Telecom	3.9	Portuguese government bonds				
Anacom (2007)	Portugal	Portugal Telecom	4.4	Portuguese government bonds				
ERSE (2009)	Portugal	EDP Distribution, REN SA	4.6	Portuguese government bonds				

Key

Considered

Source: PwC analysis. Further details are provided in Appendix I

Most of the regulators have examined yields on long term bonds with 10 years maturity. The key exceptions to this are:

- IBPT's assessment of Belgacom's cost of capital assessment in 2006 (both November and January) and 2008 examined yields on both 10 and 20 years maturity bonds;
- NPT's 2005 and 2006 assessments of Telenor's cost of capital looked at bonds with 5 years maturity; and
- Ofcom's 2001 and 2005 assessment of mobile operators and BT's cost of capital examined bonds with 4-5 years maturity.

#### 4.1.2 PwC's recommendations

PwC considers that the risk-free rate used for PTC's cost of capital calculation should be estimated as the yield on Portuguese government bonds. This is appropriate only if the bonds issued by the Portuguese government are considered to be liquid financial instruments. If Portuguese bonds are considered to be illiquid and yields are distorted due to market imperfections then it might be more appropriate to calculate the risk-free rate using a synthetic approach. A synthetic approach would apply the Portuguese Country Risk Premium ("CRP")<sup>7</sup> to the yield of a benchmark US government bond (which is considered to be a liquid financial instrument with no default risk), and adjust it for the average expected inflation differential between the USA and Portugal.

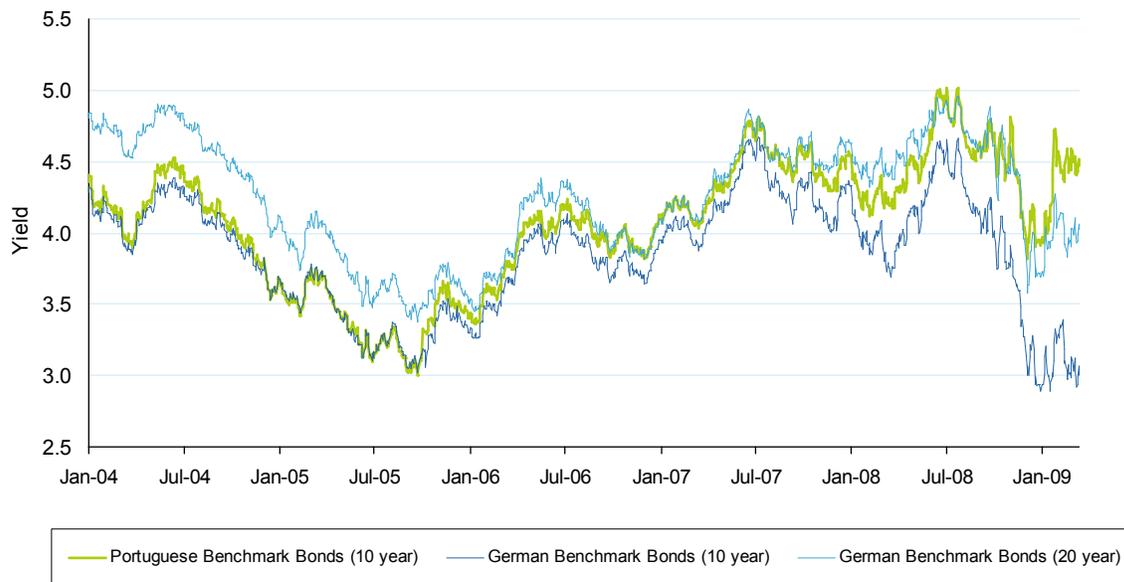
PwC consider that the maturity of the risk-free rate should match the average life of the assets of PTC. Considering that telecom companies are businesses with investments in long term assets, and taking into account the regulatory precedents set out above, PwC is of the view that a Portuguese government bond with 10-15 years left to maturity would be the appropriate financial instrument for estimating the risk-free rate. However, given that there are no active Portuguese government bonds with 15 years maturity we recommend using the yields on 10 year bonds.

A further issue is whether to consider the yields on German bonds when estimating the risk-free rate. Germany is the largest economy in the Eurozone and represents a benchmark for the region. Regulators such as ComReg have used German bonds as benchmarks in recent years. Figure 6 below shows the historic yields on Portuguese and German government bonds since 2004.

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<sup>7</sup> CRPs are available from PwC's Country Risk Model which is updated on a quarterly basis.

Figure 6: Evolution of Portuguese and German government bonds



Source: Datastream

The yields on Portuguese and German 10 year government bonds appear to have been closely aligned from January 2006 to July 2007. Since July 2007 there has been a divergent trend where the Portuguese 10 year government bond yield has remained relatively more stable than the German 10 year government bond yield. For example the spot rate as of 17th March 2009 for the Portuguese 10 year bond was 4.5%, whereas for the German 10 year bond it was 3.0%.

Based on the evidence presented above and taking in consideration that the yield of Portuguese government bonds is most likely to be considered by a PTC's investor, we believe that the yield of the Portuguese government bonds is a better estimate of the risk-free rate.

Additionally, given the current volatility in financial markets, we also recommend that a historical average (e.g. over 1-2 years) should be used for calculating the cost of capital, as this would smooth out short term fluctuations in the yield.

Data on risk-free rates can be obtained from a number of sources such as Bloomberg, Datastream and Banco de Portugal.

Our recommendation is to use the yield on 10 year Portuguese government bonds to calculate the risk-free rate. Given the current volatility in financial markets, we recommend using an average of the 10 year yield over the past 1-2 years.

Table 7 below illustrates the range of nominal risk-free rates that can be used considering the recommended methodology. As explained, due to the current volatility the risk-free rates were calculated using historic averages between 1 and 2 years.

Table 7: Risk-free rates

	1 Year Average	1.5 Years Average	2 Years Average
Portuguese 10y Bond Yields	4,52%	4,52%	4,47%

Source: Banco de Portugal (monthly observations)

Table 8: Low Range and High Range Risk-free Rate

	Low Range	High Range
Risk-free Rate	4,47%	4,52%

## 4.2 Equity beta

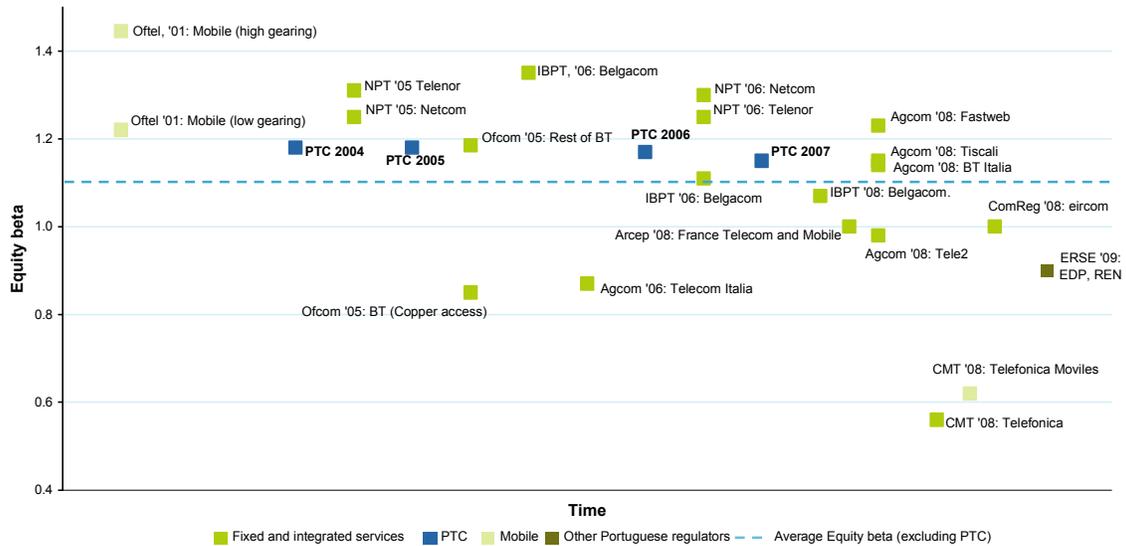
Under the CAPM framework, investors are only compensated for being exposed to systematic risk. The degree of systematic risk associated with any individual investment depends on the correlation between movements in returns on that investment and returns on the market portfolio. The stronger the correlation, and the greater the amplitude of any movement in returns as result of market-wide events, the higher the systematic risk. A company's equity beta measures this risk.

### 4.2.1 PTC's approach and regulatory precedents

PTC has used Bloomberg estimates of PT's equity beta. Bloomberg estimates are calculated by regressing historical equity returns on a stock (in this case PT) against the equity returns from the relevant market index (in this case the Portuguese stock exchange). For calculating the equity beta, PTC has used monthly equity returns since 1995 (corresponding to the complete set of available historical data). During this period, PT SGPS has suffered significant changes in its business profile and therefore, the data relative to distant past periods should be disregarded as it does not reflect the current business profile of PT SGPS.

Figure 7 below shows that equity betas used by European regulators in recent years have ranged from 0.8 to 1.4. PTC's equity beta estimates are towards the upper end of this range.

Figure 7: Regulatory precedents - equity beta estimates



Note: In cases where a range is given, we have calculated the mid-point for the purpose of the chart above.

Source: PwC analysis. Further details are provided in Appendix I

The table overleaf sets out our findings on issues related to the estimation of equity betas. The key observations are as follows:

- Most regulators have undertaken comparator analysis in order to calculate the equity beta. This involves estimating comparator equity betas that are then de-levered and averaged resulting in the average asset beta. The average asset beta based on the comparators is then re-levered at the appropriate gearing level (this methodology is explained from first principles in the following section); and
- There is mixed evidence on the estimation period and frequency of data used. Some regulators estimated an equity beta over a 1 to 2 year period, whereas others used a 5 year period. Likewise, some regulators have used monthly data whereas others have used daily or weekly data.

Table 9: Regulatory precedents – equity beta calculation methodology

Regulator	Country	Company	Equity beta estimate	Estimation period / data frequency	Methodology
IBPT (2006)	Belgium	Belgacom	1.4	n/a	Equity beta was estimated by undertaking comparator analysis. Although Belgacom is listed, the regulator did not undertake regression analysis to estimate its equity beta directly as the listed period was too short and not enough data was available.
IBPT (2008)	Belgium	Belgacom	1.1	n/a	Equity beta was calculated by undertaking comparator analysis. In particular, equity betas were calculated for listed comparator companies. These equity betas were de-levered to calculate comparator asset betas. The average of the comparators' asset beta was re-levered at the actual gearing level of Belgacom to estimate its equity beta.
Arcep (2008)	France	France Telecom	1.0	n/a	Equity beta was calculated by undertaking comparator analysis and examining regulatory precedents.
Arcep (2008)	France	Orange France, SFR, Bouygues Telecom, Orange Caraibe, SRR.	1.0	n/a	Comparator analysis/ regulatory precedents (comparators included Vodafone, Mobistar and Cosmote).
ComReg (2008)	Ireland	Eircom	1.0	Daily, weekly, monthly	Statistical estimation of eircom's equity beta using different data frequencies (daily, weekly, monthly), different market indexes and various time periods (between March 2004 and September 2005). The implied asset betas were de-levered from the equity betas estimates. Other sources considered included third-party estimates (Bloomberg and the London Business School Risk Management Service) and comparator analysis.
Agcom (2006)	Italy	Telecom Italia	0.8 – 0.9	Daily / 5 years	Comparator analysis.
Agcom (2008)	Italy	BT Italia, Fastweb, Tele2, Tiscali	1.1, 1.2, 1.0, 1.2	n/a	Comparator analysis.
NPT (2005)	Norway	Netcom, Telenor	1.3	Monthly / 5 years	Equity beta was estimated by undertaking comparator analysis. Comparators included Mobistar, O2, Tele2 and Vodafone.
NPT (2006)	Norway	Netcom, Telenor	1.3	Monthly / 5 years	Equity beta was estimated by undertaking comparator analysis. Comparators included Mobistar, O2, Tele2 and Vodafone.
CMT (2008)	Spain	Telefónica	0.6	Daily, weekly/ 3 years	Equity beta was calculated by undertaking comparator analysis. In particular, equity betas were calculated for listed comparator companies. These equity betas were de-levered to calculate comparator asset betas. The average asset beta of the comparators was re-levered at the actual gearing level of Telefónica to estimate its equity beta.
CMT (2008)	Spain	Telefónica Móviles	0.6	Daily, weekly/ 2 years	Equity beta was calculated by undertaking comparator analysis. In particular, equity betas were calculated for listed comparator companies. These equity betas were de-levered to calculate comparator asset betas. The average asset beta of the comparators was re-levered at the actual gearing level of Telefónica Móviles to estimate its equity beta.
Oftel (2001)	UK	Vodafone, BT Cellnet, One2One, Orange	0.9 – 1.5	Monthly/ 5 years	Calculated a representative equity beta for the whole group by averaging the equity beta for each listed company. Individual equity betas were based on LBS RMS equity beta calculations.
Ofcom (2005)	UK	BT	0.8 – 0.9	Daily / 1 year	Equity beta estimate was based on one-year of historic data. This gave an equity beta of around 1 which Ofcom argued was a reasonable estimate for BT.
Anacom (04–07)	Portugal	PTC	1.2	Monthly / c. 10 years	Equity beta was calculated using monthly observations of PT quoted on the stock exchange.
ERSE (2009)	Portugal	EDP Distribution	0.9-1.0	NA	Asset beta for each business unit is estimated by breaking down the group beta on the basis of their book value. Equity beta for the distribution business is then calculated by re-levering its asset beta.
ERSE (2009)	Portugal	REN SA	0.89-0.93	Daily / 1 year	Asset beta for each business unit is estimated by breaking down the group beta on the basis of their book value. Equity beta for the electricity business is then calculated by re-levering its asset beta.

Source: PwC analysis. Further details are provided in Appendix I

#### 4.2.2 PwC's recommendations

PTC's parent company, PT, is a publicly listed company and therefore its own equity beta can be directly observed in the market. However, PT is involved in a wide range of activities (see Section 2.2), some of which are unrelated to its fixed line telecoms business.

PTC has used the Bloomberg estimate of PT's equity beta. Bloomberg estimates are calculated by regressing monthly historical equity returns on PT shares against the equity returns from the Portuguese stock exchange market index. Use of a single estimate increases the degree of statistical error associated with a particular regression. In addition, the use of a range of more than 10 years of historical data for the beta's calculation is far higher than the normal market methodologies, as this approach includes data from periods when PT was significantly different from its current corporate risk profile. Furthermore, PT's beta is not necessarily a good guide to that of PTC because PT is active in some product areas which differ to that of PTC. Therefore, when determining PTC's equity beta, PT SGPS' equity beta should not be considered as the only source of information.

Furthermore, the use of a single estimate increases exposure to the statistical error associated with calculating beta through regressing returns on a company against returns on the stock market as a whole. Our recommended best practice for estimating beta is to use a range of suitable comparator equity betas to benchmark a particular investment or business and regulator's precedents.

The table below sets out a number of criteria that could be used to identify comparator companies for PTC.

Table 10: Criteria for selection of PTC's comparators

Criteria	Explanation
Income per capita	Comparator companies should operate in countries with similar income levels.
Products / line of services	Comparator companies should provide similar product and services.
Market position	Comparator should have a similar market position to the one that PTC has in Portugal.
Growth rate	Comparators should be in a similar phase of their industry life cycle. This can be inferred from the evolution of their penetration rates and revenues.
Enterprise value	Comparator companies should be of a similar size to PTC.

Source: PwC analysis

Equity betas can be calculated using daily, weekly and monthly data. PwC considers that in overall terms monthly estimates are more reliable than weekly or daily estimates, as explained in the table below.

Table 11: Assessment of alternative frequencies for estimating equity betas

	Frequency – daily	Frequency – weekly	Frequency – monthly
Advantages	- Large number of observations	- More observations relative to monthly data - Less noise relative to daily data	- Low standard errors relative to daily or weekly data - Are likely to be more representative of the underlying risk
Disadvantages	- High standard errors - Daily returns are very volatile	- High standard errors - Different results depending upon which day of the week is used	- Requires 5 years of data to provide sufficient observations. Over a 5 year period the corporate risk profile of the company may change

Source: PwC analysis

The key points to note are as follows:

- Weekly estimates suffer from the problem of different results depending upon the day of the week chosen as the basis for the regressions;
- Daily and weekly betas are less stable than monthly betas, reflecting the fact that monthly share price movements are less volatile than daily share price movements; and
- Movements in monthly returns are more likely to be representative of underlying systematic risk than daily movements because daily returns may be influenced by short-term factors that have little to do with systematic risk — this is known as "noise" because it obscures the relationship being measured. As a result standard errors of monthly betas are lower than those for daily and weekly betas as they suffer from less noise.

A related issue is the time period over which the equity beta should be estimated. PwC consider that in order to calculate a reliable monthly beta, 5 years of data are required to provide sufficient observations for the regression. This approach is appropriate only if the corporate risk profile has not changed over this 5 year period. However, if this is not the case, and the company has undergone significant changes over the past 5 years, it may be more appropriate to use a shorter time period with higher frequency of data (for example daily data over one year).

Equity betas can be obtained from sources such as Bloomberg, London Business School Publications and BARRA.

It should be noted that the betas calculated for comparators using historical market data are equity betas. Equity betas reflect the financial as well as the business risk faced by equity investors. As mentioned above, suitable comparators can be expected to have similar business risk, even if they differ in their exposure to financial risk (because of different gearing levels). The business risk of a company is independent of its financial risk and is reflected by its asset beta. In order to estimate the benchmark equity beta of PTC, it is essential first to estimate comparator companies' asset betas. Asset betas can be derived from the observable equity betas by employing a simple adjustment formula:

$$B_a = \beta_e / (1 + D / E)$$

A discussion on the use of this formula is provided in Appendix II.

Once the average asset beta across all comparators is calculated, PTC's equity beta can be calculated by applying the same formula again, using PTC's target or optimal debt/equity ratio. Section 6 contains a more detailed discussion on the appropriate gearing to be used for calculating PTC's WACC.

**We recommend using suitable comparators for estimating PTC's equity beta and regulatory precedents. Monthly data over a five year period should be used to estimate the comparators' equity betas.**

Table 12 and 13 below illustrates the range of equity betas for PTC that can be used considering the recommended methodology. These can be split in two main groups: (i) table 12 illustrates equity betas that were estimated using market inputs and (ii) table 13 illustrates equity betas from regulatory precedents. In the first group, equity betas were obtained through market data for PT SGPS and for a group of comparator companies, using monthly observations during a 5 year period and daily observations during a 1 year period. Then, those equity betas were de-leveraged at current gearing ratios and re-leveraged at a specific optimal gearing – see section 6 for detailed information on the optimal gearing. However, it must be pointed out that the selected comparators do not comply with all the requirements defined in the methodology due to the fact that, in practice, market information for such entities is not available. In the second group, betas were obtained from recent regulatory decisions regarding fixed operators.

Table 12: Equity betas estimated from market inputs at 31.12.08

Source	Beta 5y Monthly	Beta 1y Daily
<b>Beta PT SGPS at Optimal Gearing*</b>	<b>0,772</b>	<b>0,786</b>
<b>Beta Comparators at Optimal Gearing*</b>	<b>0,801</b>	<b>0,754</b>
Belgacom	0,664	0,642
BT Group	0,684	0,668
Deutsche Telekom	0,719	0,859
Elisa OYJ	1,142	0,963
France Telecom	0,543	0,734
Hellenic Telecommunications	0,751	0,438
KONINKLIJKE KPN NV	0,478	0,389
Magyar Telecom	1,073	1,051
Swisscom	0,618	0,447
Telekom Austria	0,798	0,784
Telecom Italia	0,654	0,834
Telefonica	0,683	0,626
Telenor ASA	1,130	1,004
TeliaSonera AB	1,275	1,120
<b>Average</b>	<b>0,787</b>	<b>0,770</b>

\* As determined in Section 5

Source: PwC analysis using data from Bloomberg,

Table 13: Equity betas from regulatory precedents

Regulatory Precedents	Defined Beta
IBPT - Belgacom	1,1
Arcep – France Telecom	1
ComReg – Eircom	1
CMT – Telefónica	0,6
Agcom - Various entities	1,125
NPT – Telenor	1,3
<b>Average</b>	<b>1,021</b>

Source: PwC Analysis

Table 14: Low Range and High Equity Betas

	Low Range	High Range
Equity Beta	0,77	1,02

### 4.3 Equity market risk premium (“EMRP”)

The EMRP represents the premium of the market portfolio above the risk-free rate. It is the return investors expect over and above the risk-free rate to compensate for the additional risk associated with investing in equities instead of investing in risk-free assets. Arithmetically, it is calculated as:

$$EMRP = R_m - R_f$$

Where:

R<sub>m</sub> is the expected return on the market portfolio

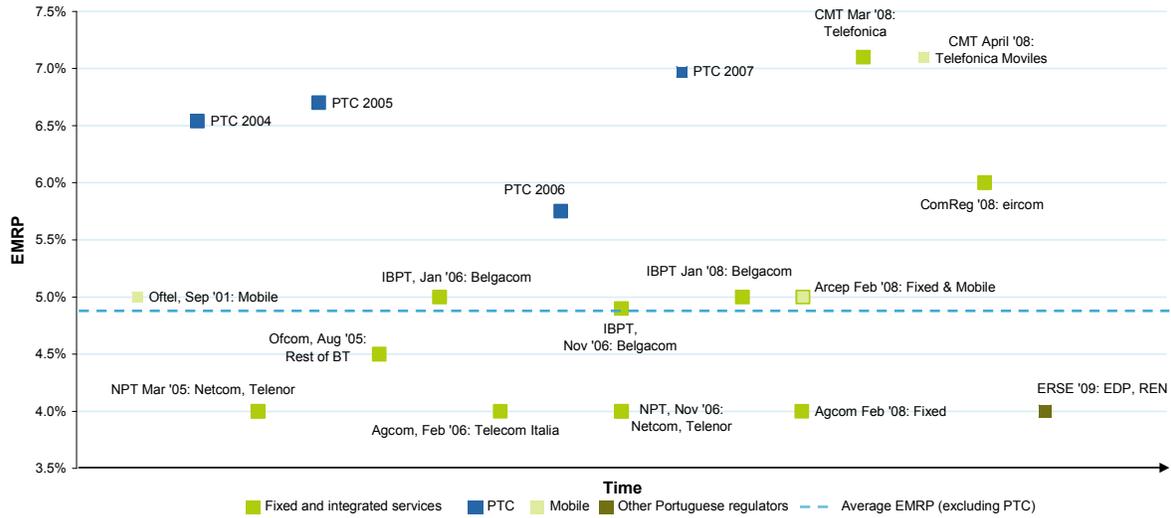
R<sub>f</sub> is the risk-free rate

#### 4.3.1 PTC’s approach and regulatory precedents

The EMRP adopted by PTC in its cost of capital analysis is based on Bloomberg’s forward looking EMRP estimate. Bloomberg’s EMRP is calculated using the DGM.

Figure 8 below demonstrates that the European regulators we considered have used an EMRP ranging between 4.0% and 7.2%. PTC’s recent EMRP estimate of 6.97% is therefore towards the top end of this range.

Figure 8: Regulatory precedents - EMRP estimates



Note: In cases where a range is given, we have calculated the mid-point for the purpose of the chart above.

Source: PwC analysis. Further details are provided in Appendix I

The table below sets out the approach that European regulators have undertaken for estimating the EMRP. Regulators have primarily considered three main types of sources for the EMRP:

- Regulatory precedents — for example, Ofcom (2005) looked at the EMRP estimates that have been used by other UK regulators, Ofwat, Ofgem, the ORR and the MMC;
- Third party estimates — for example, France has primarily based its estimates on the analysis undertaken by Vernimmen (2006); and
- Empirical analysis — for example, CMT (2008) has based its EMRP on the average excess returns (calculated using data from Ibbotson) over a 34 year period.

Our database indicates that regulators have considered both arithmetic and geometric averages when deciding on the appropriate range. Most regulatory decisions have put more weight on ex-post estimates (i.e. estimates based on historic data) than on ex-ante estimates (i.e. estimates based on forward-looking expectations). Both these issues are discussed in more detail below.

Table 15: Regulatory precedents - methodology underlying EMRP estimates

Regulator	Country	Companies	Value (%)	Ex-post / Ex-ante	Methodology
<b>IBPT (Jan 2006)</b>	Belgium	Belgacom	5.0	Ex-post	EMRP was based on the average excess returns (calculated using data from Ibbotson) over a 34 year period. Both the arithmetic and geometric averages were considered.
<b>IBPT (Nov 2006)</b>	Belgium	Belgacom	4.9	Ex-post	EMRP was based on the average excess returns (calculated using data from Ibbotson) over a 34 year period. Both the arithmetic and geometric averages were considered.
<b>IBPT (2008)</b>	Belgium	Belgacom	5.0	Ex-post	EMRP was based on the average excess returns (calculated using data from Ibbotson) over a 34 year period. Both the arithmetic and geometric averages were considered.
<b>Arcep (2008)</b>	France	France Telecom	5.0	Ex-post	EMRP is based on the analysis undertaken by Vernimmen (2006) that estimated the EMRP to be 5% on average for the period 1980-2006.
<b>Arcep (2008)</b>	France	Orange France, SFR, Bouygues Telecom, Orange Caraibe, SRR.	5.0	Ex-post	EMRP is based on the analysis undertaken by Vernimmen (2006) that estimated the EMRP to be 5% on average for the period 1980-2006.
<b>ComReg (2008)</b>	Ireland	Eircom	6.0	Ex-post	Considered regulatory precedents and DMS <sup>8</sup> (2006) estimates. The upper end of the range (6%) was based on regulatory precedents. The lower end of the range (4.8%) was the midpoint of the geometric mean relative to bonds (3.6%) and the arithmetic mean relative to bills (6.0%), from the DMS 2006 dataset.
<b>Agcom (2006)</b>	Italy	Telecom Italia	4.0	n/a	n/a
<b>Agcom (2008)</b>	Italy	BT Italia, Fastweb, Tele2, Tiscali	4.0	n/a	n/a
<b>NPT (2005)</b>	Norway	Netcom, Telenor	4.0	Ex-post	EMRP reflected the average excess returns on the Oslo stock exchange index over 105 years.
<b>NPT (2006)</b>	Norway	Netcom, Telenor	4.0	Ex-post	EMRP reflected the average excess returns on the Oslo stock exchange index over 105 years.
<b>CMT (2008)</b>	Spain	Telefónica	7.1	Ex-post	EMRP is calculated as the arithmetic average of the difference between the monthly IBEX 35 returns and the yield on the 10 year government bond.
<b>CMT (2008)</b>	Spain	Telefónica Móviles	7.1	Ex-post	EMRP is calculated as the arithmetic average of the difference between the monthly IBEX 35 returns and the yield on the 10 year government bond.
<b>Oftel (2001)</b>	UK	Vodafone, BT Cellnet, One2One, Orange	5.0	Both Ex-ante and Ex-post	Considered regulatory precedents and third party estimates. Regulatory precedents consisted of: Ofwat (3%-4%), ORR (3.25%-3.75%), Ofgem (3.5%) and MMC (3.5%-5%). Third party estimates included Oxera (5%) and PwC (5%) estimates.
<b>Ofcom (2005)</b>	UK	BT	4.5	Both Ex-ante and Ex-post	Considered DMS (2004) estimates and regulatory precedents. However the final range was based on DMS estimates, where the upper end was equal to the arithmetic mean and the lower end was equal to the geometric mean. Furthermore, the point estimate was biased towards the upper end of range in order to incentivise investment.
<b>Ancacom (2004)</b>	Portugal	PTC	6.5	Ex-ante	EMRP is based on Bloomberg's forward looking EMRP estimate. Bloomberg's EMRP is calculated using the DGM (using risk-free rate from Bloomberg).

<sup>8</sup> DMS refers to Dimson, Marsh and Staunton's annual publication entitled "Global investment return yearbook".

Regulator	Country	Companies	Value (%)	Ex-post / Ex-ante	Methodology
<b>Ancacom (2005)</b>	Portugal	PTC	6.7	Ex-ante	EMRP is based on Bloomberg's forward looking EMRP estimate. Bloomberg's EMRP is calculated using the DGM (using same risk-free rate as in CAPM ie from Banco de Portugal )
<b>Ancacom (2006)</b>	Portugal	PTC	5.8	Ex-ante	EMRP is based on Bloomberg's forward looking EMRP estimate. Bloomberg's EMRP is calculated using the DGM (using same risk-free rate as in CAPM ie from Banco de Portugal).
<b>Ancacom (2007)</b>	Portugal	PTC	7.0	Ex-ante	EMRP is based on Bloomberg's forward looking EMRP estimate. Bloomberg's EMRP is calculated using the DGM (using same risk-free rate as in CAPM ie from Banco de Portugal).
<b>ERSE (2009)</b>	Portugal	EDP, REN	3.5 – 4.5	Ex-ante	EMRP is based on the DMS (2006) estimates and the empirical analysis undertaken by ERSE

Source: PwC analysis. Further details are provided in Appendix I

### 4.3.2 PwC's recommendations

The size of the EMRP is contentious as it cannot be directly observed in the market and must instead be estimated. In principle, the EMRP is an ex-ante (forward-looking) rather than an ex-post (historic) concept. However, in practice, both historic and forward-looking approaches are commonly used.

Table 16 provides a summary of some particularly well known studies on the ex-post EMRP.

Table 16: Ex-post estimates of EMRP

Source	Time period considered	EMRP – geometric mean (%)	EMRP – arithmetic mean (%)
<b>DMS – LBS (2008):</b>			
France	1900 – 2007	4.1	6.2
Ireland	1900 – 2007	3.5	5.1
Italy	1900 – 2007	4.4	7.7
Netherlands	1900 – 2007	4.1	6.1
Norway	1900 – 2007	2.9	5.6
Spain	1900 – 2007	2.7	4.6
UK	1900 – 2007	4.1	5.4
<b>Barclays Capital (2007):</b>			
UK	1900 – 2006	4.2	
<b>Ibboston (2006):</b>			
US	1970 – 2005	4.8	n/a
Canada	1970 – 2005	3.9	n/a

Source: DMS (2008), "Global Investment Returns Yearbook 2008"; Barclays Capital (2007), "Equity Gilt Study"; Ibboston (2006), "Stocks, Bonds, Bills and Inflation Year Book".

There are two main sources of ex-ante EMRP estimates:

- Implied value – EMRP is implied from the required rate of return calculated using the DGM.
- Survey of expectations – aggregate investors' expectations about returns from investing in the market as a whole are derived by survey.

Table 17 below shows some examples of ex-ante estimates of EMRP.

Table 17: Ex-ante estimates of EMRP

Source:	EMRP (%)	Comments
Competition Commission (2008)	3.8–5.0	Based on DGM
Welch — GM (2008)	4.0–6.0	Based on a survey of 400 finance professors
Welch — AM (2008)	4.5–7.0	Based on a survey of 400 finance professors
Gregory — GM (2007)	1.7–3.3	Based on dividend and earning growth models
Gregory — AM (2007)	2.0–3.9	Based on dividend and earning growth models
Competition Commission (2007)	2.1–3.3	Based on dividend growth models
Claus and Thomas (2001)	3.4	Based on DGM

Sources: Competition Commission (2008), “Stansted Airport – Q5 price control review”; Welch, Ivo (2008) “The Consensus Estimate For The Equity Premium by Academic Financial Economists in December 2007”; Gregory (2007), “How Low is the UK Equity Risk Premium?”; Competition Commission (2007), “A report on the economic regulation of the London airports companies (Heathrow Airport Ltd and Gatwick Airport Ltd)”; Claus and Thomas (2001), “Equity premia as low as three percent? Empirical evidence from analysts earnings”.

A further issue is whether to consider the geometric mean (“GM”) or the arithmetic mean (“AM”) for the analysis of historic returns<sup>9</sup>. The GM return for a period gives a measure of the average annual return achieved by an investor as if the investor enters into a buy and hold strategy for the whole period under consideration. The AM return is equal to the average of all the single year returns over the period being considered. The GM return provides a more accurate estimate if one believes that equity investors could be assumed to engage in a buy and hold strategy for the period under consideration. In the case of the EMRP, where actual returns are considered over the long term (20 years or more) it is unrealistic to assume such a long holding period. If it is considered that it is realistic to assume that equity investors would move in and out of equities over the holding period then the AM is more relevant. On balance, we consider that both AM and GM estimates of the EMRP should be considered.

We recommend that both ex-ante and ex-post evidence should be considered, along with the regulatory precedents, in formulating a view on the EMRP. However it is important to note that ex-ante EMRP approaches are generally seen as weak, as EMRPs calculated on this basis tend to be volatile (DGM approach) or judgemental and unreliable (survey approach). Therefore we suggest that more weight is placed on the ex-post rather than the ex-ante evidence.

Given the current turmoil in the financial markets, it is important to analyse the effect that this has had on the required rates of return in capital markets. A number of recent studies on the EMRP have taken this into account and have adjusted their long term EMRP estimates accordingly. These are summarized in the table below.

<sup>9</sup> Given a sample set {u<sub>1</sub>, u<sub>2</sub>... u<sub>n</sub>...u<sub>N</sub>}, the arithmetic mean is calculated as  $\sum_{i=1}^n U_i / n$  and the geometric mean is calculated as

$$\left( \prod_{i=1}^n u_i \right)^{1/n}$$

Table 18: Recent views on the EMRP taking into consideration the current financial turmoil

Source	Date	EMRP (%) – reflecting the impact of the current financial turmoil	Author's comments
Grabowski	30 January 2009	6.0	Using an EMRP derived during “normal” economic times will underestimate the cost of equity.
Citigroup	4 December 2008	5.1 – 5.3	Adjusted from 4.0% to reflect the long term re-pricing of risk.
Nomura	27 October 2008	8.0	Risky financial assets such as equities have significant risk premia embedded in them, to reflect the expectation of policy failure.

Sources: Grabowski, J, Roger (2009), “Problems with cost of capital estimation in the current environment – update”, 30th January; Citigroup Global Markets (2008), “Calculating the cost of capital in a downturn”, 4th December; and Nomura, “European Strategy Weekly”, 27 October 2008.

Table 19 below provides a summary of EMRP estimates based on the alternative sources presented above.

Table 19: Summary of EMRP sources

EMRP basis	Minimum (%)	Maximum (%)
Regulatory precedents	4.0	7.2
Ex-post, geometric	2.7	4.8
Ex-post, arithmetic	4.6	7.7
Ex-ante	1.7	7.0
Recent reviews	5.1	8.0
Range	1.7	8.0

On this basis we consider that PTC's EMRP estimate should be based on an assessment of all available sources, taking into consideration the impact of the current financial turmoil on the required rates of return as well as the regulatory precedents. The magnitude of the adjustment can only be determined by undertaking a detailed empirical analysis. PwC UK has recently increased its view of the UK EMRP from 4.5% to 5%. We would therefore expect the EMRP in Portugal to be 5% or higher.

We recommend that all EMRP sources, including ex-post and ex-ante, are considered when estimating the EMRP. Furthermore the effect of the recent turmoil in financial markets on the long run EMRP should also be taken into account.

Table 20 below illustrates two possible estimates for EMRP, considering different weights for each approach.

Table 20: Two EMRP estimates considering different weights for each source

Approach	Source	AM/GM/AP*	EMRP	Weighting Scenario I	Weighting Scenario II	
<b>Ex-post</b>	DMS and LBS (2008) – France	AM	6,20%	5,0%	5,0%	
		GM	4,10%	2,5%	5,0%	
	DMS and LBS (2008) – Italy	AM	7,70%	5,0%	5,0%	
		GM	4,40%	2,5%	5,0%	
	DMS and LBS (2008) – Ireland	AM	5,10%	5,0%	5,0%	
		GM	3,50%	2,5%	5,0%	
	DMS and LBS (2008) – Spain	AM	4,65%	5,0%	5,0%	
		GM	2,70%	2,5%	5,0%	
	<b>Ex-post Weighting</b>				<b>30,0%</b>	<b>40,0%</b>
	<b>Ex-ante</b>	Competition Commission (2008)	AP	4,40%	2,5%	2,5%
Welch (2007)		GM/AP	5,00%	2,5%	5,0%	
		AM/AP	5,75%	5,0%	5,0%	
<b>Ex-ante Weighting</b>				<b>10,0%</b>	<b>12,5%</b>	
<b>Recent Reviews</b>	Grabowski (2009)		6,00%	15,0%	7,5%	
	<b>Recent Reviews Weighting</b>				<b>15,0%</b>	<b>7,5%</b>
<b>Regulatory Precedent</b>	CMT Spain (2008)	AP	7,00%	17,5%	13,3%	
	ComReg Ireland (2008)	AP	6,00%	17,5%	13,3%	
	Arcep France (2008)	AP	5,00%	10,0%	13,3%	
	<b>Regulatory Precedent Weighting</b>				<b>45,0%</b>	<b>40,0%</b>
<b>Weighted Average EMRP</b>				<b>5,75%</b>	<b>5,42%</b>	

\* AP – Average Point

Source: PwC analysis

As mentioned above, the estimation of the EMRP is much more a judgement call than a calculation exercise. Different entities may calculate different EMRP depending on the data sources used and their specific views about market future prospects. The table above presents two indicative alternative scenarios. The two main differences between both scenarios are as follows:

- More weight attributed to Recent Reviews in Scenario I than in Scenario II. The two scenarios reflect different views of EMRP future prospects;
- More weight attributed to geometric mean of ex-post data in Scenario I than in Scenario II. The two scenarios reflect different views about PTC investor profile.

## 5. Cost of debt inputs

### 5.1 Debt premium

The debt premium is the additional return over the risk-free rate required by debt investors for holding corporate debt and reflects the compensation required for being exposed to the risk that the company might default on its debt obligation.

#### 5.1.1 PTC's approach and regulatory precedents

As set out in Section 3.3.1, PTC currently uses the weighted average of the forward looking market based interest rate on medium and long term debt and the actual interest rate on liabilities related to employee benefits to calculate its cost debt. It does not explicitly estimate the debt premium, but its implied debt premium can be calculated as the difference between the cost of debt and the risk-free rate (the yield on 10 year Portuguese government bonds).

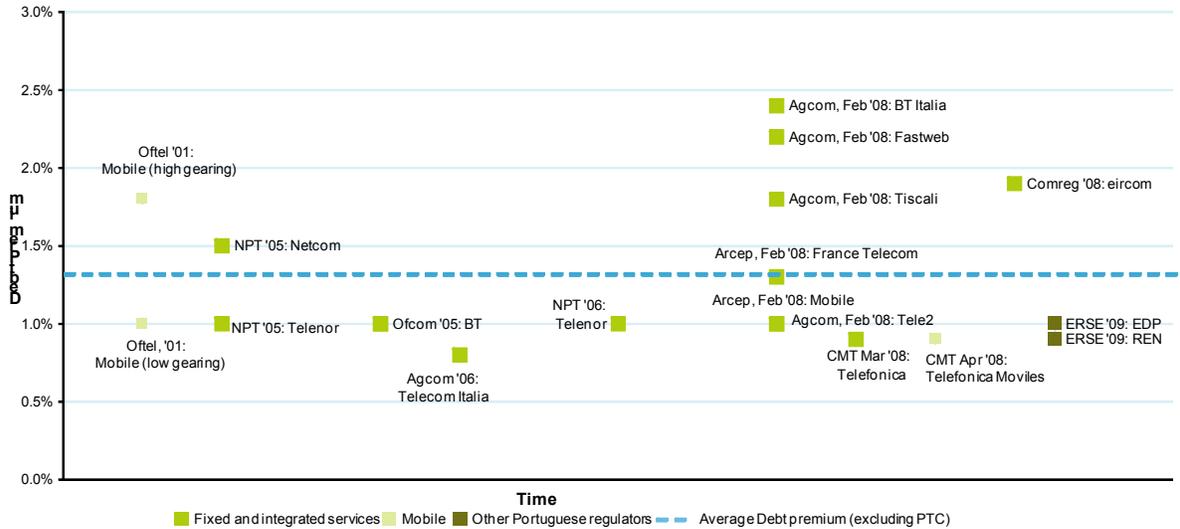
Table 21: PTC's implied debt premium

	2004	2005	2006	2007
Cost of debt (%)	[IC]	-	-	-
Risk-free rate (%)	-	-	-	-
Implied debt premium (%)	-	-	-	[FIC]

Source: PTC regulatory submissions

The figure below sets out the debt premium that has been used by regulators across Europe. Although, the debt premium is a firm specific factor that we would expect to vary across companies, it is reasonable to observe that most regulators have used a debt premium between 0.7% and 2.4%. The average debt premium across all regulators is 1.3%.

Figure 9: Regulatory precedents - debt premium



Note: In cases where a range is given, we have calculated the mid-point for the purpose of the chart above

Source: PwC analysis. Further details are provided in Appendix I

The debt premium implied from PTC's cost of debt estimates in 2006 and 2007 is at the bottom of the range based on the other regulators' analyses.

The table overleaf shows the sources of information considered by regulators for estimating debt premium. The sources considered include regulatory precedents, spreads on tradable debt issued by the telecoms operator and its comparators, and the interest rate on long term, non-tradable debt. The type of tradable debt instruments considered includes bonds, interest rate swaps and credit default swaps. Most debt instruments considered had a maturity of around 10 years.

Table 22: Regulatory precedents - evidence considered for calculating the debt premium

Regulator	Country	Companies	Debt premium (%)	Evidence considered
ComReg (2008)	Ireland	eircom	1.9	<ul style="list-style-type: none"> <li>spreads on eircom long term bonds with ten years maturity relative to Irish government bonds and German government bonds</li> </ul>
Agcom (2006)	Italy	Telecom Italia	0.8	<ul style="list-style-type: none"> <li>spreads on Telecom Italia corporate bonds with 10 years maturity</li> <li>cost of other long term liabilities (including TFR10)</li> </ul>
Agcom (2008)	Italy	BT Italia	2.4	<ul style="list-style-type: none"> <li>corporate bonds with 10 years maturity</li> </ul>
Agcom (2008)	Italy	Fastweb	2.2	<ul style="list-style-type: none"> <li>corporate bonds with 10 years maturity</li> </ul>
Agcom (2008)	Italy	Tele2	1.0	<ul style="list-style-type: none"> <li>corporate bonds with 10 years maturity</li> </ul>
Agcom (2008)	Italy	Tiscali	1.8	<ul style="list-style-type: none"> <li>corporate bonds with 10 years maturity</li> </ul>
CMT (2008)	Spain	Telefónica	0.9	<ul style="list-style-type: none"> <li>average spread on interest rate swaps with 10 years maturity</li> <li>average spread on Telefónica S.A.'s credit derivative swap with 10 years maturity</li> </ul>
CMT (2008)	Spain	Telefónica Móviles	0.9	<ul style="list-style-type: none"> <li>average spread on interest rate swaps with 10 years maturity</li> <li>average spread on Telefónica S.A.'s credit derivative swap with 10 years maturity</li> </ul>
Oftel (2001)	UK	Vodafone, BT Cellnet, One2One, Orange	1.0 – 1.8	<ul style="list-style-type: none"> <li>based on regulatory precedents (Competition Commission 1998 - Calls to Mobile Phones)</li> </ul>
Ofcom (2005)	UK	BT	1.0	<ul style="list-style-type: none"> <li>yields on long term A- rated corporate bonds as at the end of June 2003 (1.03% ), June 2004 (0.74%) and June 2005 (0.64%)</li> <li>average promised yield on recently issued long term BT debt, as of the end of January 2004</li> </ul>
Anacom (2005)	Portugal	PTC	[IC]	<ul style="list-style-type: none"> <li>interest rate on inter-company loan from PT to PTC</li> </ul>
Anacom (2006)	Portugal	PTC	[IC]	<ul style="list-style-type: none"> <li>medium and long term liabilities</li> </ul>
Anacom (2007)	Portugal	PTC	[IC]	<ul style="list-style-type: none"> <li>medium and long term liabilities</li> </ul>
ERSE (2009)	Portugal	EDP Distribution	0.8 – 1.0	<ul style="list-style-type: none"> <li>spread on EDP bonds over the six months Euribor</li> <li>debt premium used in the previous regulatory decision</li> </ul>
ERSE (2009)	Portugal	REN SA	0.5 – 0.9	<ul style="list-style-type: none"> <li>spread on REN bonds over the six months Euribor</li> <li>debt premium used in the previous regulatory decision</li> </ul>

Source: PwC analysis. Further details are provided in Appendix I

<sup>10</sup> TFR is the amount of an employee's salary that the employer withholds and is paid back to the employee once they have left the company.

### 5.1.2 PwC's recommendations

PTC currently has no tradable debt. Therefore, in order to estimate a forward looking debt premium, it is important to consider the debt premium on tradable debt issued by its comparators. We consider that yields on corporate bonds with 10 years maturity should be used, since it is important that the maturity of the debt instrument is consistent with the maturity of the financial instrument used for estimating the risk-free rate.

We recommend using a 10 year debt margin based on either tradable debt issued by comparators or composite bonds with comparable ratings to PTC, or a combination of both. Given the current volatility in financial markets, we recommend using an average of a past period of 1-2 years.

Table 23 and 24 below illustrates two indicative possible sources for the debt premium considering the recommended methodology. In table 23, the debt premium was obtained through the implicit spreads of the Credit Default Swaps (CDS) curves for PT SGPS and for comparator companies. In table 24, the debt premium was obtained through the historical average of the spread between the Bloomberg Fair Value Curve for 10 year bonds of European telephone companies with rating BBB and the risk-free rate.

Table 23: 10 year Credit Default Swap Spreads at 31.12.08

Name	Rating	Actual	1y Average	2y Average
Telecom Italia	BBB	4,28%	2,22%	1,54%
France Telecom	A-	1,11%	1,06%	0,78%
Telefonica	A-	1,27%	1,30%	0,95%
BT Group	BBB+	1,49%	1,24%	0,96%
Deutsche Telekom	BBB+	1,27%	1,20%	0,89%
Hellenic Telecommunications	BBB	1,51%	1,02%	0,81%
Swisscom	A-	3,19%	1,58%	1,41%
Telekom Austria	BBB+	0,85%	0,95%	0,75%
Telenor ASA	BBB+	1,50%	1,00%	0,75%
TeliaSonera AB	A-	0,93%	0,95%	0,75%
KONINKLIJKE KPN NV	BBB+	1,07%	1,14%	0,99%
<b>Average</b>		<b>1,68%</b>	<b>1,24%</b>	<b>0,96%</b>

Source: Bloomberg

The 10 year Credit Default Swap Spreads at 31.12.08 presented in the table above, compare with a 1,5%, 1,43% and 1,24% of actual, 1y and 2y average, respectively, Credit Default Spreads at 31.12.2008 for PT SGPS. The rating of PT SGPS as of 31.12.2008 was BBB-.

Table 24: Spread between BFV Eur Phone Curve BBB and Risk-free rate at 31.12.08

	Actual	1y	2y
Spread between BFV Eur Phone BBB and Risk-free	2,84%	1,98%	1,48%

Source: Bloomberg

Table 25: High Range and Low Range Debt Premium

	Low Range	High Range
Debt Premium	0,96%	1,98%
Risk-free Rate	4,47%	4,52%
Debt Rate	5,44%	6,50%

## 6. Gearing

Gearing reflects the proportion of debt in the capital structure of a company and is equal to the total value of debt as a proportion of the sum of the total value of debt and equity.

### 6.1 PTC's approach and regulatory precedents

PTC has used its "actual" gearing for calculating its cost of capital. The table below sets out PTC's gearing calculation for 2004 to 2007.

Table 26: PTC's gearing calculations (2004 – 2007)

€, millions	2004	2005	2006	2007
Book value of equity	[IIC]	⋮	⋮	⋮
Provision of early retirement and contract suspension	⋮	⋮	⋮	⋮
Total equity	⋮	⋮	⋮	⋮
Provision for past service costs	⋮	⋮	⋮	⋮
Medium and long term debt	⋮	⋮	⋮	⋮
Total debt	⋮	⋮	⋮	⋮
Gearing (%)	⋮	⋮	⋮	[FIC]

Source: PTC regulatory submissions

From 2004 to 2007 PTC's gearing decreased from [IIC] to [IC], primarily reflecting a decrease in PTC's medium to long term debt.

In terms of PTC's gearing calculation, the key aspects to note are as follows:

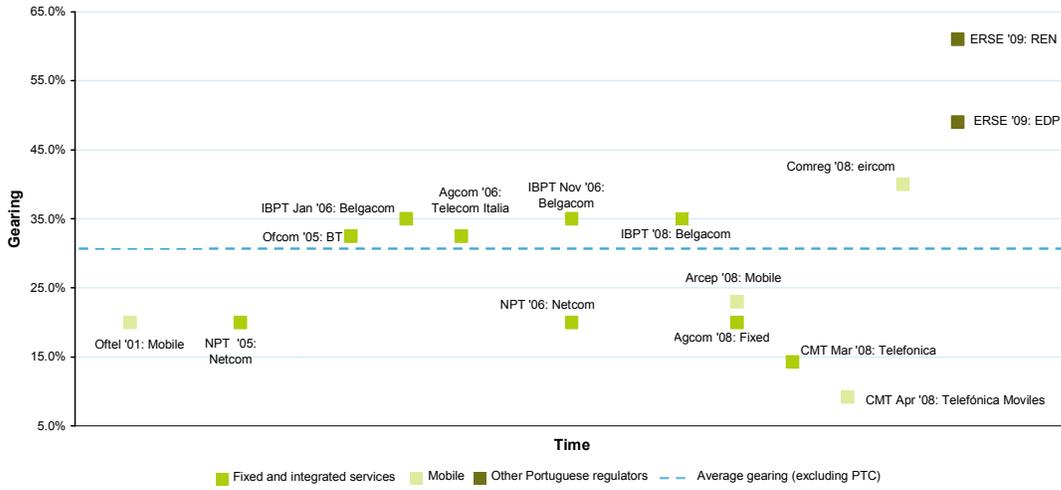
- The calculations are based on accounting data; and
- PTC has included liabilities related to past service costs<sup>11</sup> and equity adjustments related to early retirement and contract suspension<sup>12</sup> in its gearing calculations. Past service costs are not a source of funds for the business and should not be included in the gearing calculations.

Figure 10 below sets out the gearing ratios used by European regulators. For telecom operators, the regulatory precedents on gearing mostly lie in the range of 15% - 45%. However, the gearing ratio used by Portugal's energy regulator is significantly higher, reflecting their lower business risk.

<sup>11</sup> Past service costs is a type of pension liability.

<sup>12</sup> Adjustments related to early retirement and contract suspension reflect an increase in the book value of equity as a result of a decrease in the book value of pension liabilities, following a reduction in head count.

Figure 10: Regulatory precedents - gearing



Note: In cases where a range is given, we have calculated the mid-point for the purpose of the chart above

Source: PwC analysis. Further details are provided in Appendix I

The figure below summarises the results from our regulatory database on the framework used by European regulators for calculating the gearing ratio.

Figure 11: Regulatory precedents - calculating gearing ratio

Regulator	Country	Companies	Gearing (%)	Methodology	Gearing			
					Target	Actual	Optimal	Regulatory precedents
IBPT (Jan 2006)	Belgium	Belgacom	35.0	Comparator analysis.				
IBPT (Nov 2006)	Belgium	Belgacom	35.0					
IBPT (2008)	Belgium	Belgacom	35.0					
Arcep (2008)	France	France Telecom	n/a	Target is the level to which Arcep expects France's current gearing to converge to. Also considered regulatory precedents in Europe.				
Arcep (2008)	France	Orange France, SFR, Bouygues Telecom, Orange Caraibe, SRR.	23.0	Considered the gearing of publicly listed mobile operators and that of 3 parent companies of operators.				
ComReg (2008)	Ireland	eircom	40.0	Comparator analysis.				
Agcom (2006)	Italy	Telecom Italia	25.0 – 40.0	Reference to comparators.				
Agcom (2008)	Italy	BT Italia, Fastweb, Tele2, Tiscali	10.0 – 30.0	Reference to current capital structure, regulatory precedence and comparable companies				
NPT (2006)	Norway	Telenor <sup>13</sup>	20.0	Corresponds to historic average (2001-2005).				
CMT (2008)	Spain	Telefónica	14.3	Total company value is estimated from the arithmetic mean of valuations from 19 banks, (excluding outliers and valuations older than 3 months). The valuation methodology is based on EBIDTA multiples. Total value of debt is taken from 2007 balance sheet and its composition from 2006 accounts.				
CMT (2008)	Spain	Telefónica Móviles	9.2					

<sup>13</sup>

Regulator	Country	Companies	Gearing (%)	Methodology	Gearing	
Oftel (2001)	UK	Vodafone, BT Cellnet, One2One, Orange	10.0 – 30.0	Set optimal range based on actual gearing of UK mobile operators		
Ofcom (2005)	UK	British Telecom	30.0 – 35.0	30% based on anticipated (future) gearing, 35% is current gearing.		
Anacom (2004)	Portugal	Portugal Telecom	IC	Actual gearing.		
Anacom (2005)	Portugal	Portugal Telecom	IC			
Anacom (2006)	Portugal	Portugal Telecom	IC			
Anacom (2007)	Portugal	Portugal Telecom	IC			
ERSE (2009)	Portugal	EDP Distribution	49.0	Use optimal gearing since debt has increased significantly in recent years..		
ERSE (2009)	Portugal	REN SA	61.0			

Key	Considered
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Source: PwC analysis. Further details are provided in Appendix I

The frameworks used by European regulators include:

- Actual gearing — reflects the current gearing of the company. In principle it should be calculated using market values of debt and equity rather than book values;
- Targeted gearing — the gearing level the company aims to achieve in the long term. For practical reasons, this could be different from the optimal gearing level;
- Optimal gearing — in principle this is the gearing level that would minimise the cost of capital of the company. However, in practice this is usually estimated as the average gearing level across the industry (explained in more detail in the next section); and
- Regulatory precedents — the gearing levels that have been used by regulators in the past.

The majority of the regulators have used either actual or optimal gearing levels in their cost of capital estimations.

## 6.2 PwC's recommendations

PTC's cost of capital should reflect its optimal gearing as opposed to its actual or current gearing. There are two main approaches that can be used for estimating the optimal gearing level: industry benchmarking and fundamental analysis. Industry benchmarking seeks to evaluate the optimal gearing level by examining the average of the actual observed level of gearing across its comparators.

Under the fundamental analysis approach, financial models can be constructed which can simulate the performance of a business at different levels of gearing, calculating the resultant cost of equity, cost of debt and firm value, to assess the level of debt that maximises firms value. However, such models require a substantial amount of information on debt margins, probability of bankruptcy and other related market evidence.

From Anacom's perspective, fundamental analysis might not be that relevant as this approach does not take into account regulatory objectives (such as continuous provision of products and services to consumers and quality management) that are likely to differ from the objective of maximising that value of PTC.

We consider that PTC's optimal gearing should be based on industry benchmarks and regulatory precedents. It is important to note that any estimation of gearing should be based on market values of debt and equity.

Table 27 and 28 below illustrates two possible sources for the optimal gearing considering the recommended methodology. In table 27, the optimal gearing is implied through an average gearing of comparator companies. In table 28, the optimal gearing is obtained through the averaging of regulatory precedents.

Table 27: Comparator Companies' Gearing at 31.12.08

Company	3 Year Average Gearing	5 Year Average Gearing
Belgacom	43,42%	30,05%
BT Group	59,15%	63,08%
Deutsche Telekom	39,76%	39,43%
Elisa OYJ	30,96%	30,53%
France Telecom	44,18%	46,76%
Hellenic Telecommunications	52,46%	46,71%
KONINKLIJKE KPN NV	63,49%	57,03%
Magyar Telecom	27,18%	26,15%
Swisscom	57,92%	43,50%
Telekom Austria	45,57%	43,91%
Telecom Italia	53,22%	54,55%
Telefonica	62,41%	56,14%
Telenor ASA	31,93%	31,02%
TeliaSonera AB	21,94%	17,39%
<b>Average</b>	<b>45,26%</b>	<b>41,87%</b>

Source: Bloomberg

Table 28: Regulatory Precedents

Regulator / Company	Defined Gearing
IBPT - Belgacom	35,00%
ComReg - Eircom	40,00%
CMT - Telefonica	14,30%
<b>Average</b>	<b>29,77%</b>

Source: PwC Analysis

Table 29: High Range and Low Range Gearing

	Low Range	High Range
<b>Gearing</b>	45,26%	29,77%

## 7. Tax rate

In competitive markets, prices settle at a level such that investors can recover the costs incurred in operating the business and earn the required post-tax rate of return. Under a competitive market framework, tax is treated as a cost that should be recovered in prices and therefore the price control must provide companies with sufficient revenues to meet their tax liabilities.

A business can be remunerated for its tax expense under three different WACC approaches: pre-tax WACC, post-tax WACC and vanilla WACC. These are set out in Table 30 below.

Table 30: Approaches to assessing the WACC and tax expense

Approach	Description
<b>Pre-tax WACC</b>	$g \times K_d + 1/(1-t) \times K_e \times (1-g)$ Where g is gearing, Kd is the pre-tax cost of debt, Ke is the post-tax cost of equity and t is the corporation tax rate
<b>Vanilla WACC</b>	$g \times K_d + K_e \times (1-g)$ Where g is gearing, Kd is the pre-tax cost of debt and Ke is the post-tax cost of equity
<b>Post-tax WACC</b>	$g \times K_d \times (1-t) + K_e \times (1-g)$ Where g is gearing, Kd is the pre-tax cost of debt, Ke is the post-tax cost of equity and t is the corporation tax rate

Source: PwC analysis

Under the pre-tax WACC approach, the post-tax WACC is uplifted to provide an allowance for tax payable on the return component of the allowed revenues. In particular, the post-tax cost of equity is converted to a pre-tax basis by uplifting it by  $(1/(1-t))$ , also referred to as the tax wedge. When the pre-tax basis value is applied to the capital base to calculate the allowed return, it provides sufficient cash flows to meet tax liabilities and deliver the expected post-tax return required by equity investors.

Under the post-tax framework, the WACC (and in turn the cost of equity) is not uplifted to provide an allowance for the tax expense. Therefore, tax needs to be modelled explicitly in the cash flows. However, it is important to note that the allowed revenues estimated using a post-tax WACC take into account the benefit of the interest tax shield. To avoid double counting, it is essential that the amount of tax payable in the cash flows incorporates tax payable assuming zero gearing.

The vanilla WACC approach also does not provide any uplift for the tax expense in the WACC and therefore under this approach tax should be modelled explicitly as well. The vanilla WACC entails a pre-tax cost of debt and therefore allowed returns (WACC x capital base) do not take account of the interest tax shield. In this case, a separate cash flow allowance, equal to the tax payable at the current level of gearing, is required. A summary of the necessary cash flows adjustments for each WACC approach is provided in Table 31 below.

Table 31: Approaches to assessing the WACC and corresponding adjustment to cash flows

Approach	Adjustment to cash flows
<b>Pre-tax WACC</b>	No cash flow modelling of tax is needed but the issue is what level of tax should be assumed in the WACC calculation.
<b>Vanilla WACC</b>	Allowed revenues calculated using a vanilla WACC do not take account of the interest tax shield. In this case, a separate cash flow allowance, equal to the tax payable at the current level of gearing, is required.
<b>Post-tax WACC</b>	Allowed revenues estimated using a post-tax WACC take into account the interest tax shield advantage. To avoid double counting it is essential that cash flows incorporate tax payable assuming zero gearing.

Source: PwC analysis

A key issue under the pre-tax approach is what tax rate should be used to calculate the tax wedge. The two tax rates that are usually used are the statutory tax rate and the effective tax rate. For a number of reasons, the effective tax rate can be different from the statutory tax rate. In principle, the effective tax rate should be used. However, it can be difficult to estimate the effective tax rate and therefore regulators such as CAA<sup>14</sup> in the past have used the statutory tax rate when setting the price caps on a pre-tax basis.

### 7.1 PTC’s approach and regulatory precedents

PTC currently calculates its cost of capital on a pre-tax basis. The tax rate it uses to calculate the tax wedge is equal to its actual annual tax rate (calculated as tax payable as a proportion of the total pre-tax income).

Our regulatory database indicates that all of the sampled European regulators have considered a pre-tax WACC. In terms of the tax rate used, the evidence is more mixed. Some of the regulators such as Ofcom and Agcom have used a statutory tax rate whereas other such as CMT and IBPT have considered the effective tax rate. This is set out in more detail in the table below.

<sup>14</sup> CAA (2008) “Economic regulation of Heathrow and Gatwick Airports 2008–2013”.

Table 32: Regulatory precedents - WACC approaches

Regulator	Country	Companies	WACC	Statutory tax rate	Effective tax rate
IBPT (Jan 2006)	Belgium	Belgacom	Pre tax		
IBPT (Nov 2006)	Belgium	Belgacom	Pre tax		
IBPT (2008)	Belgium	Belgacom	Pre tax		
Arcep (2008)	France	France Telecom	Pre tax		
Arcep (2008)	France	Orange France, SFR, Bouygues Telecom, Orange Caraibe, SRR.	Pre tax		
ComReg (2008)	Ireland	Eircom	Pre tax		
Agcom (2006)	Italy	Telecom Italia	Pre tax		
Agcom (2008)	Italy	BT Italia, Fastweb, Tele2, Tiscali	Pre tax		
NPT (2006)	Norway	Telenor	Pre tax		
CMT (2008)	Spain	Telefónica	Pre tax		
CMT (2008)	Spain	Telefónica Móviles	Pre tax		
Oftel (2001)	UK	Vodafone, BT Cellnet, One2One, Orange	Pre tax		
Ofcom (2005)	UK	British Telecom	Pre tax		
Anacom (2004-2007)	Portugal	Portugal Telecom	Pre tax		
ERSE 2009)	Portugal	EDP Distribution, REN SA	Pre tax		

Key

Considered

Source: PwC analysis. Further details are provided in Appendix I

## 7.2 PwC's recommendations

In principle, all the approaches are equivalent and allow the investors to earn the same post-tax returns if detailed tax modeling is undertaken. However, the equivalence breaks down from a practical perspective and therefore the question of which approach to use becomes important.

The pre-tax approach is conceptually straightforward. However, it is quite difficult to estimate the effective tax rate. Using the statutory tax rate instead of the effective tax rate is likely to result in under- or over-recovery.

Modeling the precise tax explicitly can be less difficult. Even in this case, the post-tax approach requires tax modeling under the unrealistic assumption of a zero gearing level. The vanilla approach, on the other hand, requires modeling of the actual tax rate which a business would be required to model in any case.

On this basis we recommend a vanilla WACC approach for PTC. However, taking in consideration the practical implementation issues, the pre-tax approach is the most straightforward methodology to be used.

In determining the effective tax rate, PTC should consider only the tax charges/benefits which relate to the regulated activities, either directly or indirectly.

Table 33 below illustrates possible scenarios for the tax rate, if the pre-tax WACC approach is used. These scenarios consider the use of the statutory tax rate and the use of the current effective tax rate, adjusted so that it only reflects identified permanent differences related with regulated assets. As referred above, the statutory tax rate is likely to result in over or under recover which can only be compensated in the long run, or in some cases, never compensated at all. Using the current effective tax rate can also introduce distortions in both short and long term.

Table 33: Tax rate

Scenario	Tax Rate
Statutory tax rate	26,50%
Actual effective rate (2007)	27,34%

Source: data for the determination of an indicative effective tax rate - information provided by Anacom:

Annual Effective Tax Rate	2007
Result before taxes (1)	165,415,188
Statutory Tax rate	25%
Derrama	1.38%
Statutory Tax Rate + Derrama (2)	26.38%
Taxable profit (3) = (1) x (2)	43,636,527
Permanent differences related with regulated activities (Marconi's goodwill)*	1,582,800
Total adjustments to taxable profit (4)	1,582,800
Tax charge (5) = (3) + (4)	45,219,327
Effective tax rate (6) = (5) / (1)	27,34%

\* With the information available, this was the only identifiable adjustment; nevertheless, there could be other permanent differences related with regulated assets that should be considered

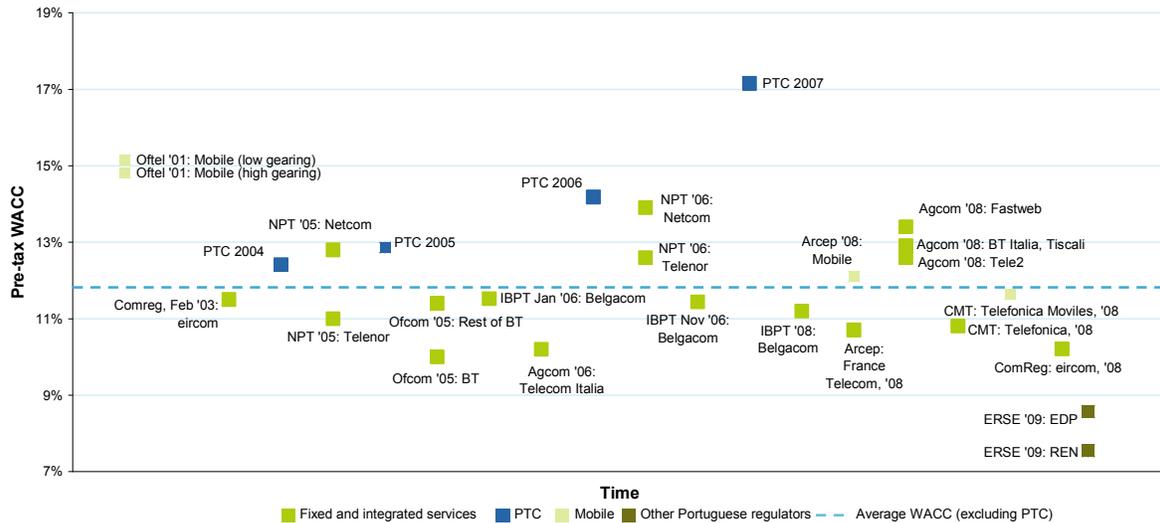
Table 34: High Range and Low Range Tax Rate

	Low Range	High Range
Tax Rate	26,50%	27,34%

## 8. Conclusions

Figure 12 below sets out PTC's WACC estimates and those used by European regulators.

Figure 12: Regulatory precedents - pre-tax WACC estimates



Note: In cases where a range is given, we have calculated the mid-point for the purpose of the chart above

Source: PwC analysis. Further details are provided in Appendix I

As is evident, PTC's WACC estimates from 2004 to 2007 are all towards the upper end of the range. This reflects a number of aspects of its WACC methodology.

We summarise below PTC's WACC methodology and our recommended approach.

- Conceptual framework for calculating the cost of equity:** PTC has used CAPM for calculating the cost of equity. PwC considers CAPM to be the most appropriate framework, as it is the most widely used and accepted of available techniques. Alternative methods considered include the DGM, FFTM and the multi-factor APT. DGM is seldom used as the primary method of estimating the cost of capital. FFTM is primarily used in the case of small firms and is unlikely to produce estimates significantly different from CAPM in the case of PTC. The multi-factor APT model has not been widely adopted and is generally considered more of a conceptual academic model than a practical one, mainly because of problems with data availability.
- Conceptual framework for calculating the cost of debt:** PTC does not estimate the two components of the cost of debt separately. Rather it directly estimates the cost of debt on the basis of accounting information. PwC recommends that the two components of PTC's cost of debt should be estimated separately on the basis of market evidence.
- Risk-free rate:** PTC has used a nominal risk-free rate that is based on the average yields on 10 year Portuguese government bonds. PwC agrees that the risk-free rate should be calculated using average yields on 10 year Portuguese government bonds, and that this should be done over a 1 to 2 year period.
- Equity beta:** PTC has used the Bloomberg estimate of PT's equity beta. Bloomberg estimates are calculated by regressing monthly historical equity returns on PT shares against the equity returns from the Portuguese stock exchange market index. Use of a single estimate increases the degree of statistical error associated with a particular regression. Furthermore, PT's beta is not necessarily a

good guide to that of PTC because PT is active in some product areas which differ to that of PTC. PwC recommends the use of a range of suitable comparator equity betas to benchmark a particular investment or business to minimise this statistical error. Five years of monthly data should be used to estimate comparator equity betas. Regulatory precedents should also be considered, due to the unavailability of market information for adequate comparators.

- **EMRP:** The EMRP adopted by PTC in its cost of capital analysis is based on Bloomberg's forward looking EMRP estimate using the DGM. PwC recommends the use of a range of sources including ex-ante estimates, ex-post estimates, regulatory precedents and recent views on the EMRP.
- **Debt premium:** PTC currently uses a weighted average of the forward looking market based interest rate on medium and long term debt and the actual interest rate on liabilities related to employee benefits for estimating its cost of debt. PTC currently has no active market-traded debt to use to estimate a forward looking debt premium, and it is therefore necessary to consider the debt premium on tradable debt issued by comparator companies. As in the case of the risk-free rate, we consider that yields on corporate bonds with 10 years to maturity should be used. Given the current volatility in the financial markets, we recommend the use of an average of a past period of 1 to 2 years.
- **Gearing:** PTC has used its actual gearing which is calculated on the basis of accounting information. We recommend using PTC's optimal gearing to reflect industry benchmarks and regulatory precedents. Furthermore, any estimate of gearing should be based on market values of debt and equity.
- **Tax:** PTC currently calculates its cost of capital on a pre-tax basis. The tax rate it uses to calculate the tax wedge is equal to its actual annual tax rate (calculated as tax payable as a proportion of the total pre-tax income). PwC recommends using a vanilla WACC approach, however, taking in consideration the practical implementation issues, the pre-tax approach is the most straightforward methodology to be used.

Table 35 below illustrates possible estimates for PTC's WACC, considering the different sources and scenarios that were developed for each parameter. The low range and high range scenarios illustrate the higher and lower ranges of the results for each parameter, while the midpoint scenario represents an averaging of the other two scenarios.

Table 35: WACC Estimates

<b>Cost of Capital</b>	<b>Low Range WACC</b>	<b>Midpoint WACC</b>	<b>High Range WACC</b>
<b>Risk-free interest rate</b>	4,47%	4,50%	4,52%
<b>Debt Premium</b>	0,96%	1,47%	1,98%
<b>Debt Rate</b>	5,44%	5,97%	6,50%
<b>Beta</b>	0,76	0,89	1,02
<b>EMRP</b>	5,42%	5,58%	5,75%
<b>Gearing</b>	45,26%	37,51%	29,77%
<b>Tax rate</b>	26,50%	26,92%	27,34%
<b>Cost of equity</b>	8,64%	9,49%	10,39%
<b>Vanilla WACC</b>	<b>7%</b>	<b>8%</b>	<b>9%</b>
<b>Pre-tax WACC</b>	<b>9%</b>	<b>10%</b>	<b>12%</b>
<b>Post-tax WACC</b>	<b>7%</b>	<b>8%</b>	<b>9%</b>

Different methodologies and assumptions could have been considered in the calculations presented and, consequently, different results could have been achieved. Accordingly, Anacom may determine a cost of capital which differs from the indicative results presented in this report. The selection of the methodology, assumptions considered and the cost of capital to be applied for regulatory purposes is solely of Anacom's responsibility. Other relevant factors may need to be considered by Anacom when defining the methodology, assumptions considered and the cost of capital to be applied for regulatory purposes.

## 9. Other Considerations

### 9.1 Regulatory Period

#### 9.1.1 Anacom's approach and regulatory precedents

Historically, Anacom has requested PTC to calculate its WACC rate annually, with all the parameters being adjusted by the changes during the period. PTC calculated the WACC rate for each period during the semester immediately after the specific period; for example, the WACC rate for 2007 was calculated with data from 2007 during the first semester of 2008.

Our regulatory database indicates that most of the regulators under analysis reviewed the calculation of the WACC rate on an ad hoc basis i.e. there was no fixed period. Nevertheless, some regulators opt to define a specific period for the WACC rate calculation – most of these define a regulatory period of 3 to 5 years, where the WACC rate is fixed through the entire period

#### 9.1.2 PwC Recommendation

The WACC rate in a regulatory framework should be clearly defined and understandable by regulated entities and it should not undergo large short-term variations, as this could have unexpected impacts in long-term investments by regulated operators. Hence, the WACC rate should be defined in a specific period of 3 to 5 years. Nevertheless, Anacom should have the possibility to review any of the parameters of the cost of capital model during the regulatory period, so that it can adjust the WACC for significant and enduring adjustments in the market.

### 9.2 Cost of Capital Allocation

#### 9.2.1 PTC's approach and regulatory precedents

PTC is applying the fully distributed allocation method. PTC determines the invested capital as the sum of: (i) statutory equity, adjusted by retirement benefits provision; and, (ii) medium and long term debt, which include retirement benefits and other long term payables. In parallel, PTC identifies all medium and long term assets, namely, tangible assets, intangible assets, financial investments and medium and long term receivables. The total amount of identified medium and long term assets is compared to the total amount of the invested capital and the difference arising is considered by PTC as a common asset (common costs).

The total cost of capital is determined taking into consideration: (i) total identified medium and long term assets; and, (ii) common assets. Subsequently, the total cost of capital is allocated to the regulated and non-regulated activities, by the application of an allocation key. Consequently, a portion of the common asset, and the respective cost of capital, is allocated to the regulated activity.

#### 9.2.2 PwC Recommendation

The cost of capital should be calculated taking in consideration identified assets which are related (fully or partially) with the regulated activity. Therefore, in order to achieve the cost of capital relevant to the regulated activities, PTC should identify and list all assets and compute the total cost of capital for the referred asset base, taking in consideration the allocation key for services and products.

We did not review or conclude on the adequacy of the allocation key being used for identified assets nor the common asset.

## Appendix I – Regulatory Precedents

Company	Country	Decision date	Decision reference	WACC – post-tax	WACC – pre-tax
Belgacom	Belgium	11 Jan 06	IBPT Jan 2006: Belgacom	8.40%	11.5%
Belgacom	Belgium	22 Nov 06	IBPT Nov 2006: Belgacom	8.30%	11.4%
Belgacom	Belgium	23 Jan 08	IBPT Jan 2008: Belgacom	8.07%	11.2%
France Telecom	France	07 Feb 08	Arcep Feb 2008: FT	n/a	10.7%
Orange France, SFR, Bouygues Telecom, Orange Caraibe, SRR.	France	07 Feb 08	Arcep Feb 2008: Mobile	n/a	12.1%
Eircom	Ireland	03 Feb 03	ComReg Feb 2003: Eircom	n/a	10.5%
Eircom	Ireland	22 May 08	ComReg May 2008: Eircom	n/a	10.2%
Telecom Italia	Italy	09 Feb 06	Agcom 2006: TI	n/a	10.2%
Fixed: BT Italia, Fastweb, Tele2, Tiscali	Italy	19 Feb 08	Agcom 2008: Fixed	n/a	12.9%
Netcom	Norway	01 Mar 05	NPT 2005: Netcom	n/a	12.8%
Telenor	Norway	01 Mar 05	NPT 2005: Telenor	n/a	11.0%
Netcom	Norway	01 Nov 06	NPT 2006: Netcom	n/a	13.9%
Telenor	Norway	01 Nov 06	NPT 2006: Telenor	n/a	12.6%
Telefónica	Spain	18 Mar 08	CMT Mar 2008: Telefónica	n/a	10.8%
Telefónica Móviles	Spain	24 Apr 08	CMT Apr 2008: Telefónica Móviles	n/a	11.6%
EDP Distribution	Portugal	Dec 2008	ERSE 2009: EDP.	n/a	8.55%
REN SA	Portugal	Dec 2008	ERSE 2009: REN	n/a	7.55%
Vodafone, BT Cellnet, One2One, Orange <sup>7</sup>	UK	26 Sep 01	Oftel 2001: Mobile	10.6%, 10.36% (for low and high gearing)	15.2%, 14.8% (for low and high gearing)
British Telecom	UK	18 Aug 05	Ofcom 2005: BT	7%, 8% (for Copper access and rest of BT)	10%, 11.4% (for Copper access and rest of BT)

Note: In cases where a range is given, we have calculated the mid-point for the purpose of the table above

Source: PwC Analysis

## Appendix II – Equity and asset betas

### Summary

In choosing a beta de-levering/re-levering formula to use in estimating the WACC an assumption must be made about the degree of certainty around future debt tax shields. Treating companies' future debt tax shields as certain is generally not a realistic assumption to make. A more reasonable assumption is that future debt tax shields are uncertain, consistent with companies having active debt management policies (although the first year's debt tax shields might, perhaps, be considered as certain).

This assumption points to the Harris and Pringle beta de-levering/re-levering formula, being the appropriate formula to use in all beta de-levering/re-levering calculations. The formula is as follows:

$$\beta_e = \beta_a \left( 1 + \frac{D}{E} \right) \quad (1)$$

where:

- $\beta_e$  is the company's equity beta;
- $\beta_a$  is the company's asset beta;
- $D$  is the market value of the company's debt; and
- $E$  is the market value of the company's equity.

It is noted that provided the same formula is used for de-levering the comparable company betas as is used for re-levering the target company beta, and that the comparable companies have similar gearing and tax rates as the target company, the target company equity beta estimate should not be particularly sensitive to the choice of beta de-levering/re-levering formula.

### Background

The beta input required for the CAPM is an equity beta ( $\beta_e$ ). Equity betas reflect the "riskiness" of shareholder returns that arises as a result of fixed debt servicing commitments (i.e. the effects of financial leverage or gearing) as well as the underlying riskiness of the firm's assets. The latter is measured as an asset beta ( $\beta_a$ ). Only equity betas are "observed" in the market place, through statistical analysis of share price behaviour for companies whose shares are actively traded. Since financial leverage varies between companies the preferred, and indeed conventional, approach to estimating the equity beta for the firm being valued is as follows:

- Obtain equity beta estimates for a sample of listed companies that are considered comparable to the company being valued ("compcos");
- Obtain financial leverage details for the compcos;
- "De-lever" the compco equity betas to arrive at asset beta estimates for the compcos (formulae for doing this are discussed below). This step removes the influence on beta arising from variations in compco financial leverage;
- Having regard to the compco asset betas, make an assessment of the asset beta appropriate for the "target" company being valued; and
- "Re-lever" the assessed asset beta for the level of gearing being assumed for the target company, to arrive at an assessed equity beta for that company (the formula used is generally the reverse of that applied in the "de-levering" process).

## Formulae for De-levering/Re-levering Betas

Fundamentally the asset beta of a company is a weighted average of that company's equity beta and its debt beta ( $\beta_d$ ). Estimation of debt betas is problematic, so current practice among most practitioners and many academics is to assume that companies' debt betas have a value of zero. This simplifies the relationship between equity beta and asset beta, but three issues still need to be considered in determining the appropriate formula to use. These issues are:

- The company's effective corporate tax rate ( $T_c$ );
- The effect of investors' taxes on the value (if any) of the tax shield arising from the use of debt; and
- The effect of the company's debt management policy on the value of the debt tax shield.

### The Hamada Formula

Under a classical tax system (i.e. one where dividends are paid from company earnings after corporate tax, and are then subject to personal taxes at the investor level) and where the company adopts a passive debt management policy (i.e. the future debt servicing schedule is assumed to be known with certainty at the valuation date), then the appropriate formula for relating equity and asset betas is:

$$\beta_e = \beta_a \left[ 1 + (1 - T_c) \frac{D}{E} \right] \quad (2)$$

where:

$D$  is the market value of the company's debt; and

$E$  is the market value of the company's equity.

The above formula is known as the "Hamada" formula<sup>15</sup> and is widely used by practitioners and academics. However, the assumption that the company's future debt servicing schedule is known with certainty is questionable. For example, in the face of changes to its enterprise value a company is likely to adjust its level of debt in order to maintain a target leverage ratio. Furthermore, features of the personal tax regime may significantly reduce the value of the tax shield attributable to the use of debt financing.

### The Harris and Pringle Formula

Where all of the company's future debt tax shields, including those arising in the first period, are treated as uncertain or risky then analysis by Harris and Pringle (1985) provides the following relationship between the equity beta and asset beta:

$$\beta_e = \beta_a \left( 1 + \frac{D}{E} \right) \quad (3)$$

The above formula is known as the "Harris and Pringle" formula and is derived from different assumptions to the Hamada formula. If the company is expected to maintain a target leverage ratio through time (i.e. it has an active debt management policy), but with total firm value evolving with uncertainty, then it follows that the future debt servicing schedule is uncertain. Typically this assumption is more realistic than the alternative of

<sup>15</sup> Hamada (1969).

assuming that the future debt servicing schedule is known with certainty. This means that in most circumstances the Harris and Pringle formula will be more appropriate than the Hamada formula.

### The Miles and Ezzell Formula

Miles and Ezzell (1985) derive a beta de-levering/re-levering formula that assumes that the tax shield on debt is certain for the first period (i.e. the first year), but thereafter is uncertain. These assumptions fall between those of Hamada and of Harris and Pringle so, as to be expected, the resulting formula falls between formulae (2) and (3) above. The Miles and Ezzell formula is:

$$\beta_e = \beta_a \left[ 1 + \left( 1 - \frac{r_f T_c}{1 + r_f} \right) \frac{D}{E} \right] \quad (4)$$

where:

$r_f$  is the risk-free rate of return.

## Appendix III – References

1. "Ofcom's approach to risk in the calculation of cost of capital" (18 Aug 2005)  
[http://www.ofcom.org.uk/consult/condocs/cost\\_capital2/statement/final.pdf](http://www.ofcom.org.uk/consult/condocs/cost_capital2/statement/final.pdf). Previous consultation document issued by the Director General of Telecommunications (Feb 2001) <http://www.ofcom.org.uk/static/archive/Oftel/publications/mobile/mmr0201.htm>
2. "Effective Competition Review: Mobile" (Oftel, 26 Sep 2001)  
<http://www.ofcom.org.uk/static/archive/Oftel/publications/mobile/mmr0901.pdf> previous consultation Partial Private Circuits Charge Control (24 June 2004) [http://www.ofcom.org.uk/consult/condocs/ppc\\_charge\\_control/ppc\\_charge\\_control/ppc.pdf](http://www.ofcom.org.uk/consult/condocs/ppc_charge_control/ppc_charge_control/ppc.pdf) and Partial Private Circuits Charge Control Final Decision (30 Sep 2004)  
[http://www.ofcom.org.uk/consult/condocs/ppc\\_charge\\_control/statement/ppc\\_stmnt.pdf](http://www.ofcom.org.uk/consult/condocs/ppc_charge_control/statement/ppc_stmnt.pdf)
3. "Resolución sobre la propuesta de Telefónica España S.A de tasa anual de retorno a aplicar para el cómputo de los costes de capital en la contabilidad de costes del ejercicio 2008 (AEM 2008-2)." (CMT, 18 Mar 2008)  
[http://www.cmt.es/cmt\\_ptl\\_ext/SelectOption.do?tipo=html&detalles=090027198005bad1&nav=busqueda\\_resoluciones&hcomboA\\_nio=2008&hcomboMes=4&categoria=todas](http://www.cmt.es/cmt_ptl_ext/SelectOption.do?tipo=html&detalles=090027198005bad1&nav=busqueda_resoluciones&hcomboA_nio=2008&hcomboMes=4&categoria=todas)
4. "Resolución sobre la propuesta de Telefónica Móviles España S.A de tasa anual de retorno a aplicar para el cómputo de los costes de capital en la contabilidad de costes del ejercicio 2008 (AEM 2008-2)." (CMT, 24 Apr 2008)  
[http://www.cmt.es/cmt\\_ptl\\_ext/SelectOption.do?tipo=html&detalles=090027198005bad1&nav=busqueda\\_resoluciones&hcomboA\\_nio=2008&hcomboMes=4&categoria=todas](http://www.cmt.es/cmt_ptl_ext/SelectOption.do?tipo=html&detalles=090027198005bad1&nav=busqueda_resoluciones&hcomboA_nio=2008&hcomboMes=4&categoria=todas) additional reference [http://www.agcom.it/provv/d\\_344\\_01\\_CONS.htm](http://www.agcom.it/provv/d_344_01_CONS.htm)
5. "Mercato dell'accesso disaggregato all'ingrosso (ivi compreso l'accesso condiviso) alle reti e sottoreti metalliche, ai fini della fornitura di servizi a banda larga e vocali (mercato n. 11 fra quelli identificati dalla raccomandazione della commissione europea n. 2003/311/CE): identificazione ed analisi del mercato, valutazione di sussistenza di imprese con significativo potere di mercato ed individuazione degli obblighi regolamentari" (Agcom, 9 Feb 2006)  
[http://www.agcom.it/provv/c\\_p\\_415\\_04\\_CONS/d\\_415\\_04\\_CONS.htm](http://www.agcom.it/provv/c_p_415_04_CONS/d_415_04_CONS.htm) additional document Determinazione del tasso medio di remunerazione del capitale applicabile alla contabilità predisposta da Telecom Italia ai fini regolatori (6 Aug 2001)  
[http://www.agcom.it/provv/d\\_344\\_01\\_CONS.htm](http://www.agcom.it/provv/d_344_01_CONS.htm)
6. "Valutazione ai sensi della delibera n. 417/06/CONS art. 40, comma 4, delle condizioni economiche del servizio di terminazione delle chiamate vocali in postazione fissa richieste dagli operatori Bt Italia, Fastweb, Tele 2 e Tiscali" (Agcom, 19 Feb 2008)  
[http://www.agcom.it/provv/d\\_692\\_07\\_CONS/d\\_692\\_07\\_CONS.htm](http://www.agcom.it/provv/d_692_07_CONS/d_692_07_CONS.htm) additional document "Mercato della terminazione di chiamate vocali su singole reti mobili (mercato n. 16 fra quelli identificati dalla raccomandazione della Commissione europea n. 2003/311/CE): Identificazione ed analisi del mercato, valutazione di sussistenza di imprese con significativo potere di mercato ed individuazione degli obblighi regolamentari" (Jan 2006) [http://www.agcom.it/provv/d\\_03\\_06\\_CONS/d\\_03\\_06\\_CONS.htm](http://www.agcom.it/provv/d_03_06_CONS/d_03_06_CONS.htm)
7. "Détermination du WACC pour l'année 2006" (IBPT, 11 Jan 2006)  
<http://www.ibpt.be/fr/462/DocAndContentsListPub/Décisions/DocAndContentsListPub.aspx?themeID=33+225+229+233+237+241+245+249+253+257+261&view=date>
8. "Decision du Conseil de l'IBPT du 22 Novembre 2006 concernant le cout du capital a utiliser dans les offres de reference de Belgacom" (IBPT, 22 Nov 2006)  
<http://www.ibpt.be/fr/462/DocAndContentsListPub/Décisions/DocAndContentsListPub.aspx?themeID=33+225+229+233+237+241+245+249+253+257+261&view=date>
9. "Decision du Conseil de l'IBPT du 23 Janvier 2008 concernant le cout du capital a utiliser dans les offres de reference de Belgacom" (IBPT, 23 Jan 2008)  
<http://www.ibpt.be/fr/462/DocAndContentsListPub/Décisions/DocAndContentsListPub.aspx?themeID=33+225+229+233+237+241+245+249+253+257+261&view=date>
10. "Kapitalkostnad for norske mobilskoper" (NPT, March 2005)  
[http://www.npt.no/iKnowBase/Content/kapitalkostnad\\_mobilskoper.pdf?documentID=44292](http://www.npt.no/iKnowBase/Content/kapitalkostnad_mobilskoper.pdf?documentID=44292)
11. "Kapitalkostnad for norske mobilskoper" (NPT, Nov 2006)  
<http://www.npt.no/iKnowBase/Content/kapitalkostnad.pdf?documentID=50962>
12. "Décision n° 2008-0162 de l'Autorité de régulation des communications électroniques et des postes en date du 7 février 2008 fixant le taux de rémunération du capital employé pour évaluer les coûts et les tarifs des activités fixes régulées de France Télécom pour les années 2008 et 2009" (Arcep, 7 Feb 2008) (search for decision 08-0162 on <http://www.arcep.fr/index.php?id=recherchedecisions>) additional document "Taux de rémunération du capital des activités régulées du secteur fixe, du secteur mobile et du secteur de la télédiffusion" (3 Dec 2007)  
[http://www.arcep.fr/uploads/tx\\_gspublication/consult-taux-remun-capital-031207.pdf](http://www.arcep.fr/uploads/tx_gspublication/consult-taux-remun-capital-031207.pdf)
13. "Décision n° 2008-0163 de l'Autorité de régulation des communications électroniques et des postes en date du 7 février 2008 fixant le taux de rémunération du capital employé pour la comptabilisation des couts et le controle tarifaire des operateurs mobiles pour les annees 2008 et 2009" (Arcep, 7 Feb 2008). (search for decision 08-0163 on <http://www.arcep.fr/index.php?id=recherchedecisions>) additional document "Taux de rémunération du capital des activités régulées du secteur fixe, du secteur mobile et du secteur de la télédiffusion" (3 Dec 2007)  
[http://www.arcep.fr/uploads/tx\\_gspublication/consult-taux-remun-capital-031207.pdf](http://www.arcep.fr/uploads/tx_gspublication/consult-taux-remun-capital-031207.pdf)

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