Europe Economics

Cost of Capital for Mobile Termination Rates, Fixed-Line, and Broadcasting Price Controls

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1 Executive Summary

Europe Economics has estimated the cost of capital for hypothetical efficient operators in four telecommunications sectors on behalf of the Commission for Communications Regulation (ComReg). These four sectors are:

- Mobile: The sector for wholesale mobile call termination and the rate charged for that service (the mobile termination rate, or "MTR").
- Fixed Line: The WACC for fixed line telephony is primarily estimated with reference to an Irish fixed-line incumbent with an efficient capital structure.
- Broadcasting: Access to digital terrestrial television (DTT) transmission assets ("Market A", in which 2rn, a wholly-owned subsidiary of RTÉ, operates) and the DTT multiplex ("Market B" in which RTÉ operates). We argue that the best-estimate for the WACC for these two markets is likely to be the same. Thus, we estimate a WACC for an Irish broadcaster with an efficient capital structure.

We estimate forward-looking WACCs for these four sectors, for Ireland. All WACC parameters are estimated out to the visible horizon — i.e. over the next few years, for a period sufficiently long to constitute a meaningful period until another review is conducted (noting that Comreg does not have a determinate length of price control period). A natural concrete interpretation of this time period would be about three to five years.

1.1 Theoretical Approach

In line with standard regulatory practice around Europe, we estimate the regulatory rate of return using the weighted average cost of capital-capital assets pricing model (WACC-CAPM) approach. The details of the CAPM model and the regulatory WACC are set out in Appendix 1.

The CAPM can be implemented in a number of different ways. We set out two such approaches here. In the main text we set out a WACC calculated in accordance with the CAPM approach Comreg adopted in 2014, an approach that has also been used by other European communications regulators such as ARCEP in France. In Appendix 4 we present WACC estimates obtained under an alternative approach — which has come to be standard in the UK in the past eighteen months.[1] We estimate the WACC on a pre-tax nominal basis, consistent with ComReg's regulatory approach.

1.2 Generic Parameters in the CAPM

The generic parameters are: inflation, the tax rate, the risk-free rate, the equity risk premium (ERP), and the total market return (TMR)[2]. Our proposed estimates of these common parameters are reported in the table below.

[1] As will be seen, there are slight differences in the results under the two methods, with differences ranging between 8 and 16bps for the overall pre-tax WACC.

[2] The ERP is the difference between the TMR and the risk-free rate.

Table 1.1: Common parameters

	Low	High	Point
Inflation	1.10%	1.80%	1.30%
Tax Rate	12.5%	12.5%	12.5%
Real risk-free rate	1.70%	2.20%	2.10%
Nominal equity risk premium (ERP)	4.30%	4.75%	4.60%
Real equity risk premium (ERP)	4.25%	4.67%	4.54%
Real total market return (TMR)	6.00%	6.95%	6.70%

1.3 Specific Parameters in the CAPM

The specific parameters in the CAPM are gearing, beta and the debt premium / cost of debt. On gearing, we use a notional gearing informed by market evidence on operators' actual gearing in each sector, consistent with ComReg's previous approach in regulatory WACC determinations.

The following table presents our point estimates for gearing, asset betas, equity betas and the debt premium for mobile, fixed line and broadcasting. Ranges appear in the main text in the relevant sections.

	Mobile	Fixed	Broadcasting
Gearing	35%	40%	25%
Asset beta	0.43	0.40	0.40
Equity Beta at notional gearing	0.66	0.67	0.53
Debt Premium (%)	1.50%	1.50%	1.50%

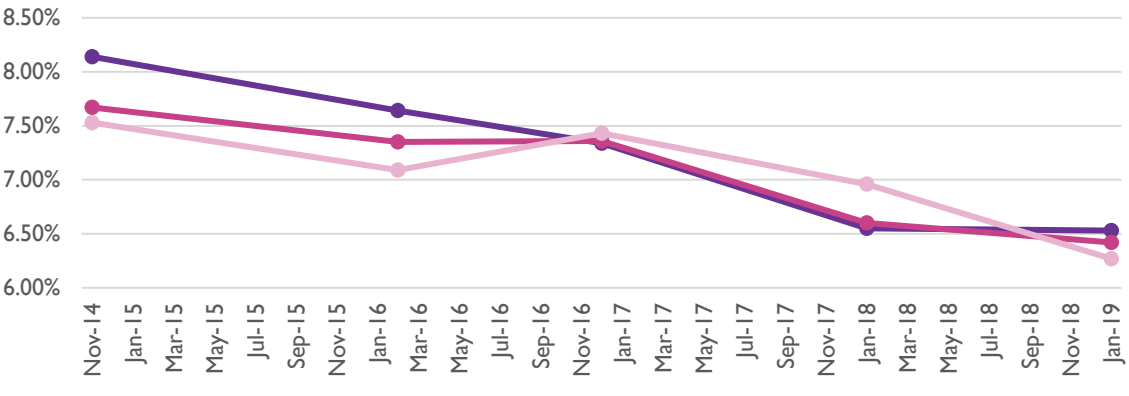
1.4 Pre-tax WACCs

The following table reports our point estimates for nominal costs of equity and nominal pre-tax WACC with the 2014 results. The 2014 WACC estimates and the subsequent updates are illustrated in Figure 1.1. More detailed breakdowns, including ranges, are available in the relevant sections. We can see that whilst the pre-tax WACCs are down for all sectors compared with 2014, almost all of that change was already in place in the parameter updates, especially the shift between December 2016 and January 2018.

	Mobile	Fixed	Broadcasting
Pre-tax cost of equity	7.39%	7.42%	6.72%
Cost of debt	4.93%	4.93%	4.93%
Pre-tax WACC	6.53%	6.42%	6.27%
Pre-tax WACC (Nov-2014)*	8.14%	7.67%	7.53%

Notes: * For consistency, the 2014 and updates figures quoted here are the pre-aimed-up figures.

Figure 1.1 Evolution of the WACC since 2014



	Nov-14	Feb-16	Dec-16	Jan-18	Jan-19
Mobile	8.14%	7.64%	7.34%	6.55%	6.53%
Fixed-line	7.67%	7.35%	7.36%	6.60%	6.42%
Broadcasting	7.53%	7.09%	7.43%	6.96%	6.27%

Notes: * For consistency, the 2014 and updates figures quoted here are the pre-aimed-up figures.

2 Introduction

2.1 Markets within the scope of the analysis

ComReg has commissioned Europe Economics to produce recommendations on the appropriate costs of capital for the following price controls:

- Mobile: The sector for wholesale mobile call termination and the rate charged for that service (the mobile termination rate, or "MTR").[3] The appropriate WACC to be used in the MTR price control is assessed on the basis of a "hypothetical efficient mobile operator".
- Fixed Line: The WACC for fixed line telephony is primarily estimated with reference to an Irish fixed-line incumbent with an efficient capital structure. The WACC is estimated for an Irish fixed-line operator with an efficient capital structure.
- Broadcasting: Access to digital terrestrial television (DTT) transmission assets ("Market A", in which 2rn, a wholly-owned subsidiary of RTÉ, operates) and the DTT multiplex ("Market B" in which RTÉ operates). We argue that the best-estimate for the WACC for these two markets is likely to be the same. Thus, we estimate a WACC for an Irish broadcaster with an efficient capital structure.

2.2 Estimation approach

The WACC-CAPM (Weighted Average Cost of Capital—Capital Asset Pricing Model) approach has been the standard conceptual framework within which the cost of capital has been examined in Irish regulatory determinations and has generally been favoured in other European jurisdictions (for example, the UK, France). Therefore WACC estimates are based on WACC-CAPM framework (theoretical details on the WACC-CAPM model and alternative frameworks are provided in Appendix 1 and Appendix 2).

Within the WACC-CAPM framework there are number of alternative estimation approaches available to determine the WACC components. The estimation approach we have been instructed to adopt here closely mirrors that adopted by ComReg in its 2014 price review. Roughly speaking, this approach can be seen as a judgement-based approach whereby the WACC is regarded as an underlying equilibrium parameter in the economy that is inferred rather than observed and judgement is required to take account of various distortions in the observed data that might arise from factors such as quantitative easing.

By using that same approach ComReg is able to be consistent in its treatment of the WACC between reviews, enhancing the predictability of its decisions and hence potentially minimising regulatory risk. However, for reference and consideration, we also report results under an alternative approach — that has come to be adopted by UK regulators over the past 18 months. That approach, by contrast with the first, employs a much more "let the data speak" philosophy, treating the WACC as a concrete observable rather than inferred equilibrium feature. We provide detailed discussion of this alternative approach and its impact on WACC estimates in Appendix 4.

This report gives our recommendations on costs of capital for each of the three sectors. We proceed as follows:

[3] Mobile Voice Call Termination (MVCT) rates, applied to the following six mobile providers deemed to have significant market power: Meteor, Lycamobile Ireland Ltd, Tesco Mobile Ireland Ltd, Three Ireland (Hutchison) Ltd, and Vodafone Ireland Ltd.

- In Section 3 we give our recommendations on the generic parameters of the cost of capital. These are the risk-free rate, the equity risk premium and, in this case, the tax rate.
- In Section 4 we discuss methodological issues in determining the specific parameters of the cost of capital, namely gearing, equity beta and the debt premium.
- In Section 5 we present our recommendations on the appropriate cost of capital for the mobile sector.
- In Section 6 we present our recommendations on the appropriate cost of capital for Irish fixed line operators with Significant Market Power.
- In Section 7 we present our recommendations on the appropriate cost of capital for broadcasting, consisting of a joint recommendation for Market A and Market B.

3 Generic Parameters in the WACC-CAPM Model

This section deals with the WACC parameters that will be common across all three price controls. The key generic parameters are the risk-free rate, which is the return investors require to invest in an asset that bears no risk, and the equity risk premium, which is the additional return investors require to take on the risk of investing in equities. Together the risk-free rate and the equity risk premium constitute the total market return. To assess these parameters we consider a range of evidence, including previous regulatory precedent, estimates from market data, and authoritative third-party sources.

The other key generic parameter is taxation. In theory the tax rate could be specific, since companies may differ in the effective tax rate that they pay. We understand that Comreg is to consult on the use of statutory versus effective rates. For our purposes here we set out our results in terms of the statutory rate, hence taxation is a generic parameter.

3.1 Risk-Free Rate

This section outlines our assessment of the risk-free rate in Ireland, under the approach we have adopted here[4] and the European Commission approach. We begin with a discussion of conceptual features of a risk-free rate in general and the Irish risk-free rate in particular. We then use this discussion as our point of departure for determining the Irish risk-free rate empirically.

3.1.1 Nominal versus Real Risk-Free Rates

Since our estimate is for a pre-tax nominal WACC, we estimate the appropriate nominal risk-free rate. What matters for investors is the real return on their investments, but to achieve this within a regulatory WACC there will need to be some allowance for inflation either within the WACC itself or within the value of the asset base. In this case, since the asset base is not adjusted for inflation, compensation for inflation occurs through the WACC, which must be expressed in nominal terms.

Our approach to estimating the appropriate nominal risk-free is to estimate separately the real risk-free rate and inflation. In principle nominal risk-free rates could be estimated directly from yields on nominal gilts. However, it is useful to decompose the nominal risk-free rate into the real rate and inflation, which are related as follows:

$$(1 + i) = (1 + r) * (1 + \pi)$$

where i is the nominal interest rate, r is the real interest rate, and π is the rate of inflation.

3.1.2

3.1.3 The risk-free rate for Ireland

Under the approach we are taking here, consistent with that adopted in 2014, we attempt to form a judgement as to the underlying equilibrium value of the risk-free rate for the Eurozone, treating the Eurozone

[4] An alternative approach to the risk-free rate is set out in Appendix 4.

as by-and-large one capital market (though we shall argue that Ireland's strong macroeconomic performance justifies placing it above the mid-point of the plausible equilibrium risk-free rate range for the Eurozone). We form this judgement based on a review of the macroeconomic outlook, bond yields across the Eurozone and regulatory precedent.

As we can see from the figure below, the year on year GDP growth rate for Ireland is expected to fall from 6.8 per cent in 2018 to 4.1 percent in 2019 and 3.7 per cent in 2020 which translates into an average expected growth of 4.9 per cent for 2018-2020.

Figure 3.1 GDP growth (year-on-year per cent) and forecasts for Ireland, 2007-2020

Note: 2018-2020 figures (dashed line) are forecasts based on the European Commission data.
Source: European Commission.

Eurozone growth has remained the same and Irish growth has been spectacular and its growth forecasts are improved from those predicted in November 2017.

Based on the forecasts presented in **Error! Reference source not found.**, the outlook for growth in the Eurozone over the next couple of years is between 1.7 per cent (the 2020 forecast) and 1.9 per cent (the 2019 forecast).

There is a strong theoretical connection between changes in risk-free rates and changes in the medium-term growth rate of economies.[5] Europe Economics has developed an econometric model of the relationship between changes in the risk-free rate and changes in sustainable growth[6] which suggests that the two variables

[5] In standard long-term economic growth models, such as the Ramsey-Cass-Koopmans model, a key equilibrium condition is that (absent population growth and for a given level of time preference) changes in the sustainable growth rate of the economy equal changes in the risk-free rate. Indeed, in corporate finance theory the risk-free rate of return is sometimes viewed as arising from the sustainable growth rate (i.e. causality runs from the sustainable growth rate to the risk-free rate).

[6] See Lilico, A. and Ficco, S. (2012) "The relationship between sustainable growth and risk-free rate: Evidence from UK government gilts" Europe Economics Staff Working Paper 2012.1 available at: http://www.europe-economics.com/publications/sustainable_growth_rate_working_paper.pdf. The data used in the econometric model were quarterly yields on ten-year index-linked bonds, and the actual average growth rate over the subsequent ten years. We find one series break, in the fourth quarter of 1992 with the introduction of inflation targeting, and get a

are correlated with coefficient of around 0.7 —i.e. if potential output growth falls (increases) by 1 percentage point, the risk-free rate will fall (increase) by 0.7 percentage points.[7]

To use our model, first we identify the Eurozone risk-free rate for the period prior to government bonds becoming poor proxies for the risk-free rate. In Table 3.1 we set out some examples of the levels at which European regulators set the risk-free rate prior to the 2007-08 financial crisis. We can see that in the Eurozone typical figures for the real risk-free rate were in the region 2 to 2½ per cent, though figures at the lower end of this range appear to have been uncommon.

Table 3.1: European regulatory precedent for the risk-free rate—Before 2007

Regulator	Subject	Year	Risk-free rate
AEEGSI	Italian gas TSO	2005	4.259%* (in the WACC determination the inflation was 1.7%)
CER	Irish Electricity TSO	2003	2.50%
Ofwat	English & Wales water companies	2005	2.5% - 3.0%
CRE	French Electricity TSO and DSO	2005	3.55%* (NB French CPI in 2005 was 1.53%)
Ofgem	Great Britain Electricity TSO	2007	2.50%

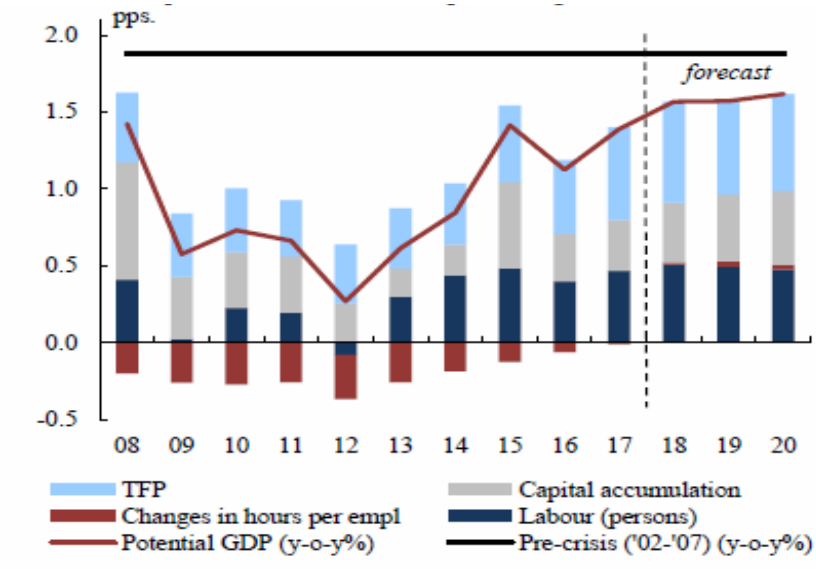
Source: regulatory decisions
Note: (*) nominal

Next we consider how the rate of growth in potential output has changed for the Eurozone for the period prior to 2007 (when government bonds were still a good proxy for risk-free rates) and subsequently. According to the European Commission's latest forecasts (autumn 2018) the potential output in the euro area is estimated to have expanded at increasing rates in recent year. Estimates of potential GDP growth in the Eurozone were around 0.25 per cent in 2012 and they have increased to almost 1.5 per cent by in 2017 (see Figure below). Based on the European Commission's Autumn 2018 forecasts, potential growth forecasts for the next couple of years remain below the pre-crisis level (which was around 2 per cent).

correlation of 0.83. The econometric models explains movements in yields by a constant, a dummy variable for the introduction of inflation targeting, and the average GDP growth rate over the subsequent ten years.

[7] We note that our estimates of the structural relationship are based on data up to 2010 because, the quantitative easing measures implemented in response to the financial crisis resulted in government bonds yields post-2010 being distorted. Whilst structural relationships may be expected to be more stable than day-to-day data, over a sufficient time period they can change. That implies that we might have less confidence in the validity of a structural relationship based on pre-2010 data now than we had in 2014, since their applicability requires not only that the structural relationships have not changed but also that results based on UK evidence continue to be applicable to Ireland. That is one key reason it is helpful to consider the analysis set out in Appendix 4 as an alternative approach and cross-check on the main text results. On the other hand, as we shall see in Appendix 4, the approach set out there has its own uncertainties for Ireland, associated especially with the wide rate of possibilities that exist for the Total Market Return. That means that, despite the uncertainties there are regarding the applicability of the approach described in the main text and despite the importance of considering other approaches as a cross-check, we believe that, for Ireland, the approach set out here continues to be that which should carry the most weight.

Figure 3.2: Contributions to potential growth, euro area



Source: Graph I.27, European Commission Autumn 2018 forecasts

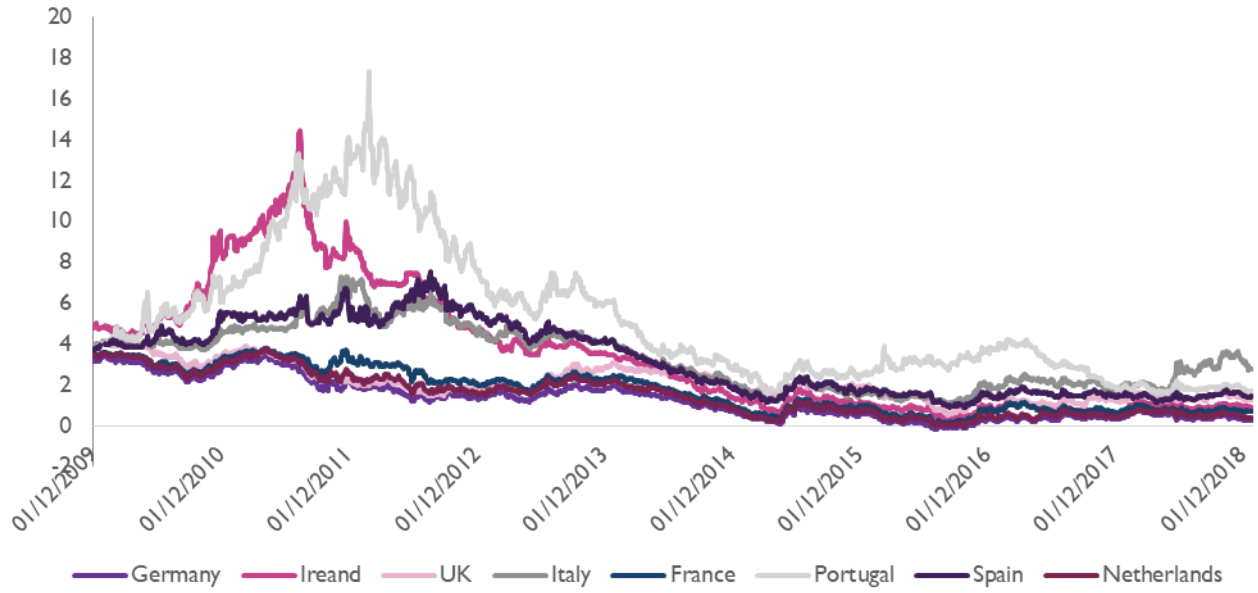
We can see from the figure above that, the European Commission's Autumn 2018 forecasts implied that by 2020 the potential growth for the Eurozone would remain around 0.3 per cent below the pre-crisis level. The European Commission's Winter 2019 forecasts show growth prospects in the Eurozone deteriorating since autumn 2018 (see Table below). That report did not include an update of the rate of growth in potential output, but the downgrades appear sufficiently significant that it is natural to assume that had the exercise been done, there would have been a fall in potential output growth.

Table 3.2: Real GDP growth forecasts (YoY%)

	Forecasts in Winter 2019			Forecasts in Autumn 2018		
	2018	2019	2020	2018	2019	2020
France	1.5	1.3	1.5	1.7	1.6	1.6
Germany	1.5	1.1	1.7	1.7	1.8	1.7
Ireland	6.8	4.1	3.7	7.8	4.5	3.8
Italy	1.0	0.2	0.8	1.1	1.2	1.3
Spain	2.5	2.1	1.9	2.6	2.2	2.0
UK	1.4	1.3	1.3	1.3	1.2	1.2
Eurozone	1.9	1.3	1.6	2.1	1.9	1.7

That message is reinforced if we consider bond yields. The figure below shows nominal yields on a sample of European sovereign 10 year bonds.

Figure 3.3 Nominal yields on European sovereign 10 year bonds



Source: Thomson Reuters.

We can see from the figure above that sovereign bond yields have remained very low and indeed the average for 2018 was negative in real terms, down a little even from 2017's low level. As of 31 December 2018, the value of Irish nominal yields is 0.906, compared to a value of 0.672 recorded on 29 December 2017.

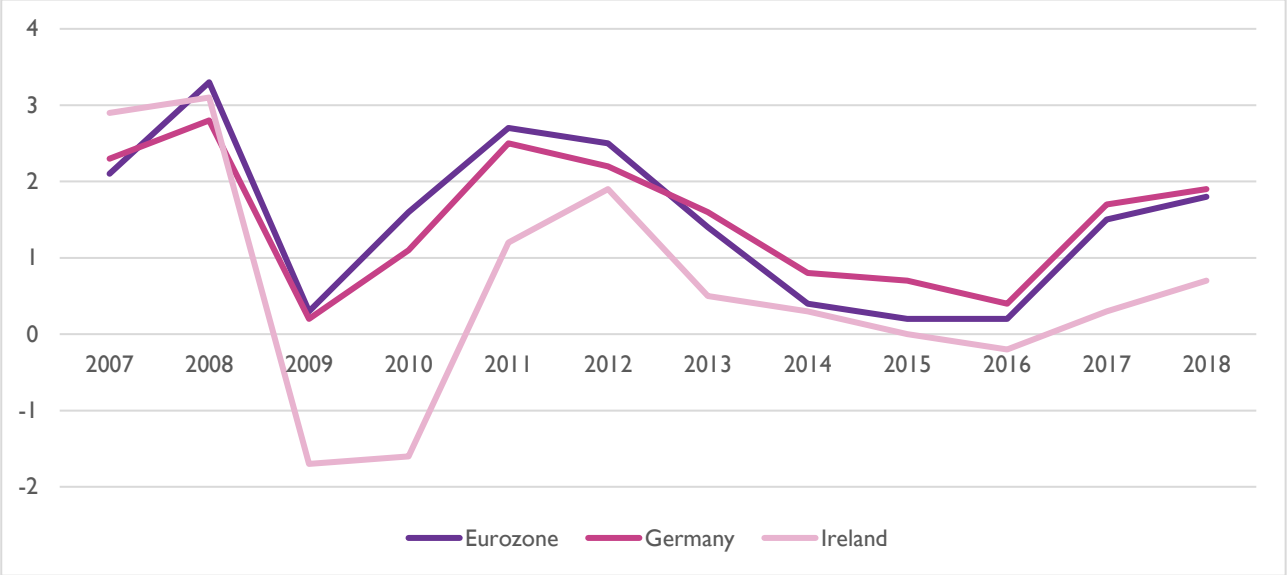
Taking these points in the round, we therefore extend the 0.3 per cent drop noted above, relative to the pre-crisis period, to 0.4 per cent.

Using our 0.7 coefficient and that assumed drop in potential output growth for the Eurozone of 0.4 per cent, that implies a fall in the risk-free rate, relative to its pre-crisis level, of around 0.3 percentage point. So, given our range for the pre-crisis risk-free rate of around 2.0-2.5, that implies that the Eurozone risk-free rate should by 2020 should be around 1.7-2.2 per cent. As noted above, Ireland's GDP growth rate is much faster than that of the average Eurozone economy. We believe that this justifies the use of a risk-free rate estimate for Ireland that lies in the upper part of the Eurozone range. Accordingly, we recommend **2.1 per cent** for the real risk-free rate in Ireland (above the centre point of the 1.7-2.2 range).

3.1.4 Inflation

The analysis of the risk-free rate has up to now focused on the real risk-free rate. When calculating the WACC, however, we will use nominal variables, consistent with previous ComReg practice. Converting the risk-free rate from real to nominal requires an estimate of the rate of inflation over the price control period. The following chart plots the year-over-year inflation in Eurostat's harmonised index of consumer prices for Ireland, Germany, and the Eurozone.

Figure 3.4: Year-on-year HICP inflation in Ireland, Germany, and the Eurozone



Source: Eurostat.

Among the three inflation rates, the Irish rate has been the most volatile. The average Irish inflation rate over the past 10 years has been around 0.14 per cent, compared with an average rate of 1.31 per cent in Germany and 1.26 per cent in the Eurozone.

The ECB's mandate is to maintain price stability, which it has interpreted as keeping inflation "below, but close to, 2 per cent" on a year-over-year basis. Recently, inflation has been low across the Eurozone, including Ireland.

The Irish central bank forecast for inflation for 2019 is 0.7 per cent and for 2020 is 1.1 per cent.[8] The European Commission forecast the Eurozone for 2019 is 1.4 per cent and 1.5 per cent for 2020.

We take the Irish central bank forecast for inflation in 2020 as our lower bound for inflation during the price control. As our upper bound, we take the ECB's implicit inflation target ("below 2 per cent"), which we interpret as 1.8 per cent. We select 1.3 per cent as our point estimate, giving more weight to the Irish forecast as we might expect Irish communications sector price changes to reflect Irish economy conditions more closely than those of the Eurozone as a whole.

3.2 The Equity Risk Premium

The equity risk premium ("ERP") is the additional return investors in equities demand above the risk-free rate. Investors require an additional return over the risk-free rate because, by definition, equities are riskier than a risk-free asset. The ERP represents the mean level of additional return over the risk-free rate that investors need to bear equity risk.

3.2.1 Regulatory precedent

Irish regulatory precedent on the equity risk premium, shown in the table below, has been in the range of four and three quarters to six per cent since 2000.

[8] https://www.centralbank.ie/publication/quarterly-bulletins/quarterly-bulletin-q2-2019

Table 3.3: Total market returns in Irish regulatory determinations, 2000-2018

Regulator	Subject	Year	ERP
CER	ESB PG	2000	5.4
CAR	Aer Rianta	2001	6.0
CAR	Irish Aviation Authority	2002	6.0
CER	Bord Gáis Éireann	2003	6.0
ComReg	Eircom	2003	6.0
CAR	Dublin Airport Authority	2005	6.0
CER	ESB PG	2005	5.25
ComReg	Eircom	2008	6.0
CAR	Dublin Airport Authority	2009	5.0
CER	EirGrid and ESB	2010	5.2
CAR	Irish Aviation Authority	2011	5.0
CER	EirGrid and ESB	2014	5.0
CER	Irish Water	2014	5.0
ComReg	Eircom	2014	5.0
CAR	Dublin Airport	2014	5
CER	Eirgrid and ESB	2015	4.75
CER	Irish Water	2016	4.75

Source: Various regulatory determinations.

Note that determinations in the period up to 2005 generally had higher ERPs, with a strong preference for 6.0 per cent, whereas in the period after determined risk premia have been lower. This may appear counterintuitive, but may reflect very high total market returns in Ireland during the early 2000s in a period of particularly strong growth. Precedent therefore suggests an equity risk premium in the range of 4.75-6.0 per cent.

3.2.2 Long-run evidence

For the purposes of the CAPM, we wish to know what is the expected excess return to equity. In line with the other CAPM parameters that are expressed in expectation terms, our primary evidence on what is expected comes from evidence on what actually happened. For example, we use recent evidence on actual returns on companies' debt to estimate what premium over the risk-free rate is required to allow companies to offer investors a sufficiently high expected return on their debt. This estimation involves a trade-off between analysing a long enough period of data to be able to distinguish the true expected value from statistical noise, and focussing on a sufficiently recent period so that changes in investors' required returns are taken on board.

In the case of the ERP this exercise is complicated by the fact that returns to holding equity vary substantially over short periods of time. Because of this variation, there is a very real danger that analysing too short a period of time would fail to capture the expected equity return, since we would in fact be sampling only a part of the distribution of equity returns. Further, because of the magnitude of changes in returns, the addition of a particular period in time or the other can often have a substantial effect on the mean return calculated. To address these issues, the equity risk premium is generally estimated using very long-run historical data (often over 100 years).

Dimson, Marsh, and Staunton (DMS) (2002) sought to address the fact that many of the long-run empirical studies on the equity risk premium had been based on the experience of the US only. [9] DMS argued that, given how successful the US economy had been, the US risk premium was unlikely to be representative, so

[9] Dimson, Elroy, Marsh, Paul and Staunton, Mike (2002) "Global evidence on the equity risk premium" London: London Business School.

extended the evidence on the equity risk premium by examining data on bond and bill returns in 16 countries over a 102 year period (1900-2002). Their results showed that the equity risk premium has typically been lower than previous research had suggested.

Long-run risk premia are now estimated annually using the DMS methodology. **Error! Reference source not found.** below shows worldwide equity risk premia over bonds from the latest round of estimates on data from 1900 to 2017.[10]

Table 3.4 Worldwide equity risk premiums relative to bonds, 1900-2017

Country	Geometric mean %	Arithmetic Mean %	Standard error %	Standard dev. %	Minimum return%	Min year	Maximum return %	Max year
France	3.1	5.4	2.1	22.5	-49.2	2008	84.3	1946
Germany	5.1	8.4	2.6	28.2	-51.5	2008	116.6	1949
Ireland	**2.7**	**4.7**	**1.8**	**19.7**	**-66.9**	**2008**	**83.2**	**1972**
Italy	3.2	6.5	2.7	29.1	-48.1	2008	152.2	1946
Spain	1.8	3.8	1.9	20.5	-43.7	2008	69.1	1986
United Kingdom	3.7	5.0	1.6	17.0	-38.4	2008	80.8	1975
Europe	3.0	4.3	1.4	15.7	-47.9	2008	54.6	1923
World ex-USA	2.8	3.8	1.3	14.4	-48.6	2008	35.4	1919
World	3.2	4.4	1.4	15.3	-48.7	2008	37.4	1958

Source: Dimson, Marsh, and Staunton (2018), "Credit Suisse Global Investment Returns – Yearbook 2018"

The DMS series can be though as a set of draws from an underlying distribution of returns. This means that, for the purpose of forming a view on the expected future return, the Arithmetic Mean is the relevant permanent (since the arithmetic mean of a sample is the Expected Value of returns, which is our target concept).

As we use 10 year governments bonds as our risk-free rate, the appropriate ERP is over bonds, rather than over short-maturity bills. For Ireland, DMS estimate the arithmetic ERP over bonds to be 4.7 per cent.[11]

The latest DMS figures (4.7 per cent for Ireland and 4.3 per cent for Europe[12]) and recent regulatory precedent (4.75 per cent-PR4) suggest a range for the EPR of 4.3-4.75 per cent (i.e. the European number is used as the lower bound, whilst the most recent regulatory precedent in Ireland is used as the upper bound).

The current review is taking place in an extended period of solid economic growth for Ireland. We note that many regulators have elevated their ERP estimates in periods of recession or extended economic volatility, reflecting a Bank of England study suggesting the ERP may be 20 per cent higher in recessions. But if the ERP is 20 per cent higher than its average value in recessions, then, mathematically speaking, in non-recessions it must be lower than its long-run average so that the average is achieved.

Between 1960Q2 and 2018Q3 the Irish economy contracted, on a quarterly basis, about 15 per cent of the time. If the ERP would be elevated by 20 per cent in the about 15 per cent of the time the economy is

[10] Dimson, Elroy, Marsh, Paul, and Staunton, Mike (2018) *Credit Suisse Global Investment Returns Yearbook 2018*.
[11] More specifically, DMS estimates the arithmetic ERP over 20-year bonds.
[12] DMS provides also ERP figures relative to bills, which in the case of Europe is 5.2 per cent.

contracting, and its average value is 4.7, then when the economy is growing the ERP must be about 4.55. We round that to 4.6 and use 4.6 as our estimate of the Irish ERP.[13]

3.3 Taxation

Taxation represents a cost to a regulated company, and it is a principle of economic regulation that such costs ought to be recovered by the company in question. Some regulators, such as Ofwat, give companies explicit tax allowances in their charges, effectively treating taxation as an operating expense. Other regulators give companies allowed returns on a pre-tax basis, effectively including an allowance for taxation in the return on capital. We note that this is similar to the case for inflation, with some regulators using a real WACC with an index-linked asset base, and others using a nominal WACC without asset base indexation. ComReg's practice has been to use a nominal pre-tax WACC.

Given the tax shield resulting from the ability to deduct interest expenses from taxes, calculating a pre-tax WACC involves inflating the cost of equity by a value of one less the tax rate:

$$WACC_{PRE\text{-}TAX} = g \cdot r_D + [(1 - g) / (1 - t)] \cdot r_E$$

where g is the level of gearing, t is the tax rate, r_D is the pre-tax cost of debt and r_E is the post-tax cost of equity.

Regulatory precedent in Ireland overwhelmingly favours the use of the statutory tax rate in the calculation of the pre-tax WACC, though we understand that Comreg is consulting on the option of using effective rates. Here we use the Irish statutory corporation tax rate of 12.5 per cent when calculating a pre-tax WACC.

3.4 Conclusion on Generic Parameters

The table below shows our suggested ranges for the generic WCC parameters.

Figure 3.5: Generic WACC parameters

	Low	High	Point
Inflation	1.10%	1.80%	1.30%
Real risk-free rate	1.70%	2.20%	2.10%
Nominal risk-free rate	2.82%	4.04%	3.43%
Real ERP	4.25%	4.67%	4.54%
Nominal ERP	4.30%	4.75%	4.60%
Tax Rate	12.5%	12.5%	12.5%

3.5 Evolution of generic parameters since 2014

We provide below a table setting out the evolution of the main generic parameters (i.e. the risk free rate and the ERP) since the 2014 determinations.

[13] In Appendix 4 we set out an alternative approach which involves focusing upon a Dividend Growth Model of the total market return (i.e. the sum of the risk-free rate and the ERP).

Figure 3.6: Evolution of generic parameters

	Nov-14	Feb-16	Dec-16	Jan-18	Jan-19
Real RFR	2.10%	2.10%	2.10%	2.10%	2.10%
Real TMR	7.10%	6.85%	6.85%	6.85%	6.64%
ERP	5.00%	4.75%	4.75%	4.75%	4.54%

We notice that the real risk free rate has not changed since 2014 and that the ERP (and as a result the TMR) is the only parameter to have experienced a relatively moderate decline (from 5 per cent in 2015 to 4.54 per cent in 2019) over the last four years.

3.5.1 Comparison between our recommendations and those obtained following the European Commission's methodology

In Appendix 4 we report an alternative methodology for assessing the WACC (based on the approaches taken by UK regulators Ofwat, Ofgem and the CAA — though Ofwat continues to employ a methodology more in the spirit of the methodology we use in the main text here) and in Appendix 5 we report the WACC approach recommended by the European Commission.[14] It can be seen that there are non-trivial differences in both directions.

	EE	Alternative methodology	EC Methodology
Inflation	1.30%	1.30%	1.80%
Real risk-free rate	2.10%	0.90%	-0.59%
Nominal risk-free rate	3.43%	2.21%	1.20%
Real ERP	4.54%	7.84%	4.22%
Nominal ERP	4.60%	7.94%	4.30%
Real TMR	6.64%	8.74%	3.63%

As context here, it is perhaps worth noting that the TMR assessed by the UK regulators, when they adopted a methodology in line with that we spell out in Appendix 4, has been around 6.5 per cent[15], just a little lower than the TMR implied by our main methodology here. The European Commission approach thus implies a total market return for Europe of nearly 3 per cent lower than that adopted by UK regulators produces for

[14] http://ec.europa.eu/information_society/newsroom/image/document/2018-27/05-07-2018_wacc_background_document_60A8BB89-B677-CE6F-C44D838BD437C73D_53397.pdf

[15] More specifically, the figure for Ofwat was 6.47 per cent, for Ofgem was 6.25-6.75 per cent, and for the CAA was 6-6.5 per cent.

the UK, whereas our application of that same UK methodology implies that the Irish return would be around 2 per cent higher than that in the UK (and indeed in line with TMRs adopted in Ireland in the mid-2000s). In this context it is perhaps also worth remarking that the DMS source the European Commission methodology recommends be used for the estimation of the ERP itself reports a TMR of 6.2 per cent for Europe and of 7.0 per cent for Ireland, meaning that our recommended value sits close to the mid-point between those values.

4 Specific Parameters in the WACC-CAPM Model

This section we first present the set of relevant comparators and we then discusses methodological issues in the estimation of specific parameters in the WACC-CAPM model. These are the WACC parameters that *may* vary between the mobile, fixed line and broadcasting controls

- Gearing
- Equity Beta
- Debt premium

4.1 Set of comparators

The set of comparators chosen and their respective operations across the three main sectors is provided in the table below.

Table 4.1: Set of comparators

Company	Country	Fixed-line	Mobile	Broadcasting
American Tower Corp	US			√
British Telecom	UK	√	√	
Cellnex	ES			√
Crown Castle	US			√
Deutsche Telekom	DE	√	√	
EI Tower	IT			√
KPN	NL	√	√	
Orange	FR	√	√	
SBA Communications	US			√
Telefonica	ES	√	√	
Telia	SE	√	√	
TIM	IT	√	√	
Swisscom	CH	√	√	
Vodafone	UK		√	

Since most comparators in our sample provide both mobile and fixed-line services, we have a adopted an approach in which we give different weights to different companies — with weights determined according to the share of revenues generated by each company in from the mobile and fixed-line segment — in order to inform our views the beta and the debt premium (more details on such approached are provided in later sections of the report).

4.2 Gearing

4.2.1 Introduction to Gearing

The gearing of a company is the ratio of its fixed financing to its total financing, or the ratio of the value of its debt to the sum of its debt and equity.[16] Although gearing itself does not necessarily affect the WACC, it is important for an assessment of the WACC for several reasons:

- We determine the WACC by assessing the costs of debt and equity, and gearing determines the appropriate weighting between the two.
- The costs of debt and equity are not invariant to the company's level of gearing.
- When setting the WACC for an entire industry, it is important to consider whether a company's observed, actual gearing should be used or a notional industry-wide gearing.
- Related to the above, interest paid on debt can be tax deductible, and therefore there may be tax shields associated with debt. Understanding the proportion of a company's financing costs consisting of debt is critical to understanding the presence and consequences of tax shields. This is especially important if the specified notional gearing differs significantly from actual gearing.

In Appendix 3 we consider the Modigliani-Miller Theorem and its implication on gearing.

4.2.2 Notional versus actual gearing

There is no standard approach to gearing in cost of capital regulation, partly reflecting the Modigliani-Miller capital structure irrelevance result. Some regulators, such as the UK's Ofcom in its regulation of BT, analyse the actual gearing of regulated companies. In the 2014 Comreg determinations , a notional approach was adopted, which involved the regulator choosing a crediting rating for the company that it believes compatible with the company's obligations under their licence and the regulator's duties to ensure financeability. Based on the credit rating, notional gearing is set so that the credit rating can be secured at the determined WACC. With a target credit rating determined, the notional gearing is typically set at close to the highest level of gearing compatible with the target credit rating, bearing in mind regulatory precedent and companies' actual levels of gearing. This implies that some iteration in WACC calculation may be necessary to the extent that financeability analysis finds that the WACC at the notional gearing level is not compatible with the target credit rating. It is this latter approach that we adopt here.

4.3 Equity and Asset Beta

4.3.1 Beta and systematic risk

A beta is a measure of systematic investment risk. In particular, betas measure the extent to which the returns on any particular asset[17] are correlated with the returns across all assets in the economy. In developed economies it usually safe to assume that all systematic risks can be constructed using just the equities in the main listed equities market (the "stock market") — i.e. the set of stocks on the stock market is sufficiently diverse that by using some combination of them one could replicate any systematic risks (upside or downside) that one desired. Hereafter we shall assume this is true and refer to returns across all assets in the economy as returns across "the market".

[16] This is the definition we have used, consistent with previous Irish and international regulatory precedent. Another interpretation of this definition of gearing is fixed financing over total capital.

[17] By "asset" here we refer to any investment or capital project. In the next subsection we consider the distinction between equity and asset betas.

A beta of 1 indicates that returns on the asset and return on the market move in a proportionally identical fashion, so that falls or increases in returns in the market are matched by falls or increases in the asset's returns of the same proportion. Similarly a beta of less than 1 indicates that falls in the market return are matched by less severe falls in the assets' return, while a beta of more than 1 indicates that falls in market returns are matched with more severe falls in the asset's returns.

In other words, betas measure systematic risk, which comprises risk that affects the entire market and cannot be avoided by investors through portfolio diversification. Specific risk, by contrast, refers to those risks that affect a particular company or group of companies. Investors can avoid specific risk by diversifying their investments.

Since systematic risks are determined to varying extents by economy-wide factors, they cannot be diversified away by investors. Therefore the company has to compensate its investors for bearing the risk through the cost of capital. Examples of systematic risks might include:

- Macroeconomic fluctuations, such as in the rate of growth of GDP — such fluctuations contribute to the willingness to pay for telecommunications services being uncertain;
- Changes in interest rates;
- Changes in oil prices and the prices of related factor inputs;
- Catastrophic events, such as terrorist attack, war, or a global pandemic, undermining demand in so far as they affect the market as a whole.

4.3.2 Levering and re-levering

The beta used in the CAPM is called the "equity beta" or "levered beta". For companies, the equity beta measures the systematic risk of the company's equity at a given level of gearing. A company's "asset" beta measures a company's exposure to systematic risk, ie the exposure of the assets themselves (eg plant and machinery) rather than the systematic risk of financial claims on those assets (eg the equity). The asset beta is related to the betas on equity and debt according to the following formula:

$$\beta_A = g * \beta_D + (1 - g) * \beta_E$$

where $ß_A$ is the company's asset beta, $ß_D$ is a company's debt beta, $ß_A$ is a company's equity beta, and g is the company's gearing. The debt beta is frequently, but not always, assumed to be zero. If the debt beta is equal to zero, then the asset beta is simply the equity beta multiplied by equity's share of the capital structure (or one minus debt's share of the capital structure). Unless a company is completely financed by equity and has a gearing of zero, the equity beta will be greater than the asset beta. The more the company is geared, the higher the equity beta for a given asset beta. This is because more highly geared companies have more fixed financing costs relative to total financing costs, since interest payments are obligatory but dividends are discretionary.

Higher fixed financing costs constrain a company's ability to cut financing costs during an adverse system-wide shock. Therefore an equity investor's exposure to systematic risk is higher if a company is more highly geared, as lower cash flows to cover high fixed financing costs would result in lower shareholder's equity.

As we use a notional gearing in our WACC estimates, we present unlevered betas in the discussion below. These are then relevered using our notional gearing assumption to obtain the implied equity beta at that gearing level. We then use the resulting relevered betas to estimate the cost of equity.

4.3.3 Estimating betas

Equity beta estimation typically follows the convention that calculations of betas based on the use of daily data over a one to two year time horizon are preferred, due to favourable statistical properties (i.e. low

standard errors and relatively stable estimates). To examine the important issue of possible time variation in company betas, Smithers and Co. (2003) run rolling regressions at all frequencies, and have carried out parameter stability tests on monthly, weekly and daily data.[18]

Estimates based on many years of historical data may be of little relevance because the nature of the business risks undertaken by companies may have changed significantly over a long period such as 10 years. The choice of a one- to two-year estimation period is based on Smithers and Co.'s finding that standard errors are generally low and betas reasonably stable over this estimation period. For this reason, we place the most weight on rolling two-year betas estimated on daily data when assessing the appropriate beta for a hypothetical efficient Irish mobile operator. We supplement our impressions from the two-year betas with an analysis of one- and five-year rolling betas as well.

Because companies will be geared at different levels, we compare companies' asset betas, using the ratio of net debt to the sum of net debt and market capitalization to estimate companies gearing. There is a further issue in the use of asset betas that calculating these requires a debt beta. Irish regulators have generally assumed a zero debt beta when calculating asset betas. However, Ofcom in the UK has favoured the inclusion nonzero debt betas (at 0.1) in the context of telecoms in general and mobile call termination in particular. Because of the difficulties in robustly estimating a debt beta, when it is included it is usually assumed to be at a low level.

In the present case, the assumption of a zero, or very low (0.1) debt beta does not make a material difference to our conclusions. We therefore present our analysis with both zero and 0.1 debt betas and then determine the appropriate equity beta.

4.3.4 Choice of the relevant equity market

Betas represent the co-movement of returns on a particular asset and returns in the equity market more generally. In order to estimate betas, one must select the relevant equity market for the analysis. Using the Irish Stock Exchange (ISEQ) in this analysis could be misleading, as none of the listed companies we analyse trade on the ISEQ. An alternative could be to use the domestic equity index of the company in question (e.g. FTSE for Vodafone, IBEX for Telefonica, etc.). The relevant cost of capital for a company is that which arises when issuing equity in its domestic market, and the relevant domestic market index would certainly capture the co-movements of asset and market returns.

We argue, however, that the Eurozone is a unified capital market. If this is the case, then investors in Germany are free to invest in the ISEQ, the IBEX, or any other equity market in the Eurozone as if it were, say, the DAX. A Europe-wide equity index may be more appropriate in these circumstances.

Our methodological preference, then, is to estimate betas using a Europe-wide equity index. We estimate betas on the MSCI Europe Index for Eurozone-base companies, which is a free-float weighted index of 15 developed European countries representing approximately 85 per cent of adjusted market capitalisation in Europe.[19]

[18] However, Smithers (2003) have previously noted that beta estimates based on daily data may be downwardly biased if the stocks are not as liquid as the market portfolio: "For less frequently traded stocks where it may take more than a few hours for new information to be reflected in measured process a daily beta estimate is likely to be downward biased.". See Smithers and Co. (2003) "A study into certain aspects of the cost of capital for regulated utilities in the U.K.".

[19] Countries included as of February 2019 are: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the UK. All of the companies sampled in our analysis are listed in one of these countries.

4.4 Debt Premium

The cost of debt is the price of fixed-cost financing, such as the interest rate on bonds. For each comparator we estimate the debt premium as the average spread of comparators' corporate bonds versus the appropriate government bond benchmark, which are as follows.

- For comparators that are within the Eurozone the spread is calculated against the 10-year German government bond (which we regard as the benchmark for the Eurozone)
- For comparators that are outside the Eurozone) the spread is calculated against the respective 10-year national government bond.

An alternative approach is explored in Appendix 4. That calculates spreads against the respective national government bond for each company.

5 Mobile WACC

Given the generic WACC parameters we have estimated, and in view of the methodological discussion of the specific parameters detailed above, this section analyses evidence. Our analysis focuses on regulatory precedent, and evidence from market data, based on the following sample.

Table 5.1: Mobile companies sampled for WACC analysis

Company	Country of exchange
Telefonica SA	Spain
Vodafone Group PLC	UK
Orange SA	France
Deutsche Telekom AG	Germany
TIM S.p.A.	Italy
BT Group PLC*	UK
KPN N.V.	Netherlands
Swisscom AG	Switzerland
Telia Company AB	Sweden

Notes: * BT is a mobile virtual network operator (MVNO) focused on the provision of retail services, and as such does not own wireless network infrastructure..

5.1 Gearing

In the present case we are analysing a hypothetical efficient Irish mobile operator for a WACC that will apply in the mobile sector. To determine the appropriate level of notional gearing, we assess evidence from regulatory precedent and look at mobile companies' actual gearing.

5.1.1 Regulatory Precedent

The table below shows recent notional gearing choices of Irish regulators and non-Irish telecommunications regulators. Asset-heavy regulated industries, such as electricity and gas, airports, and fixed-line telephony, tend to be more highly geared than mobile operators. Regulatory precedent on gearing for asset-heavy industries has tended to be around 40 per cent to 60 per cent. This is considerably above gearing ranges for wholesale mobile termination rate (MTR) precedents, which has ranged from 25 per cent to 35 per cent.

Table 5.2: Recent regulatory gearing decisions

Regulator	Year	Subject	Gearing (%)
Ofcom	2018	WLA	30
Ofcom	**2017**	**MTR**	**35**
Utility Regulator	2017	RP6	45
Ofcom	2017	LLCC	30
CER	2016	Irish Water	45
Ofcom	2015	MCT	40
CER	2015	Eirgrid and ESB	55
ComReg	2014	Eircom	30
CAR	2014	Dublin Airport	50
Ofcom	2013	Openreach	40
Ofcom	**2011**	**Wholesale MTR**	**30**
Ofcom	2011	BT (wholesale broadband access)	50
Utility Regulator	2011	SONI	55
CAR	2009	Dublin Airport Authority	37-50
Ofcom	2009	Openreach	35
PTS Sweden*	**2008**	**Wholesale MTR**	**25-35**
(Finland)	**2008**	**Wholesale MTR**	**30**
NIAUR	2008	SONI	57.5
ComReg	2008	Eircom (fixed-line)	30-50
Ofcom	2005	Openreach	30-35
CER	2005	Transmission and distribution	50-60

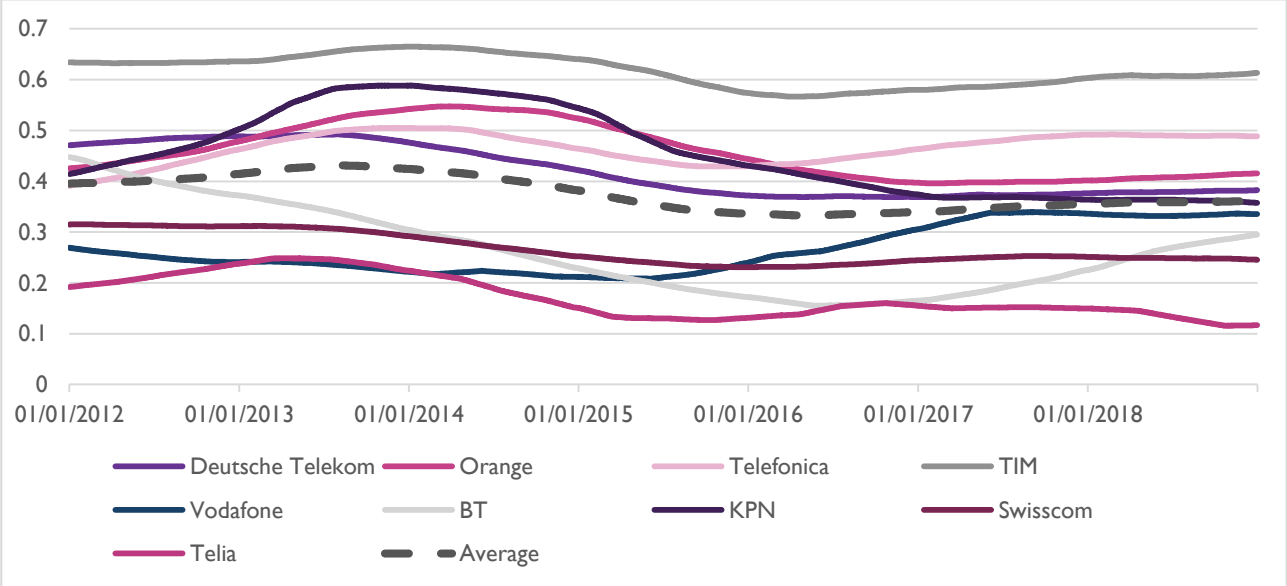
*Estimate by Copenhagen Economics.
Source: Individual regulator reports.

Among MTR determinations, the lower end of the range (25 per cent) was considered by Ofcom in its 2004 MTR price control. Evidence suggests that this is too low in light of the evidence put forth in later in this report, and the rise in gearing levels used in more recent regulator precedents. In 2008, both the Swedish and Finish telecommunications regulators decided on the appropriate WACC for mobile operators' mobile termination charges. Ficora (Finland) used 30 per cent, while Copenhagen Economics on behalf of the Swedish Post and Telecom Authority argued that 25 per cent to 35 per cent gearing was appropriate. More recently, Ofcom used a 35 per cent gearing level in its 2017 MTR price control. This was based on Vodafone's actual gearing, which Ofcom took as a good indicator of the gearing of a hypothetical efficient UK mobile operator.

5.1.2 Mobile Companies' Gearing

In order to analyse mobile companies gearing we have used market data from listed companies operating mobile businesses. The gearing measure we have chosen is the two-year rolling average of comparators net debt over enterprise value. Our sample of European telecommunications companies with mobile operations has, on average, had gearing between 30 per cent and 45 per cent since 2012. As of December 2018 the average gearing level across the sector is 36 per cent. The gearing level of Vodafone (the company in our sample closest to a pure has increased from around 20 per cent in mid-2015 to a level of 34 per cent by December 2018. With the exception of BT, Swisscom, Telia, — that have experienced gearing levels lower than 30 per cent in some periods — gearing levels among comparators have been above 30 per cent, and few comparators (Orange, KPN and TIM) have experienced gearing levels above 50 per cent.

Figure 5.1 Gearing among telecommunications companies with mobile operations, 2012-2018



Source: Thomson Reuters; Europe Economics' calculations.

Table 5.3 presents credit ratings, ratings outlooks, and average gearing levels from January to December 2018 for companies rated by at least one of the three main credit rating agencies.[20] Among the companies rated, the company with the lowest credit rating is also the company with the highest gearing: Telecom Italia. Among the larger multi-service telecommunications companies in Western Europe, KPN (36 per cent), Telefonica (49 per cent), Deutsche Telekom (38 per cent), and Orange (42 per cent) are all investment grade, with KPN and Telefonica being just within the Baa3/BBB- threshold to be considered investment grade. The only pure-play mobile service provider, Vodafone, has a credit rating of BBB+, and a gearing level (34 per cent) which is in line with the sector's average of 36 per cent.

[20] The three main credit rating agencies are Moody's, S&P, and Fitch.

Table 5.3: Credit ratings and outlooks for telecommunications companies

	Gearing Dec-2018	Moody's		Fitch		S&P	
		Rating	*Outlook*	*Rating*	*Outlook*	*Rating*	*Outlook*
Deutsche Telekom	38.2%	Baa1	Negative	BBB+	Stable	BBB+	Negative
KPN	35.8%	Baa3	Stable	BBB	Stable	BBB-	Positive
Orange	41.6%	Baa1	Stable	BBB+	Stable	BBB+	Stable
Telefonica	48.8%	Baa3	Stable	BBB	Stable	BBB	Stable
BT	29.5%	Baa2	Negative	BBB	Negative	BBB	Negative
Telia	11.7%	Baa1	Stable			BBB+	Stable
Swissccom	24.6%	A2	Stable			A	Stable
Telecom Italia	61.3%	Ba1	Stable	BBB-	Stable	BB+	Positive
Vodafone	33.6%	Baa1	*	BBB+	Stable	BBB+	Negative

Note: Telia, Swisscom not rated by Fitch and Vodafone's rating on review for downgrade by one notch.
Source: Thomson Reuters; Europe Economics' calculations.

5.1.3 Assessment

ComReg does not have a statutory obligation to ensure that regulated companies are able to finance themselves, and therefore does not set credit rating targets. Therefore we assess the notional gearing for a hypothetical efficient Irish mobile operator by assuming that the operator must maintain a credit rating within investment grade, corresponding broadly to a level within the broad Baa category (Baa1 to Baa3) by Moody's measure and within the BBB class (BBB- to BBB+) by S&P's measure.

Evidence from purer-play mobile service providers suggests that gearing of around 30 per cent is more than sufficient to ensure an investment grade credit rating. Gearing levels observed for multi-service telecommunications companies of 50 per cent to 60 per cent are likely to be too high, however. Multi-service providers may have asset-heavy natural monopoly operations, such as network businesses, in their domestic markets, which are similar to utilities and can support higher levels of gearing. More asset-light businesses, such as mobile, would be unlikely to require or support such a level of gearing given the asset-light nature of the business compared to companies with a fixed-line network.

We place most weight on the actual gearing levels of purer-play mobile operators, which are around 30 per cent, and the gearing level in recent MTR WACC determinations. However, we note that these companies have very high credit ratings, so that a hypothetical efficient mobile operator could sustain higher gearing and remain investment grade. We believe that a notional gearing level of 30 per cent (the level adopted in 2014) or more, but below the 50 to 60 per cent levels of multi-service operators would be appropriate.

Vodafone is the only pure play mobile comparator in our list, and has a 34 per cent gearing level. In its most recent determination Ofcom adopted a 35 per cent notional gearing, up from 30 per cent. Accordingly, we adopt a level of 35 per cent.

5.2 Equity Beta

ComReg will set the allowed WACC for a "hypothetical efficient Irish mobile operator". There are no publicly listed Ireland-only mobile operators. In the absence of data on a pure-play domestic Irish mobile operator, we use evidence from previous regulatory determinations and betas estimated directly from market data on telecommunications companies with mobile operations.

5.2.1 Precedent on Mobile Beta

Precedent from other European countries' mobile operator price controls give some indication of the level of systematic risk that a hypothetical efficient Irish mobile operator might carry, though it should of course be recognised that there might be different betas in different markets as countries differ in the structure of their economies and hence their use of mobile services and the correlation between the evolution in returns to mobile activities and returns to the wider economy. Nonetheless, decisions made in other countries can provide context to a decision.

Table 5.4: Recent regulatory precedent on mobile asset betas

	Year	Asset beta
UK	2018	0.55-0.75
France	2016	0,62
UK	2015	0,60
Ireland	2014	0,65
Finland	2014	0,63
Spain	2014	0,51
France	2013	0,62
Germany	2012	0,31
Italy	2011	0,53
UK	2011	0,56
France	2011	0,56
France	2010	0,70
Spain	2009	0,58
Sweden	2008	1,20
Finland	2008	1,20
UK	2007	1,18
France	2007	0,70
Spain	2007	0,56
Finland	2006	1,20

Source: Various regulator reports

As Comreg's previous decision was in 2014, it is of interest to note the asset beta used in the UK MTR price controls, given that there have been two relevant decisions since 2014, providing a sense of how the market is changing over time. In 2015, Ofcom used an asset beta of 0.6 to calculate the WACC for mobile operators. Three years later, Ofcom judged that 0.55 was an appropriate lower bound for the asset beta. That might suggest some potential fall in asset betas, though if so the change has been modest.

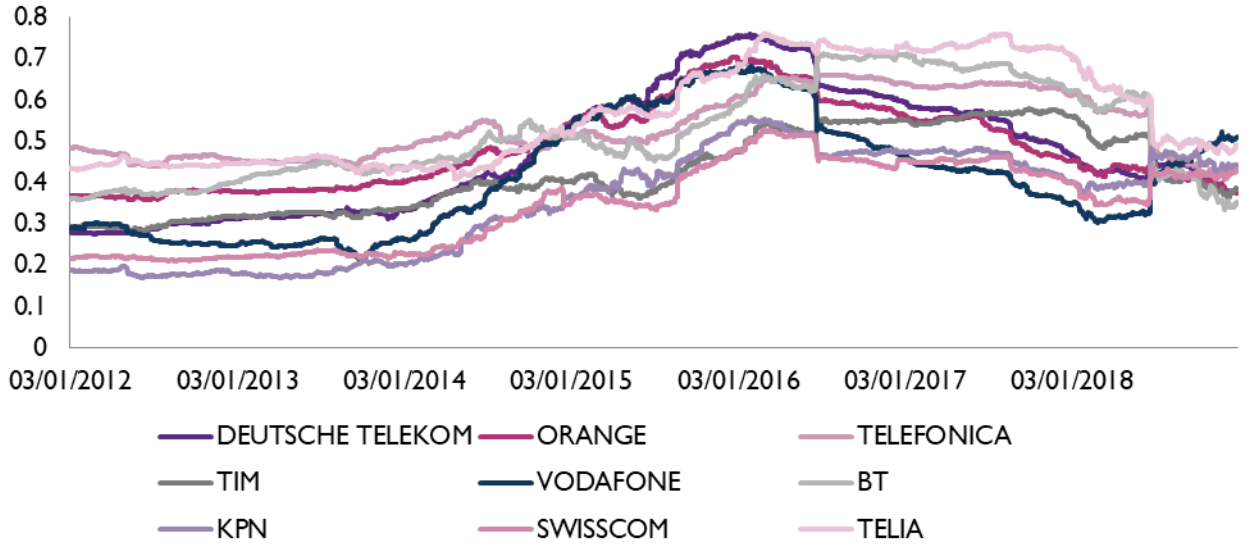
5.2.2 European Telecommunications Betas

Our examination of mobile betas focuses on the telecommunications companies listed reported in Table 5.1. These are telecommunications companies with significant mobile business, and are significant enough that their stocks will be liquid enough to ensure that accurate betas may be estimated.

Of these companies, Vodafone is the closest to a pure play mobile operator, and so we place most weight on its beta estimates. The other companies have substantial fixed-line businesses.

Two year asset betas for the companies (calculated on European market indices) are shown below. These are calculated assuming zero debt betas (see section two for an explanation of the interaction between equity, debt and asset betas).

Figure 5.2 Two year asset betas for telecommunications companies (European market index)



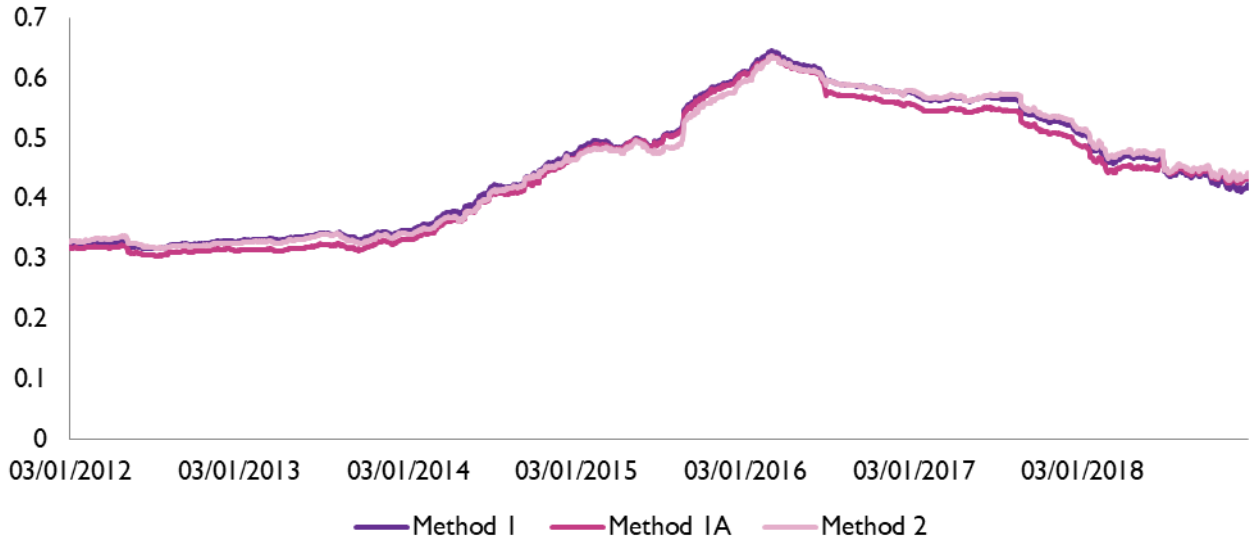
Source: Thomson Reuters and Europe Economics calculations.

Two year betas have converged relative to early 2012, and on recent data also have a range of approximately 0.3 - 0.5.

We calculate the average asset betas using three methods described below:

- Method 1: Normal Arithmetic Average
- Method 1A: Weighted Average. Weighted according to the share of mobile activities for the company.[21]
- Method 2: Average of the companies whose mobile activities dominate the fixed lines activities.

Figure 5.3 Average 2 year Asset Beta



[21] If there are two companies: Company A has a 50 per cent share of mobile in its total revenue and Company B with 25 per cent share of mobile in its total revenue. The weighted average would be (50/75)*Asset Beta A + (25/75)*Asset Beta B

Source: Thomson Reuters and Europe Economics calculations.

As expected, the three different averaging techniques give similar estimates. The range for all three methods has been 0.3 to 0.6. With the most recent range being 0.42 to 0.44.

The overall set of unlevered beta estimates suggest an asset beta approximately in the range of 0.42 to 0.44, the bulk of estimates being in this range. At 35 per cent gearing this corresponds to an equity beta of 0.65-0.68 (rounded to the nearest 0.05).

We consider the midpoint of this range to be a reasonable estimate for the asset beta. Therefore our point estimate for the asset beta is 0.43 which, at 35 per cent gearing corresponds to an equity beta of 0.66.

5.2.3 Conclusion

Our analysis suggests an equity beta range of 0.65-0.68, with a point estimate of 0.66. This is based on an asset beta of approximately 0.43 and a notional gearing of 35 per cent.

5.2.4 Comparison between our recommendations and those obtained following the European Commission's methodology

If one used the beta estimation methodology recommended by the European Commission (as illustrated in detail in Appendix 5), one would obtain an asset beta for the mobile sector of 0.5.

5.3 Debt Premium

5.3.1 Data sampling logic for market data

As mentioned above, our preferred methodology for estimating the debt premium consists of observing corporate debt spreads and not incorporating any embedded debt costs, as a hypothetical efficient new entrant in a contestable market would not carry legacy costs such as embedded debt.

Empirically, we estimate the debt premium by observing the spreads of corporate bonds over the relevant benchmark government bond. We analyse traded bonds rather than loans, leases, or other forms of debt for two reasons. First, the appropriate estimate of the debt premium is not the interest rate on the face of the debt instrument (e.g. coupon rate), but the implied market borrowing cost (i.e. the yield-to-maturity). Since loans, leases, and other sources of fixed-cost financing are not widely or not at all traded, there is no straightforward way to estimate the instrument's yield-to-maturity.

The second reason follows from the first: we use traded bonds rather than other instruments because the price (and yield) are priced in the market and can change from day-to-day, while other sources of fixed-cost financing are not as frequently priced. The risk-free rate also changes in real time. In the absence of real-time pricing on the corporate debt instrument, measuring the debt premium as the spread over a benchmark risk-free asset that prices continuously would tend to over- or under-estimate the debt premium.

We collected data on outstanding bonds for all the mobile operators listed in Table 5.1.. In order to remove the effects of default risk, currency risk, term structure risk, and other risks associated with bond investing, we filter this sample of bonds according to the following criteria:

- Since our notional gearing assumption is based on maintaining an investment grade credit rating, we sample bonds that are only listed as "Baa3" or above by Moody's or "BBB-" or above by S&P.
- We then filter the bonds by currency, by keeping only those denominated in the domestic currency of the issuers,

- We restrict the analysis to those bonds that that have between 7 and 13 years of maturity left, so as to minimise the maturity mismatch with the 10-year government benchmark we use to calculate spreads.
- Finally, we have excluded bonds from Telecom Italia because, following the establishment of the new coalition government in Italy, yields on in the Italian bond markets (sovereign and corporate) have increased significantly and this might distorts the results of our analysis.

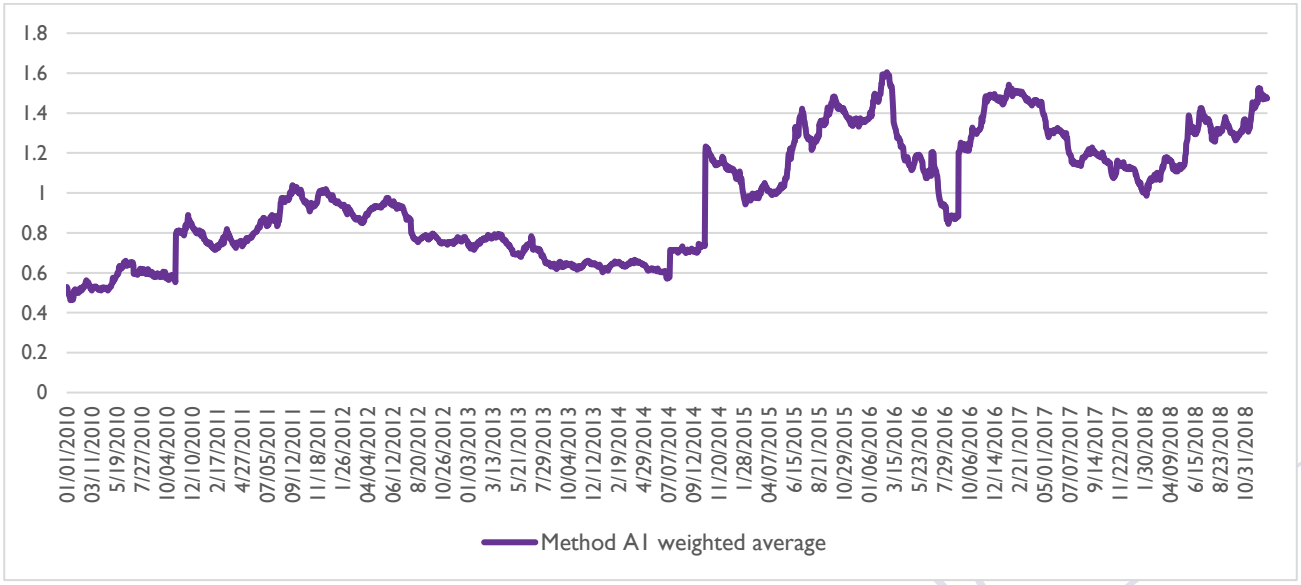
Following the section criteria illustrated above we are left with bond data for the following mobile operators: BT, Deutsche Telekom, KPN, Swisscom, Telefonica, and Vodafone.

Since we are focused mainly on European bonds, we proposed two different approaches to calculate spreads. In the first approach (our preferred approach) we collect for each bond the redemption yield, from which we then subtract the redemption yield of the 10-year German government bond (if the operators is within the Eurozone) or the 10-year national government bond (if the operators is outside the Eurozone). In the second approach, which is used mainly as a cross check, we provide the average of spreads between all relevant bond and the correspondent nationals 10-year government bond.

5.3.2 Debt premium over the appropriate European benchmarks

We estimate the average spread of telecom operators' corporate bonds versus the 10-year German government bond (for the operators within the Eurozone) or versus the 10-year national government bond (for operators outside the Eurozone)[22] At the beginning of 2010, the average spread obtained with method 1A stood at around 50 basis points (bps) for six major telecommunications companies with mobile operations.[23] The premium increased gradually up to around 160 bps by February 2016. Since 2018, the weighted average of the debt spreads for has been bounded between 100 and 160 bps.

Figure 5.4: Weighted average debt premia (%) of mobile operators versus the appropriate European benchmark



Source: Thomson Reuters EIKON; Europe Economics' calculations.

The average spreads for each operator for which we have eligible bonds data are reported in the table below.

[23] One basis point is .01 per cent.

Table 5.5: Average spread versus the appropriate European benchmark for each company

	Credit Rating	Benchmark	Average spread at December 2018
BT	BBB	10-years UK government bond	1.94%
Deutsche Telekom	BBB+	10-years DE government bond	1.38%
KPN	BBB	10-years DE government bond	1.52%
Swisscom	A	10-years CH government bond	0.71%
Telefonica	BBB	10-years DE government bond	1.80%
Vodafone	BBB+	10-years UK government bond	1.57%

Source: Thomson Reuters EIKON

5.3.3 Conclusion

Evidence suggests that a generic mobile operator's debt premium would be around 150 bps above the appropriate European benchmarks bonds. Looking at the three different averages methods, we note that, at the end of December 2018 the debt premium is within a range of 145-150bps.

Figure 5.5: Debt premia under different averaging methods

Source: Thomson Reuters EIKON; Europe Economics' calculations.

5.3.4 Conclusion on debt premium for mobile companies

Evidence from corporate bonds' spread versus the appropriate European benchmarks (our preferred apprach) suggests that a generic mobile operator's debt premium would be around 1.5 per cent. If, instead spreads were calculated versus national government benchmarks the debt premium would be in the region of 1.2 per cent.

5.3.5 Comparison between our recommendations and those obtained following the European Commission's methodology

If one used the cost of debt methodology recommended by the European Commission (as illustrated in detail in Appendix 5), one would obtain debt premium for the mobile sector of 1.49 per cent.

5.4 Overall Mobile WACC

Table 5.6 presents the unadjusted cost of capital for a hypothetical efficient Irish mobile operator calculated from parameters estimated in this report.

Table 5.6: Unadjusted cost of capital for a hypothetical efficient Irish mobile operator (Approach A)

	Low	High	Point Estimate
Real risk-free rate	1.70%	2.20%	2.10%
Real ERP	4.25%	4.67%	4.54%
Inflation	1.10%	1.80%	1.30%
Nominal risk-free rate	2.82%	4.04%	3.43%
Nominal ERP	4.30%	4.75%	4.60%
Unlevered beta	0.42	0.44	0.43
Notional gearing	35%	35%	35%
Notional equity beta	0.65	0.68	0.66
Nominal cost of equity (post-tax)	5.60%	7.25%	6.47%
Tax rate	12.50%	12.50%	12.50%
Nominal cost of equity (pre-tax)	**6.40%**	**8.29%**	**7.39%**
Debt premium	1.45%	1.50%	1.50%
Nominal cost of debt (pre-tax)	**4.27%**	**5.54%**	**4.93%**
Nominal vanilla WACC	**5.13%**	**6.65%**	**5.93%**
Nominal WACC (pre-tax)	**5.65%**	**7.33%**	**6.53%**

Source: Europe Economics' calculations from sources previous cited.

The nominal pre-tax WACC range is therefore 5.65 to 7.33 per cent. Calculating the cost of capital using our point estimate for each parameter, the cost of capital comes out at 6.53 per cent.

6 WACC for an Irish Fixed-Line Incumbent with an Efficient Capital Structure

This section analyses the regulatory WACC for an Irish fixed-line incumbent with an efficient capital structure in the context of the price control to be applied to the domestic fixed-line incumbent in Ireland.

6.1 Gearing

6.1.1 Precedent on fixed-line gearing

We analyse precedent in recent fixed-line determinations or proposals in various European countries as a guide to what an appropriate notional level of gearing for a fixed-line incumbent might be. Table 6.1 presents the levels of gearing used in those determinations.

Table 6.1: Gearing precedent in European fixed-line determination

Determination	Gearing
Ireland (2008)	40%
Belgium (2010)	40%
Portugal (2012)	42.52%
France (2013)	40%
Norway (2013)	40%
Sweden (2013)	30-50%
UK (2013)	40%
Ireland (2014)	40%
Italy (2015)	49%
UK (2017)	35%
UK (2018)	30%
Portugal (2018)	40.05%
Italy (2018)	43.3%

Notes: Swedish determination gave range for components and point estimate for WACC only; midpoint of the Swedish range is 40%. The Italy 2018 figure is from the consultations.
Source: Various regulatory determinations.

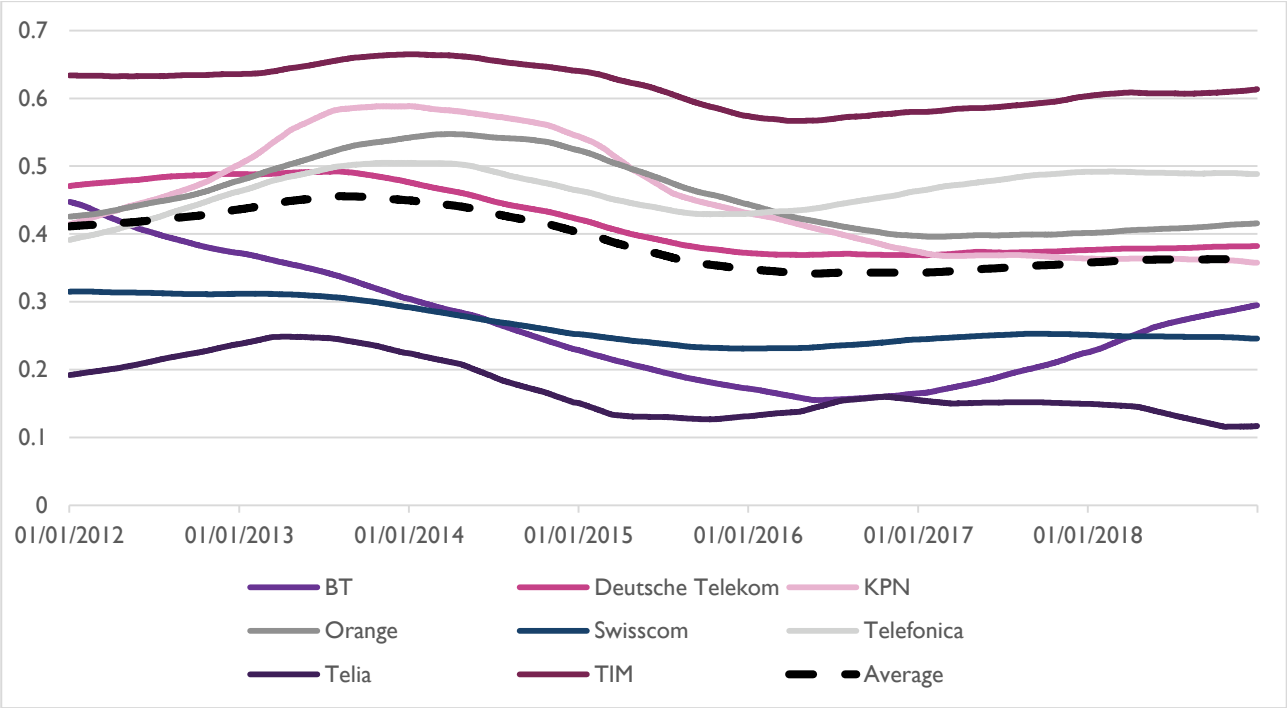
A range around 40 per cent has been common in many determinations. As a range, 30 per cent to 50 per cent has been given by the Swedish regulator, PTS in the past. In the 2014 Eircom determination, ComReg considered a point estimate of 40 per cent[24]. In short, evidence from regulatory precedent suggests that gearing for an efficient fixed-line incumbent could vary from 30 per cent to 50 per cent, with 40 per cent generally favoured within this range.

[24] ComReg (2014) "Cost of Capital • Mobile Telecommunications • Fixed Line telecommunications • Broadcasting (Market A and Market B)" ComReg Doc No. 14/136, p. 63.

6.1.2 Comparator company gearing

Figure 6.1 plots the gearing of select fixed-line comparators between 2012 and 2018.

Figure 6.1: Gearing of select European fixed-line incumbents



Source: Thomson Reuters; Europe Economics calculations.

Looking at a broader range of companies, there appear to be some persistent differences in the gearing of European fixed-line incumbents. TeliaS and Swisscom have recently been geared at below 30 per cent. By contrast, Deutsche Telekom, KPN, Orange and Telefonica have been geared in between 35 to 50 per cent. Telecom Italia is the only company in pour sample with a gearing value higher than 60 per cent. The average gearing within the sector has ranged between 35 per cent and 45 per cent, and as of December 2018 is around 46 per cent.

Table 6.2: Gearing among European fixed-line operators

	Gearing at Dec-2018	Moody's		Fitch		S&P	
		Rating	*Outlook*	*Rating*	*Outlook*	*Rating*	*Outlook*
Deutsche Telekom	38.2	Baa1	Negative	BBB+	Stable	BBB+	Negative
KPN	35.8	Baa3	Stable	BBB	Stable	BBB-	Positive
Orange	41.6	Baa1	Stable	BBB+	Stable	BBB+	Stable
Telefonica	48.8	Baa3	Stable	BBB	Stable	BBB	Stable
BT	29.5	Baa2	Negative	BBB	Negative	BBB	Negative
Telia	11.7	Baa1	Stable			BBB+	Stable
Swisscom	24.6	A2	Stable			A	Stable
Telecom Italia	61.3	Ba1	Stable	BBB-	Stable	BB+	Positive

Source: Thomson Reuters; Europe Economics calculations.

Most companies' gearing lies within the range of 25 to 50 percent (the exceptions are Telia, with a gearing level of 12 per cent, and Telecom Italia with a high gearing value of over 60 per cent).

6.1.3 Assessment of gearing evidence

Recall that regulatory precedent suggests a range of 30 to 50 per cent, with 40 per cent generally favoured within the range. Most companies' actual gearing levels are the range of 25 to just over 50 per cent. Given the wide range of actual gearing levels, we lean more on precedent in our choice of gearing level. We therefore believe that appropriate notional gearing level for an efficient fixed-line operator would be in the range of 30 to 50 per cent, and we select a point estimate of 40 per cent within this range.

6.2 Equity Beta

6.2.1 Eircom's previous determination

In the 2014 Eircom fixed-line WACC determination, the equity beta was judged to be between 0.67 and 1.00 with a point estimate of 0.83.[25]

6.2.2 Precedent on beta

Table 6.3 contains evidence on unlevered betas used in recent European fixed-line determinations.

Table 6.3: Beta precedent in European fixed-line determination

	Unlevered Beta
Ireland (2008)	0.57
Belgium (2010)	0.50
Portugal (2012)	0.42
France (2013)	0.48
Norway (2013)	0.55
Sweden (2013)	0.46-0.65
ComReg (2014)	0.50
Italy (2015)	0.43
UK (2018)	0.59
Portugal (2018)	0.61
Italy (2018)	0.53

Notes: Equity betas only reported for Portugal, France, and Sweden; asset beta calculated as figure implied by equity beta and gearing for these countries; range for Sweden calculated assuming a 40% gearing. The Italy 2018 figure is from the consultations.
Source: Various regulatory determinations.

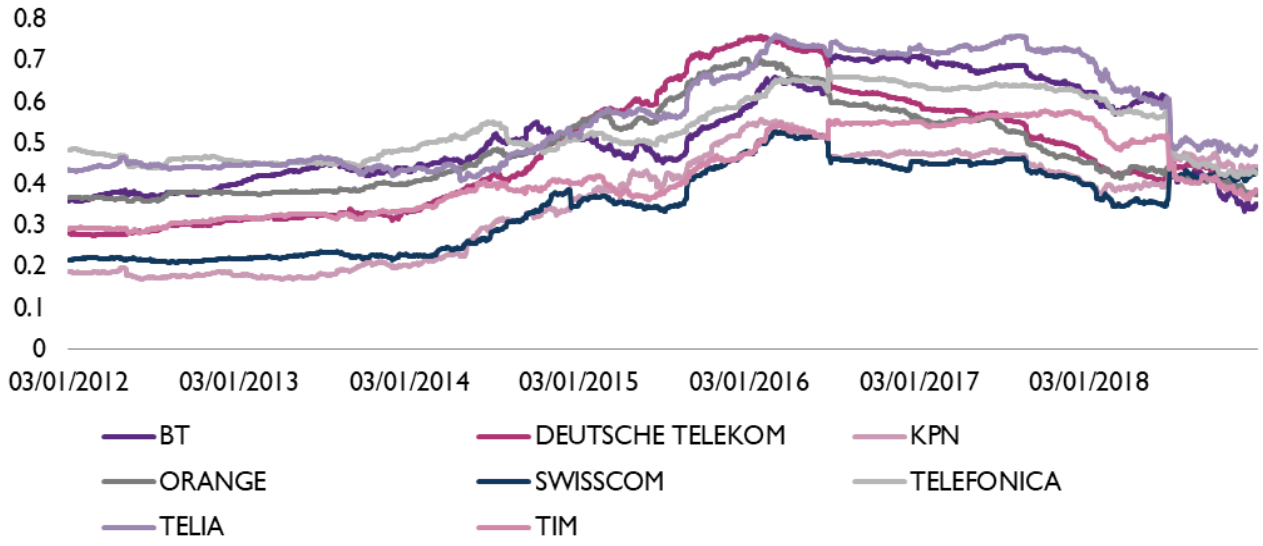
In the 2014 Eircom determination, ComReg settled on a point estimate beta of 0.50. In determinations in other European countries, the point estimate beta has tended to be lower with the exception of the UK (2018), and Portugal (2018). A range of precedent betas based on point estimates gives 0.42 at the low end (Portugal 2012) to 0.61 (Portugal 2018).

[25] https://www.comreg.ie/media/dlm_uploads/2015/12/ComReg14136.pdf

6.2.3 Comparator company betas

Figure 6.2 presents two-year rolling unlevered betas for selected European fixed-line incumbents calculated on the MSCI Europe index. Betas have in general been falling in recent years. We note that in general most observations have fallen between 0.3 and 0.5.

Figure 6.2: Two-year rolling unlevered betas of selected European fixed-line comparators



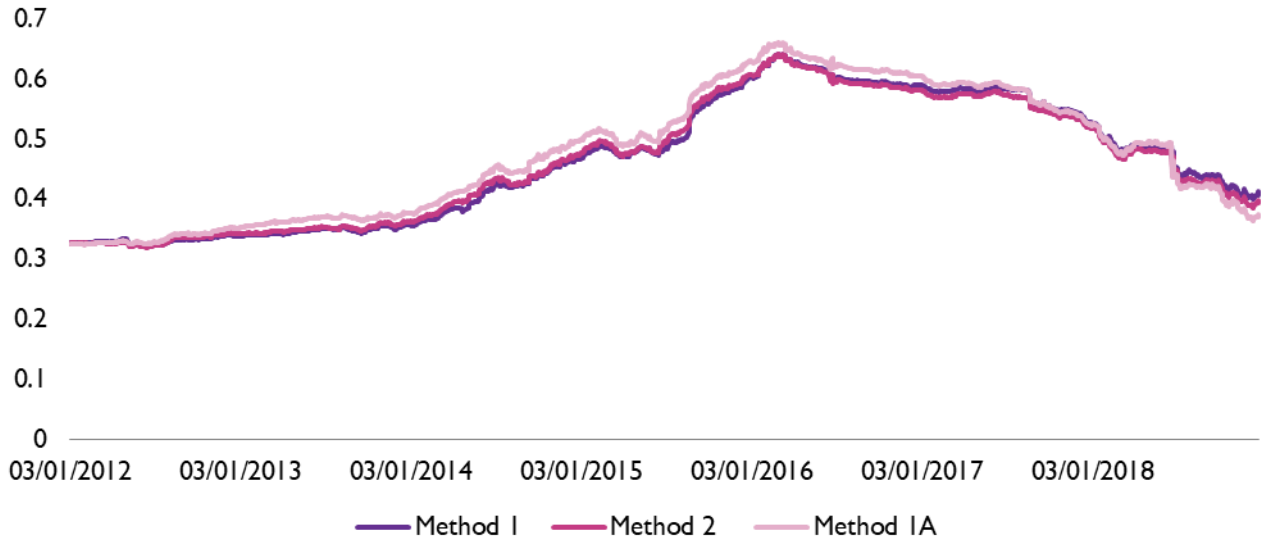
Source: Thomson Reuters; Europe Economics calculations.

We calculate the average asset betas using three methods described below:

- Method 1: Normal Arithmetic Average.
- Method 1A: Weighted Average. Weighted according to the share of fixed lines activities for the company.[26]
- Method 2: Average of the companies whose fixed lines activities dominate the mobile activities.

[26] If there are two companies: Company A has a 50% share of fixed lines in its total revenue and Company B with 25% share of fixed lines in its total revenue. The weighted average would be (50/75)*Asset Beta A + (25/75)*Asset Beta B

Figure 6.3: Average 2 year Asset Beta



Source: Thomson Reuters, Economics calculations.

As expected, the three different averaging techniques give similar estimates. The recent range has been in the region of 0.3 to 0.6. With the most recent range being 0.38 to 0.41.

The overall set of unlevered beta estimates suggest an asset beta approximately in the range of 0.38 to 0.41, the bulk of estimates being in this range. At 40 per cent gearing this corresponds to an equity beta of 0.65-0.7 (rounded to the nearest 0.05).

We consider the midpoint of this range to be a reasonable estimate for the asset beta. Therefore our point estimate for the asset beta is 0.40 which, at 40 per cent gearing corresponds to an equity beta of 0.67.

6.2.4 Assessment of beta evidence and the cost of equity

In assessing the evidence on the unlevered beta, we note the following:

- Regulatory precedent suggests 0.42 to 0.61 is appropriate for a European fixed-line incumbent.
- Market data on listed European fixed-line incumbents suggests a slightly wider range, from 0.3 to 0.5. We note, however, that unusually low outliers may drag down the range.
- The three averaging techniques suggest a range of 0.38 to 0.41.

On the basis of this evidence, we estimate that a range of 0.38 to 0.41 with a point estimate of 0.4 would be appropriate for an efficient fixed-line operator.

6.2.5 Comparison between our recommendations and those obtained following the European Commission's methodology

If one used the beta estimation methodology recommended by the European Commission (as illustrated in detail in Appendix 5), one would obtain an asset beta for the fixed-line sector of 0.5.

6.3 Data sampling and logic for market data

The data sampling techniques is the same described Section 5.3.1, i.e. we have collected data on outstanding bonds for all the fixed-line operators listed in Table 5.1, and we have applied the following criteria for bond selection:

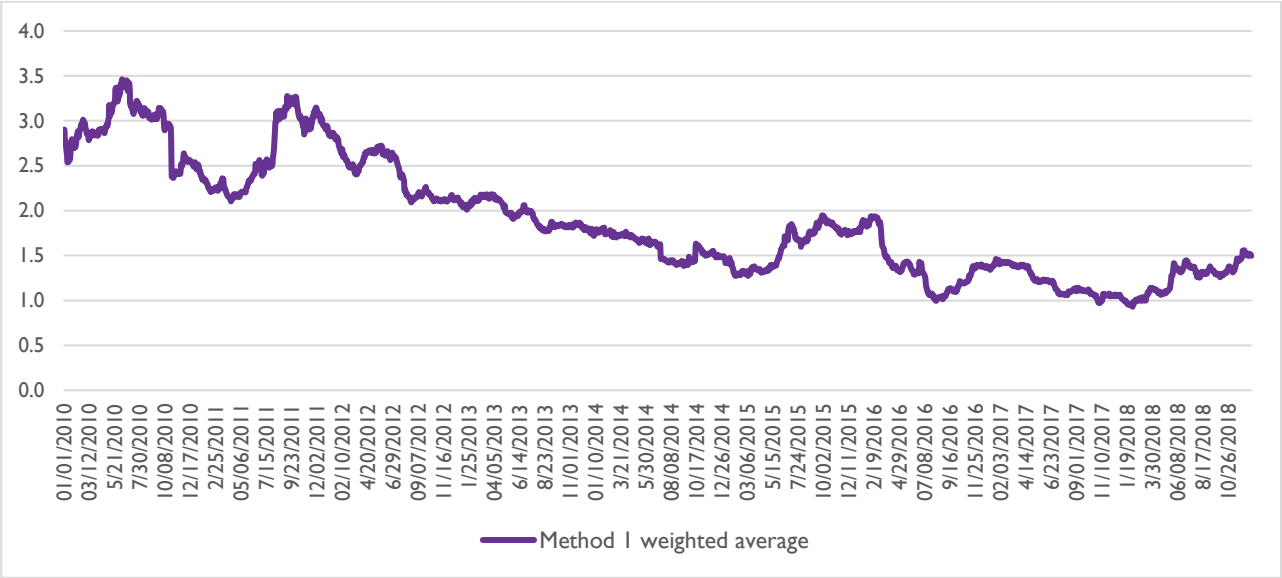
- We considered only bonds that are rated "Baa3" or above by Moody's or "BBB-" or above by S&P.
- We have excluded bonds that are denominated in a foreign (non-domestic) currency.
- We restrict the analysis to those bonds that that have between 7 and 13 years of maturity left.
- We have excluded bonds from Telecom Italia from the analysis.

Following the section criteria illustrated above we are left with bond data for the following fixed-line operators: BT, Deutsche Telekom, KPN, Swisscom, Telefonica..

6.3.1 Debt premium

Figure 6.4 plots the average spread of select fixed-line comparators' bond yields against the appropriate European benchmarks bond between 2010 and 2018. During the timeframe considered, the weighted average debt premium has decreased considerably and as of December 2018 is around 150 bps.

Figure 6.4: Weighted average debt premium (%) of fixed-line operators versus appropriate European benchmarks



Source: Thomson Reuters EIKON; Europe Economics calculations. The average spreads of each fixed line operator for which we have eligible bonds data are reported in the table below.

Table 6.4: Average spread versus the appropriate European benchmark for each company

	Credit Rating	Benchmark	Average spread at December 2018
BT	BBB	10-years UK government bond	1.94%
Deutsche Telekom	BBB+	10-years DE government bond	1.38%
KPN	BBB	10-years DE government bond	1.52%
Swisscom	A	10-years CH government bond	0.71%
Telefonica	BBB	10-years DE government bond	1.80%

6.3.2 Conclusion

Our estimates, obtained using the three different averaging methods previously presented, give us a range for the debt premium over European benchmarks bond between 145 and 165 bps.

Figure 6.5: Averages of debt premia over 10 years European benchmarks

Source: Thomson Reuters EIKON; Europe Economics calculations

Taking into account that our preferred averaging method lies in the lower part of the range above mentioned, our point estimate would be slightly above the lower bound, around 150 bps.

6.3.3 Comparison between our recommendations and those obtained following the European Commission's methodology

If one used the cost of debt methodology recommended by the European Commission (as we illustrate in detail in Appendix 5), one would obtain a debt premium for the mobile sector of 1.30 per cent.

6.4 Overall fixed line WACC

Table 6.5 gives our estimates of the fixed line WACC. Combining the generic parameters estimated previously with the specific parameters estimated in this section, we arrive at a 5.89 per cent nominal vanilla WACC for the fixed-line sector.

Table 6.5: Low, high, and point estimate for the fixed line WACC

	Low	High	Point Estimate
Real risk-free rate	1.70%	2.20%	2.10%
Real ERP	4.25%	4.67%	4.54%
Inflation	1.10%	1.80%	1.30%
Nominal risk-free rate	2.82%	4.04%	3.43%
Nominal ERP	4.30%	4.75%	4.60%
Unlevered beta	0.38	0.41	0.40
Notional gearing	40%	40%	40%
Notional equity beta	0.63	0.68	0.67
Nominal cost of equity (post-tax)	5.54%	7.29%	6.49%
Tax rate	12.50%	12.50%	12.50%
Nominal cost of equity (pre-tax)	**6.33%**	**8.33%**	**7.42%**
Debt premium	1.45%	1.65%	1.50%
Nominal cost of debt (pre-tax)	**4.27%**	**5.69%**	**4.93%**
Nominal vanilla WACC	**5.03%**	**6.65%**	**5.87%**
Nominal WACC (pre-tax)	**5.51%**	**7.27%**	**6.42%**

Source: Thomson Reuters, Europe Economics calculations

The nominal pre-tax WACC range is therefore 5.51 to 7.27 per cent, with a point estimate of 6.42 per cent.

7 Broadcasting WACC

This section estimates the specific parameters for Market A (the market for wholesale access to national terrestrial broadcast transmission services) and Market B (the market for wholesale access to DTT Multiplexing Services).[27] Collectively we refer to these markets as "broadcasting" for short. We begin with discussing issues relevant to the two broadcasting markets, including our view on how to analyse Market A and Market B together, the recent debate about the viability of a commercial DTT television platform in Ireland, and differences among regulators in their approach to regulating DTT broadcasting.

Following that, we will assess evidence on gearing, equity betas, and the debt premium used in calculating the broadcasting WACC, using evidence primarily from regulatory precedent and comparator industries. Finally, we present our range and point estimate for the broadcasting industry WACC.

7.1 The WACC in Market A and Market B

In 2013, ComReg identified two operators as having significant market power ("SMP") in DTT services markets. ComReg describes the first market, Market A, as a "wholesale market where an upstream terrestrial transmission network provider supplies a transmission and distribution service via its towers / masts infrastructure and relevant associated facilities (including transmission and distribution equipment, buildings etc.) in order to enable the broadcast of national analogue terrestrial radio signals to end-users and the broadcast by a 'Multiplex Operator' of its digital terrestrial broadcasting signals to end-users."[28] 2rn (formerly RTÉNL) operates in this market. 2rn is a fully-owned subsidiary of RTÉ, the state-owned public broadcaster, and operates at arm's length from the parent organisation.

The second market, Market B, is a "wholesale market which operates downstream from Market A, whereby a DTT Multiplex Operator, using wholesale inputs purchased (or self-supplied) in Market A, combined with carriage on its own DTT multiplex supplies a managed digital multiplexing service to terrestrial downstream TV broadcasters enabling the transmission of their DTT broadcasting signals to end-users."[29] RTÉ operates in this market.

ComReg determined that Market A and Market B should be subject to price controls and that the WACC would be a key input into determining the relevant controls. From this view, a WACC for both Market A and Market B is necessary to calculate the appropriate price control in each market. It is our view that, for regulatory purposes, the same WACC should be applied to both Market A and Market B. This is due to a number of reasons.

First, there is not a sufficiently robust basis upon which to estimate the WACCs separately. Several companies are involved both in running DTT transmission assets (Market A) and DTT multiplexing (Market B). Some European operators, such as Arqiva in the UK or Teracom in Sweden, operate in both markets outside of Ireland. For example, in their 2005 SMP decision PTS Sweden noted that their SMP investigation and subsequent regulatory decisions related to access to the DTT broadcasting network, which encompassed

[27] For background on Market A, Market B, and the reasoning behind subjecting them to price regulation, see: ComReg (2013) "Market review: broadcasting transmission services in Ireland" ComReg Document No 13/71.
[28] Ibid., p 4.
[29] Ibid., p 4.

both access to the transmission assets and, where necessary, to the DTT multiplex.[30] A single WACC was estimated for broadcasting and subsequently applied.

Furthermore, companies that only operate the DTT multiplex and are not involved in operating the transmission assets are highly varied and, to our knowledge, no pure play DTT multiplex operators exist. Indeed, many DTT multiplex operator comparators suffer from the same analytical shortcomings as RTÉ. For some operators, no market data is available since they are statutory corporations (e.g. BBC in the UK) or privately owned (e.g. TDF Group in France). Among those DTT multiplexers that are publicly listed, DTT multiplexing is a small part of their very diverse television or telecommunications operations (e.g. ITV in the UK or Portugal Telecom in Portugal). In other cases, DTT multiplexes are operated by diversified consortia composed of companies operating in several different industries (e.g. RiksTV in Norway).[31]

Finally, we see no strong conceptual reason to believe that exposure to changes in the larger economy would impact a DTT transmission assets operator and a DTT multiplexer differently. The WACC is calculated on the basis of systematic risk only. For there to be a difference in the WACC, there would need to be a difference in exposure to systematic risk between DTT transmission assets operators and DTT multiplexers. It is intuitive to think that demand for DTT transmission asset services (Market A) and the ability to transmit via those assets using the multiplex (Market B) are highly correlated and respond to systematic risks in similar ways. What is more, as the operators in the two markets are wholesalers with the similar end-customers,[32] we see no strong reason to think that costs and thus supply would respond differently to systematic risks either.[33]

Our view is that, whilst there could in principle be some difference between the WACCs for Markets A and B, any such difference is likely to be small and we believe it very likely that, given the limitations there are on available data in this sector, any differences are in practice likely to be much lower than the estimation uncertainties and the best-estimates for Markets A and B are likely to be the same.

7.2 Regulatory Approaches to Broadcasting

Regulatory precedent on broadcasting is scant. In the UK, Ofcom gave guidance on the WACC for broadcasting transmission assets in 2006[34], which was subsequently deemed as still appropriate by the Office of the Adjudicator – Broadcast Transmission Services in 2010.[35] On company-specific parameters, Ofcom received evidence arguing for figures that would either increase or decrease the WACC, drawing on qualitative evidence about the level of systematic risk a broadcaster faces and comparison with other industries. In the end, Ofcom settled on an equity beta of 1, which is the beta for a firm with the market level of risk, given the absence of robust arguments to deviate from the market average. For the debt premium and gearing, Ofcom relied on evidence from a then-recent BT determination and comparisons with other industries. In short, Ofcom was hesitant to come down strongly on either side of the arguments

[30] Swedish Post and Telecom Authority (2005) "Ärende SE/2005/0188: Programutsändningstjänster i Sverige Yttrande enligt artikel 7.3 i direktivet 2002/21/EG [Case SE/2005/0188: Programs Broadcast Services in Sweden Opinion under Article 7.3 of Directive 2002/21/EC]".

[31] This last example is particularly pertinent in the Irish case, as the three bidders for Irish DTT multiplexing licenses in 2008 were all consortia with members from different industries. See: Oliver & Ohlbaum Associates (2013) "Prospects for commercial digital terrestrial television in the Republic of Ireland", p 13.

[32] We note that they do not have the exact same customer base. 2rn's customers include analogue radio stations and mobile phone companies in addition to RTÉ's Market B customers.

[33] This is especially true considering that the revenues of Market A and Market B are fixed, with the final charge being the revenue amount divided equally among the number of customers. Were costs to increase, the charge structure allows for a high degree of cost pass-through and low revenue risk.

[34] Ofcom (2006) "Terrestrial transmission market review".

[35] Office of the Adjudicator – Broadcast Transmission Services (2010) "Report for the period 1 July–30 September 2010".

submitted to it, and instead opted to select cost of capital parameters from either the market average or broadly appropriate ranges.

PTS, the Swedish telecommunications regulator, was more willing to be informed by comparator industry analysis. In their 2007 and 2010 broadcasting WACC determination, ranges for the beta, debt premium, and gearing were all determined via comparison with other industries. Most straightforward comparisons were with tower and mast operators, of which there were few publicly listed. Similarities between broadcasting and other network or "network-like" industries led PTS to consider integrated telecommunications companies and network utilities, such as gas and electricity distribution. As we show below, PTS used equity betas outside of 1 for their WACC calculations and gearing and debt premia informed heavily by comparisons with other industries. In other words, the Swedish regulator has been more willing than Ofcom in the UK to set the WACC using comparisons with other industries.

In estimating the WACC for Irish broadcasting, we rely on past regulatory precedent and evidence from comparisons with tower and mast companies, integrated telecommunications companies, and network utility companies. We rely most on evidence from tower and mast companies, as we feel these are the most intuitive comparators to broadcasting. Nonetheless, we arrive at our final ranges and point estimates by considering the evidence in the round.

7.3 Gearing

7.3.1 Use of notional versus actual gearing

As with mobile and fixed line services, we assess the appropriate level of notional gearing for the broadcasting sector by examining regulatory precedent and the gearing levels of appropriate comparator companies.

7.3.2 Precedent on gearing

The most relevant regulatory precedent comes from determinations in the UK and Sweden. Notional gearing in these determinations, covering years from 2006 to 2015, is shown in the table below.

Table 7.1: Notional gearing in European broadcasting regulatory precedent

Country	Regulated Entity	Year	Gearing Level
UK*	Arqiva	2015	35
Sweden	Teracom	2010	30-50
UK	Arqiva	2009	35
Sweden	Teracom	2007	25-55
UK	Arqiva	2006	35

Source: Relevant regulator reports. *Report by PLUM for the Office of the Adjudicator - Broadcast Transmission Services

In the UK, PLUM published a report for the Office of the Adjudicator[36] in 2015 for the WACC for broadcast transmission for the period 2015-2025. PLUM looked at regulatory precedent and gearing levels of listed broadcasting companies to come up with a 35 per cent gearing level for Arqiva. Ofcom in 2009 took into account BT's gearing (30 per cent), and the gearing of gearing of Arqiva and Crown Castle (approximately 20%), and utility operators (50 per cent). Ofcom argued that notional gearing of 35 per cent was appropriate for broadcasting.

In Sweden, PTS Sweden considered evidence from tower companies, integrated telecoms, and utilities. In its 2010 determination it argued that the range for gearing had narrowed.

[36] https://plumconsulting.co.uk/estimated-cost-capital-broadcast-transmission-2015-2025/

Gearing in regulatory precedent has therefore ranged between 25 and 55 per cent.

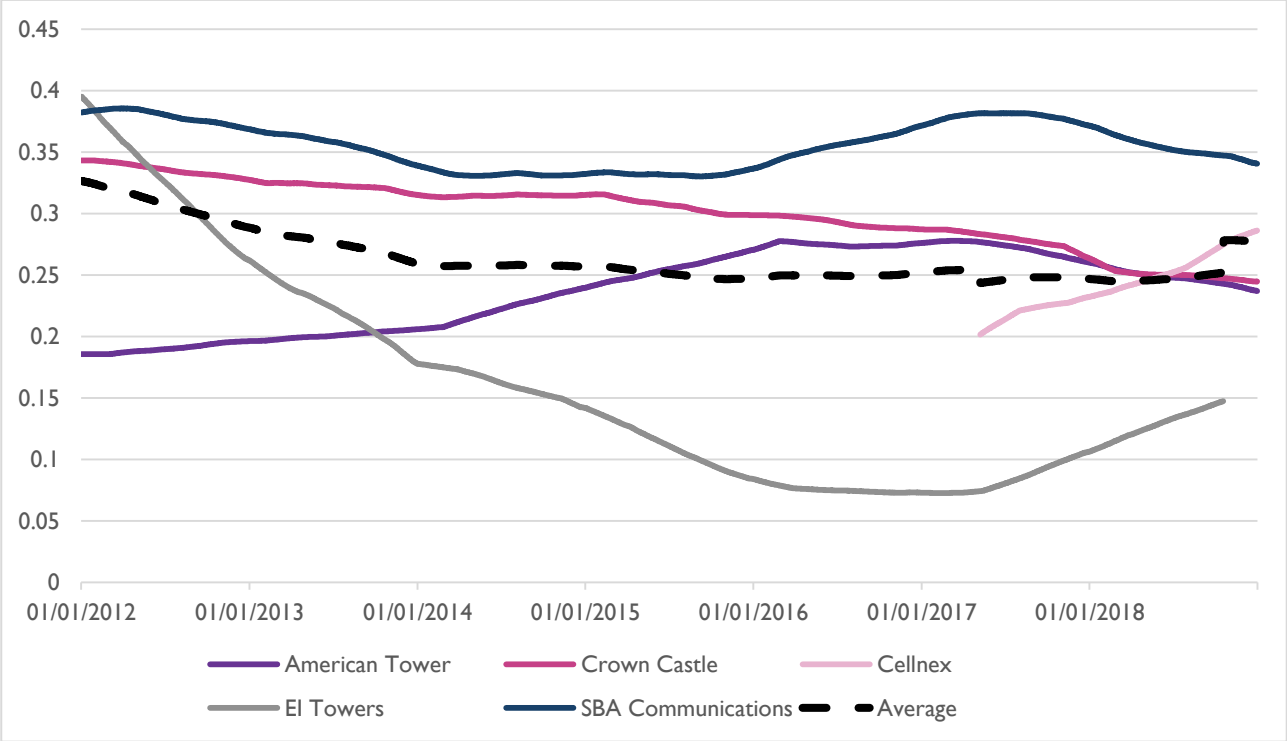
7.3.3 Gearing for comparator companies

The most clearly relevant comparator companies for the broadcasting control are those operating in the tower and mast sector. Companies for which market data are available are:

- American Tower (United States).
- SBA Communications (United States).
- EI Tower (Italy)[37].
- Crown Castle (United States).
- Cellnex (Spain).

Gearing (on the basis of net debt to enterprise value) is shown in the figure below.

Table 7.2: Tower and mast company gearing, 2012-2018



Source: Thomson Reuters, Europe Economics calculations.

With the exception of EI Tower, which has experienced gearing levels below ten percent, gearing levels among tower and mast companies, have tended to range between 20 and 40 per cent. As we can see from the Table below, as of December 2018 the gearing of comparators is in between 24 and 39 per cent, and the gearing mong companies with an investment grade rating is in the region of 25 per cent.

[37] EI Tower was delisted in 19 October 2018. However, since the de-listing date is relatively close the cut-off date we use for the analysis (i.e. 31-December 2018), we have decided not to exclude it from the set of relevant comparators.

Table 7.3: Broadcast company gearing and credit ratings

Company	Gearing	Moody's		Fitch		S&P	
		Rating	*Outlook*	*Rating*	*Outlook*	*Rating*	*Outlook*
American Tower Corp	24%	Baa3	Stable	BBB	Stable	BBB-	Stable
Cellnex	29%	-	-	BBB-	Negative	BB+	Stable
SBA Communications	34%	-	-	-	-	BB	Stable
Crown Castle	24%	Baa3	Stable	BBB	Stable	BBB-	Stable

Source: Thomson Reuters, Europe Economics calculations

7.3.4 Assessment of gearing evidence

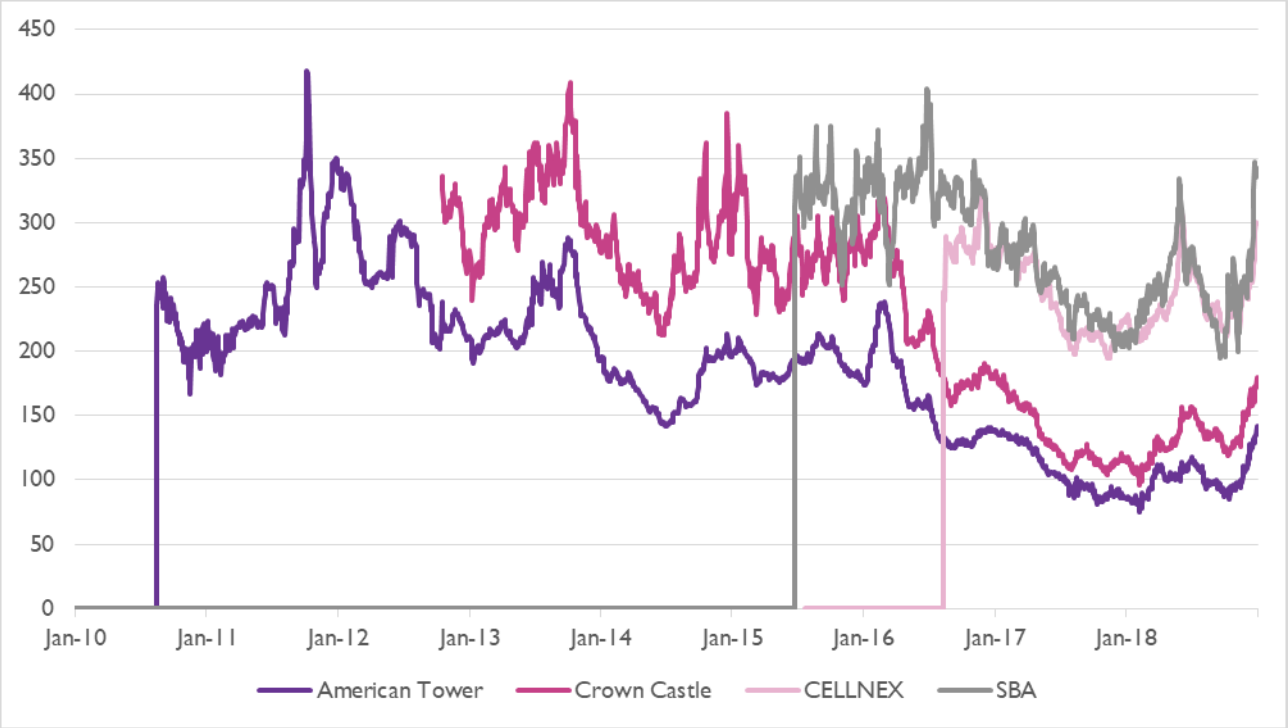
Regulatory precedents in the broadcasting sector suggest an appropriate range for gearing of 35-55.. However, we note that the gearing of the most appropriate comparators is in the range of 20 to 30 per cent. We place most weight on the gearing of these comparator companies. Further, of these comparators, we note that those with investment grade ratings have gearing of less than 30 per cent, whereas the two without investment grade ratings have gearing levels close to or in in excess of 30 per cent. This suggests that an appropriate level of gearing to maintain an investment grade credit rating would be less than the 30 per cent. Balancing these considerations in our choice of notional gearing, we believe it is appropriate to shade down from the lower end of regulatory precedent, and propose notional gearing of 25 per cent.

7.4 Debt Premium

7.4.1 Comparator companies debt premia

We have examined data on spreads for American Tower, Crown Castle, Cellnex and SBA Communications. For Cellnex and SBA Communication spreads over national government bond are available only back to 2016 and 2015, repsectively, so we have limited data on how spreads have evolved over time. Moreover, data for these two company shows that their spread are way above the values we get for American Tower and Crown Castle, as we can see from Figure 7.1. Looking at the last available data for Cellnex and SBA, these two companies have debt premia values above 300 bps, while American Tower and Crown Castle have debt premia below 200 bps. Moreover, their investment grade is lower than American Tower and Crown Castle ones, suggesting that we may not be relevant comparators for the purpose of estimating the debt premium.

Figure 7.1: Broadcasting companies debt premia



Source: Thomson Reuters EIKON, Europe Economics calculations.

We report below the debt premium as of end 2018 and the credit ratings for each company considered

Table 7.4: Debt premia and credit rating for broadcasting companies

Company	Ratings	Debt Premium end 2018
American Tower	BBB	142
Crown Castle	BBB	180
Cellnex	BBB-	299
SBA	B	342

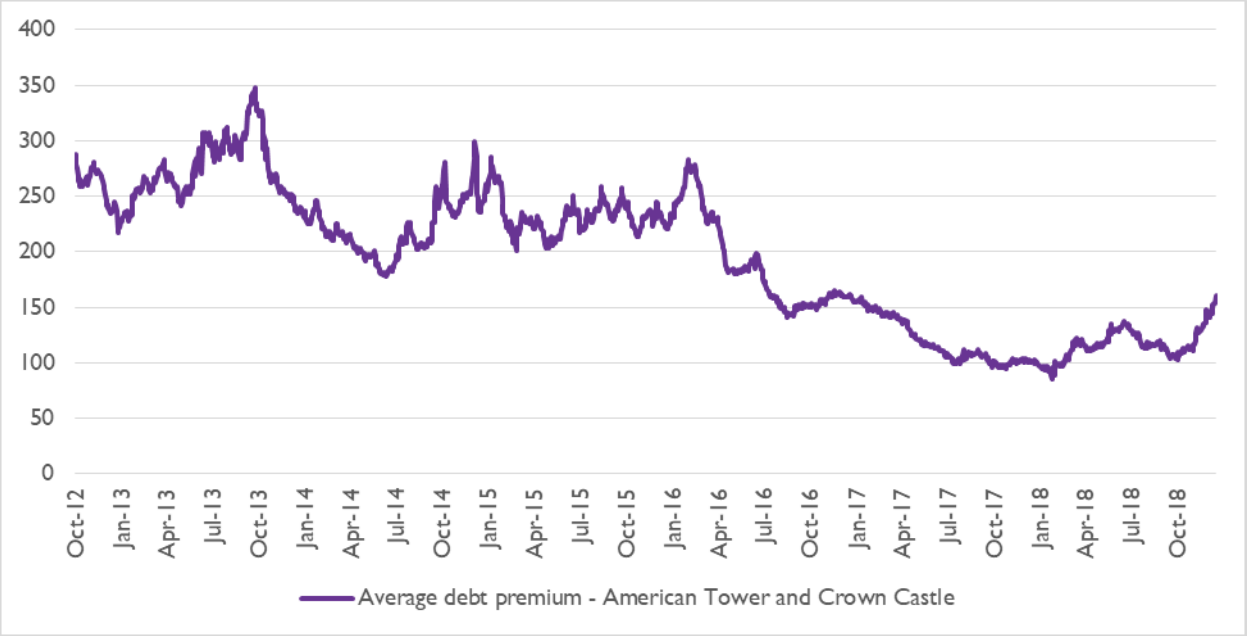
Source: Thomson Reuters EIKON

Debt premia among these companies have varied. All the bonds available for American Tower and Crown Castle have the same investment grade (BBB). Bonds for the first company presents debt premia between 75 and 155 bps, while bonds for Crown Castle have Debt premia ranging between 150 bps and 175 bps. Cellnex has debt premia between 195 bps and 275 bps, while SBA Telecommunications presents spreads between 300 and 370 bps.

7.4.2 Broadcasting debt premia

As set out in the previous section, we will consider only American Tower and Crown Castle. Therefore, in Figure 7.2 we report the average debt premium between these two companies.

Figure 7.2: Average debt premium



Source: Thomson Reuters EIKON, Europe Economics calculations.

After an initial, more volatile period, the average between American Tower and Crown Castle debt premium steadily decreased, stabilising then at around 160 bps.

7.4.3 Broadcasting debt premium

Our analysis suggest that the range for relevant broadcasting companies' debt premium would be between 140 and 180 bps. The mid-point of that range would be 160 bps, but we note that the main comparators are US firms rather than Eurozone firms, meaning that there is a lower weight to the comparators than for mobile and fixed line services. Furthermore, we note that the 150 bps we have concluded for in the other two sectors lies comfortably within the 140 to 180bps range but below its naïve midpoint. We believe debt premiums within the broad Irish communications sector are at least as relevant a precedent as those for US broadcast sector firms. Accordingly, we take 150 bps as our working assumption.

7.4.4 Comparison between our recommendations and those obtained following the European Commission's methodology

If one used the cost of debt methodology recommended by the European Commission (as illustrated in detail in Appendix 5), one woud obtain a debt premium for the broadcasting sector of 1.76 per cent.

7.5 Equity Beta

7.5.1 Precedent on beta

Regulatory precedent on broadcasting debt premia is shown in the table below.

Table 7.5: Precedent on broadcasting beta (unlevered)

Country	Regulated Entity	Year	Unlevered Beta
Sweden	Teracom	2010	0.62
UK	Arqiva	2009	0.65*
Sweden	Teracom	2007	0.49-0.54*
UK	Arqiva	2006	0.65*

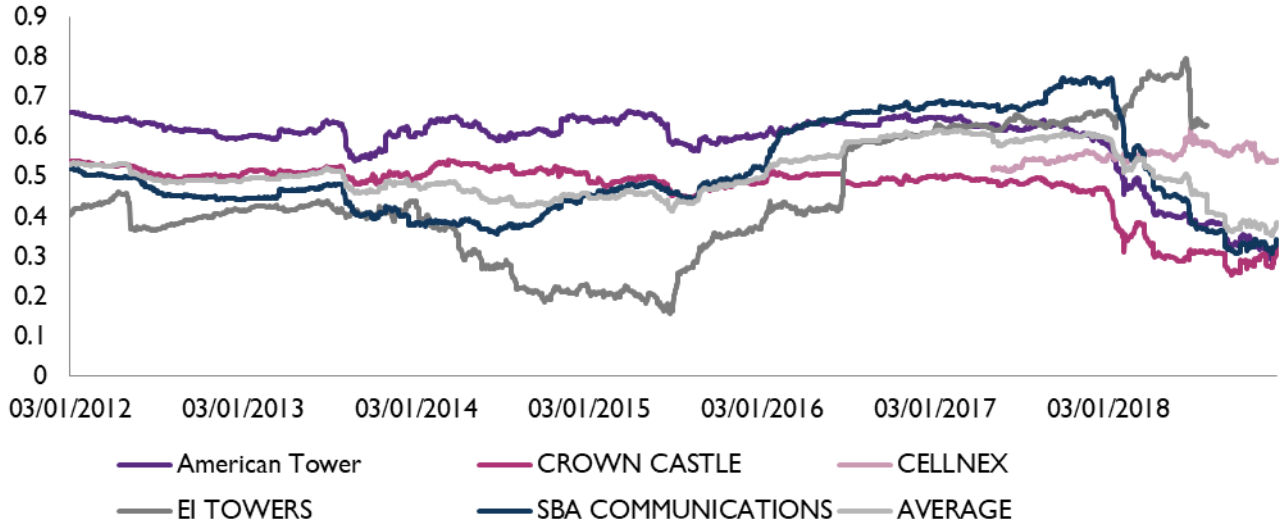
* Calculated from equity beta and gearing on assumption of zero debt beta.
Source: relevant regulator reports.

Precedent on beta is mixed. In its determinations for the UK broadcasting sector in 2009 and 2006, Ofcom provided no assessment of asset beta. Instead, they used the equity beta of the market as a whole, which is by definition 1. Given their gearing level of 35 per cent, this produces an asset beta of 0.65. Sweden, on the other hand, used comparator analysis to determine an appropriate beta. In Sweden, PTS Sweden, gave an equity beta range of 0.72 to 1.09 in 2007, which implies an asset beta of 0.49 to 0.54 under assumed gearing levels. In 2010, gave an asset beta of 0.62 based on comparison of other sector's asset betas. Asset betas in regulatory precedent have therefore varied from 0.49 to 0.65.

7.5.2 Comparator industry betas

We examine unlevered betas for the tower and mast sector, which we feel are the most relevant comparator companies for the broadcasting control. Two year unlevered betas for these companies are shown in the figure below.

Figure 7.3: Two year asset betas for Tower and Mast companies



Source: Thomson Reuters and Europe Economics calculations.

Two year betas among tower and masts companies were generally higher at the start of 2018 but have declined since. The most recent evidence suggests a range of approximately 0.30-0.50.

7.5.3 Assessment of beta evidence

Regulatory precedent suggests an unlevered beta range of 0.49-0.65, with most recent precedent being in the upper part of this range. However, we note that two year unlevered beta estimates suggest a reduction in beta since 2012, with a current range of around 0.30-0.50-, which is a similar range to fixed-line telecoms. Our overall range for unlevered beta is therefore 0.30-0.50, as suggested by the two year beta estimates.

Our recommended unlevered beta for broadcasting is the mid-point of this range 0.40. At notional gearing of 25 per cent, this equates to an equity beta range of 0.40-0.67, with a point estimate of 0.53.

7.5.4 Comparison between our recommendations and those obtained following the European Commission's methodology

If one used the beta estimation methodology recommended by the European Commission (as illustrated in detail in Appendix 5), one would obtain an asset beta for the broadcasting e sector of 0.43.

7.6 Overall Broadcasting WACC

The table below shows our estimate of the overall WACC for broadcasting under Approach A.

Table 7.6: Low high and point estimate for the broadcasting sector

	Low	High	Point Estimate
Real risk-free rate	1.70%	2.20%	2.10%
Real ERP	4.25%	4.67%	4.54%
Inflation	1.10%	1.80%	1.30%
Nominal risk-free rate	2.82%	4.04%	3.43%
Nominal ERP	4.30%	4.75%	4.60%
Unlevered beta	0.30	0.50	0.40
Notional gearing	25%	25%	25%
Notional equity beta	0.40	0.67	0.53
Nominal cost of equity (post-tax)	4.54%	7.21%	5.88%
Tax rate	12.50%	12.50%	12.50%
Nominal cost of equity (pre-tax)	**5.19%**	**8.24%**	**6.72%**
Debt premium	1.40%	1.80%	1.50%
Nominal cost of debt (pre-tax)	**4.22%**	**5.84%**	**4.93%**
Nominal vanilla WACC	**4.46%**	**6.86%**	**5.64%**
Nominal WACC (pre-tax)	**4.94%**	**7.64%**	**6.27%**

Source: Thomson Reuters, Europe Economics calculations

8 Comparison of Overall Costs of Equity and WACCs, Evolution Through Time and Aiming Up

8.1 Pre-tax WACCs

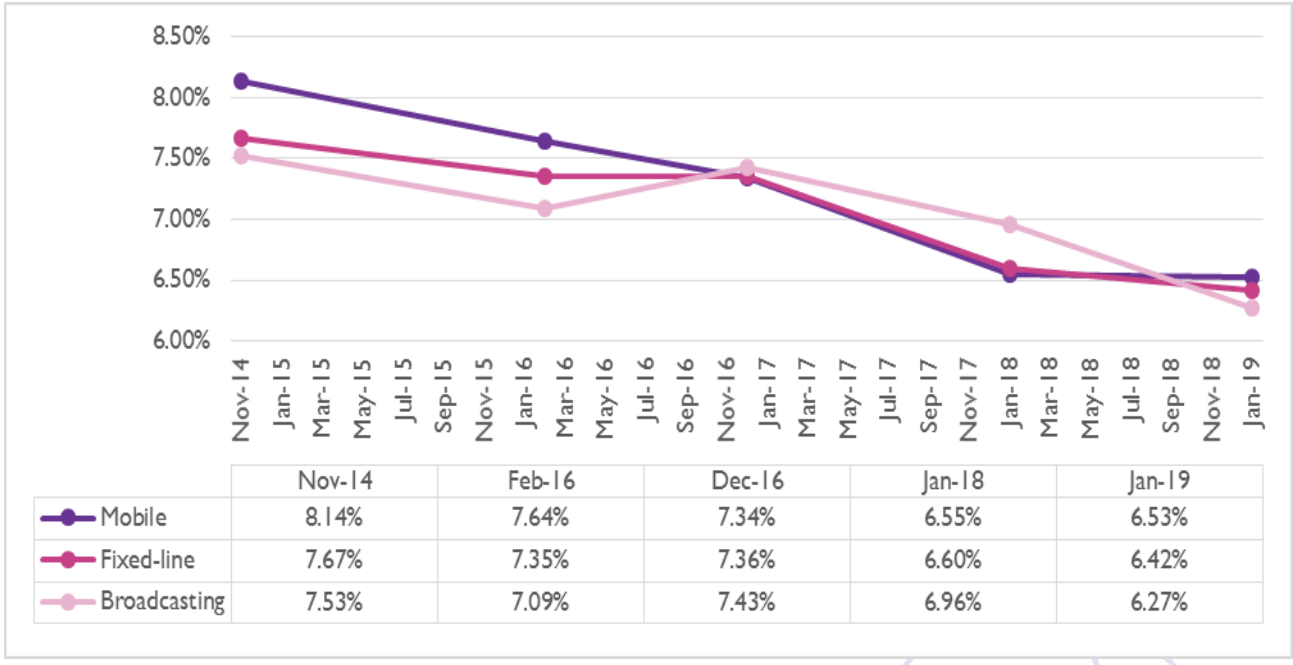
The following table reports our point estimates for nominal costs of equity and nominal pre-tax WACC with the 2014 results. The 2014 WACC estimates and the subsequent updates are illustrated in Figure 1.1. More detailed breakdowns, including ranges, are available in the relevant sections. We can see that whilst the pre-tax WACCs are down for all sectors compared with 2014, almost all of that change was already in place in the parameter updates, especially the shift between December 2016 and January 2018.

Table 8.1: Pre-tax WACCs

	Mobile	Fixed	Broadcasting
Pre-tax cost of equity	7.39%	7.42%	6.72%
Cost of debt	4.93%	4.93%	4.93%
Pre-tax WACC	6.53%	6.42%	6.27%
Pre-tax WACC (Nov-2014)*	8.14%	7.67%	7.53%

Notes: * For consistency, the 2014 and updates figures quoted here are the pre-aimed-up figures.

Figure 8.1 Evolution of the WACC since 2014



	Nov-14	Feb-16	Dec-16	Jan-18	Jan-19
Mobile	8.14%	7.64%	7.34%	6.55%	6.53%
Fixed-line	7.67%	7.35%	7.36%	6.60%	6.42%
Broadcasting	7.53%	7.09%	7.43%	6.96%	6.27%

Notes: * For consistency, the 2014 and updates figures quoted here are the pre-aimed-up figures.

8.1.1 Remark on convergence

A striking feature of our findings here is the degree of convergence in asset betas between fixed line, mobile and broadcasting in recent years. Some convergence would, perhaps, have been expected given the drift to telecoms companies providing packages with fixed line, broadband and television, the acquisition of mobile companies by fixed line providers and the construction of fixed line infrastructure by companies that previously focused on mobile. But, nonetheless, the very high degree of convergence here is perhaps even greater than would have been expected. It could, of course, be merely coincidence that they happen to be so similar at the time of our analysis and they may diverge again, even in a few months' time.

8.2 Aiming up

In 2014 ComReg "aimed up" on its central WACC estimates. Choosing a determined value for the WACC that is above the regulator's expected value for the WACC has been standard practice for regulators for many years, across many regulated sectors and in particular in the communications sector, both in Europe and outside. The process by which this is done has often been implicit — via the choice of a "conservative" estimate of a particular parameter such as the beta or the equity risk premium. In other situations it is done by choosing, as a point estimate, a value above the mid-point of quoted range for the WACC as a whole or some key building block thereof.

Wholly implicit conservativeness is not straightforward to evidence, but the practice of choosing a point estimate above the mid-point can be seen in a number of determinations. How regulators choose a point estimate from within a range was explored by the consultancy "Economic Insights" in a recent (June 2014) report for the New Zealand Commerce Commission ("*Regulatory Precedents for Setting the WACC within a Range*"). Of 53 decisions reviewed in that document, 35 involved choices of the point determination of the WACC at above the mid-point of the quoted range. The authors remarked that, for those cases where the point estimate used of the WACC is not explicitly above the mid-point of the range, "*This often reflects adopting a conservative view of the market risk premium and equity beta that are used in the Capital Asset Pricing Model (CAPM) for determining the return on equity, where 'conservative' means erring on the high side.*"

The justification for such conservativeness was set out by the UK regulator Ofcom in its 2005 methodological paper "Ofcom's approach to risk in the assessment of the cost of capital", January 2005.[38] Ofcom stated: "Traditionally, Ofcom has considered that the downside risk associated with taking too low a value for the ERP (discouraging discretionary investment) is more detrimental to the interests of consumers than taking too high a value (leading to higher prices to customers) and has tended to the higher end of the possible range. Having reviewed its approach in this area, Ofcom remains of this view".[39] We note that Ofcom's justification here is framed in terms of balancing the long-term interests of consumers (in obtaining high quality and innovative products supported by investment) with their shorter-term objectives (in paying the lowest current price) rather than in terms of a trade-off between the interests of consumers and those of investors. It should perhaps be borne in mind that this justification appears more straightforwardly applicable to the regulation of retail services than wholesale access. When there is a wholesale access purchaser, a WACC and hence price that is too high means that the provider of retail services to consumers loses profits. So in such a case the balance of advantage of aiming up will depend upon the balance of consumer-affecting

[38] See paragraphs 1.13, 4.28, and 4.33 of http://stakeholders.ofcom.org.uk/binaries/consultations/cost_capital/summary/cost_capital.pdf

[39] Note also that at *ibid* paragraph 4.33 Ofcom again confirms that it picks points above the mid-point of its ranges: "By proposing values that are towards the upper end of a reasonable range…". This methodological position was confirmed in its Final Statement of August 2005 — See paragraph 4.73 of http://stakeholders.ofcom.org.uk/binaries/consultations/cost_capital2/statement/final.pdf

innovation between that occurring at the wholesale or infrastructure levels and that occurring at the retail product level.

That caveat notwithstanding, Europe Economics has argued that, since all regulators aim up, it would be better to do so via some explicit procedure that ensured that the degree of aiming up was transparent and that the regulator did not aim up by more than is required to meet its regulatory objectives. The aiming up procedure Europe Economics proposes is not intended to result in regulators (e.g. in this case, ComReg) making a final determination figure that was higher than that regulator would have chosen absent aiming up. If anything, by making the aiming up procedure systematic the objective is to reduce the degree of aiming up needed by ensuring that no more is done than is required to meet the relevant regulatory objectives. Furthermore, by making the aiming-up process explicit, there is also the option of aiming up by zero or aiming down, if these seem appropriate (e.g. regulatory sometimes aim down when there is a desire to smooth WACCs over multiple price reviews and the WACC at the previous review is now regarded as having been excessively generous).

In technical terms, the approach we adopt to making the degree of aiming up explicit is to use Monte Carlo modelling. More precisely, we treat the size of the ranges we use for each parameter as the size of a two-standard-deviation spread, and then select parameters from a normal distribution, with a mean of our point estimate and a standard deviation half the width of the range. When we run such a selection process 1,000 times we produce a proxy distribution, enabling us to aim up to any given percentile (where the 50th percentile would be the pre-aiming-up point estimate).

More specifically in this case, if we were to aim up the results by one standard deviation they would be elevated by around 25-35bps. We can see the exact figures per market in the table below. It is perhaps worth noting that the aim-up amount is higher for broadcasting, reflecting the greater range particularly in the asset beta and the debt premium.

Table 8.2: Pre-tax WACCs, pre and post aiming up

	Mobile	Fixed	Broadcasting
Pre-tax WACC	6.53%	6.42%	6.27%
Aim-up amount	0.24%	0.24%	0.36%
Pre-tax WACC, post aiming up (1 s.d.)	6.77%	6.66%	6.63%

8.3 Evolution of specific parameters since 2014

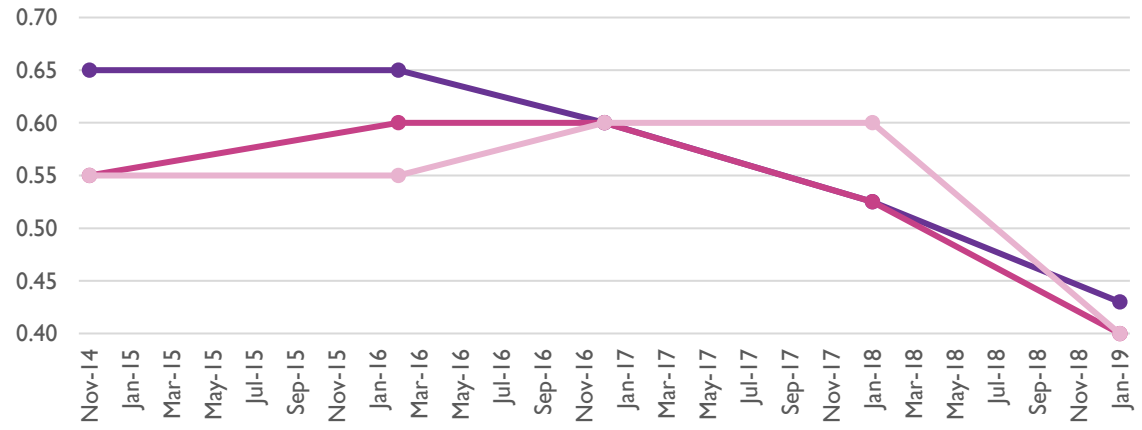
We provide below an illustration of the evolution of the specific WACC parameters (i.e. gearing, asset betas, and debt premium) since the 2014 determination.

8.3.1 Gearing

	Nov-14	Feb-16	Dec-16	Jan-18	Jan-19
Mobile	30%	30%	30%	30%	35%
Fixed-line	40%	40%	40%	40%	40%
Broadcasting	25%	25%	25%	25%	25%

The gearing for the fixed-line and broadcasting sector has not changed. The gearing for the mobile sector has increased (from 30 per cent in 2014 to 35 per cent in 2019). This increase reflects changes in gearing levels for the only pure-play mobile comparator (namely Vodafone) in our set, and a recent regulatory precedent (Ofcom adopted a 35 per cent notional gearing, up from 30 per cent).

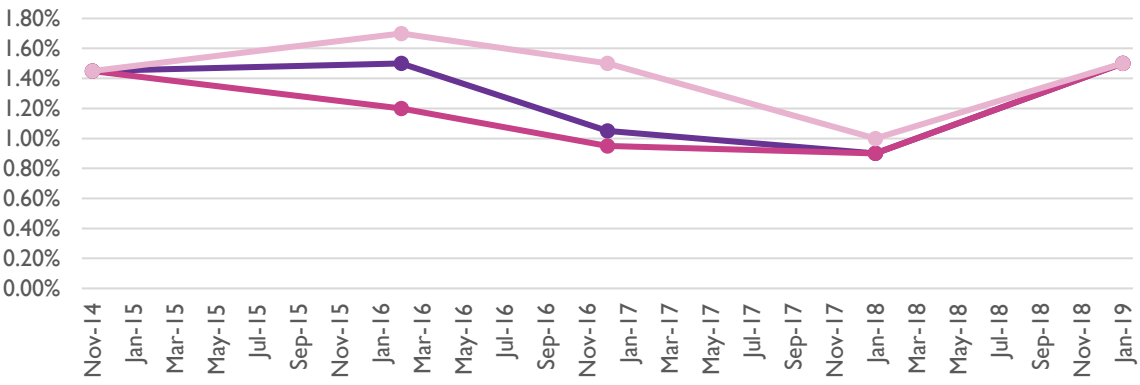
8.3.2 Asset betas



	Nov-14	Feb-16	Dec-16	Jan-18	Jan-19
Mobile	0.65	0.65	0.60	0.53	0.43
Fixed-line	0.55	0.60	0.60	0.53	0.40
Broadcasting	0.55	0.55	0.60	0.60	0.40

The asset betas of all sectors have decreased since 2014, with the mobile sector experiencing the sharpest decrease (from 0.65 in 2014 to 0.40 in 2019).

8.3.3 Debt premium



	Nov-14	Feb-16	Dec-16	Jan-18	Jan-19
Mobile	1.45%	1.50%	1.05%	0.90%	1.50%
Fixed-line	1.45%	1.20%	0.95%	0.90%	1.50%
Broadcasting	1.45%	1.70%	1.50%	1.00%	1.50%

The debt premiums have increased slightly (by 5bps) since 2014 (from 1.45 per cent to 1.50 per cent).

Appendices

Europe Economics

9 Appendix 1: The CAPM-WACC framework

9.1 The Regulatory Cost of Capital

In Weighted Average Cost of Capital (WACC) analysis, companies are regarded as financing their operations through two sources of capital: debt and equity. Each comes at a cost: the cost of debt is the price paid for fixed-payment liabilities, such as bonds and loans, while the cost of equity represents the opportunity costs of employing contributed capital, such as public shares or private equity investment. Given that the level of return to investors is uncertain, companies must compensate investors for the risk that investing in them induces in the investor's portfolio.

In economic regulation (e.g. price- or revenue-capping), the relevant thought experiment is the rate of return at the cost of capital that would occur in a competitive market.

9.2 The WACC-CAPM Approach

The WACC-CAPM (Weighted Average Cost of Capital—Capital Asset Pricing Model) approach has been the standard conceptual framework within which the cost of capital has been examined in Irish regulatory determinations and has generally been favoured in other European jurisdictions (for example, the UK, France).

The CAPM framework was developed in the 1960s, building on the portfolio analysis work of Harry Markowitz, as a way to estimate the value of assets. The key feature of CAPM is that, given its important assumptions concerning the efficiency of financial markets and that investors care only about the mean and variance of returns, investment returns can be expressed as:

$$r = r_f + MRP * \beta_A$$

where r is the (expected) return on the asset, r_f is the return that would be required for a perfectly risk-free asset, MRP is the "market risk premium", that is to say the excess return over the risk-free rate that would be delivered by a notional perfectly diversified portfolio equivalent consisting of all assets ("the whole market"), and β_A is a measure of the correlation between movements in the value of the asset of interest and in the value of assets as a whole. It is also called "beta" (or sometimes the "asset beta").

Under the capital asset pricing model (CAPM) approach, the cost of capital is computed from (a) the average cost of debt for the various forms of debt held by the company, and (b) the cost of equity. This is the return that investors (shareholders and lenders of various types) require in order to invest in the company. The weighted average cost of capital (WACC) is calculated using the following formula:

$$WACC = \left(\frac{E}{(D+E)}\right) * r_E + \left(\frac{D}{(D+E)}\right) * r_D$$

where r_E is the cost of equity, r_D is the cost of debt and E and D are the total values of equity and debt respectively used to determine the level of gearing in the company, and so giving the relative weights between the costs of equity and debt finance.

Within the context of the WACC-CAPM approach, CAPM is generally most useful in estimating the cost of equity.[40] However, the CAPM remains a theory of the prices of assets in general, not simply equity, and the cost of debt may still be usefully thought about in CAPM terms, as we discuss below.

9.3 Cost of Equity

Within the context of the WACC-CAPM approach, CAPM is used to determine the cost of equity, r_E, applying the following equation:

$$r_E = r_f + \beta_E * (TMR - r_f) = r_f + \beta_E * MRP$$

- r_f is the return on a risk free asset, usually proxied by a measure of the rate on medium to long-term government bonds.
- β_E is the correlation between the risk in company returns and those of the market as a whole, which can be estimated from primary market data.
- *MRP* is the market risk premium, the different between the Total Market Return (TMR) and the risk free rate, an economy-wide parameter. In practice the Total Equity Market Return is usually regarded as a good proxy for the TMR and accordingly the equity risk premium (ERP) is used as a reasonable proxy for the MRP. This depends on the assumption that the equity market is sufficiently diverse to span all risks for the economy as a whole (i.e. any risk can be constructed by creating a portfolio of equities alone).

Thus in the standard CAPM there are three determinants of the expected return on any asset: the return on a riskless asset; the total market return earned by investors as a whole, reflecting systematic risk; and the particular company's exposure to systematic risk. Company specific risks do not enter the cost of capital, as they can, by definition, be diversified away by investors.

9.4 Cost of debt

The cost of debt measures the combination of interest rates charged by banks to the company and the return paid by the company on corporate bonds or other debt instruments. Note that although the cost of debt may also be expressed in CAPM terms, the cost of debt is usually conceived as being made up of a risk free component and a company-specific risk premium.

$$r_D = r_f + debt\ premium$$

Assuming reasonable efficiency in capital markets, the premium on debt from one source should be the same as that on debt from any other source involving the same risk. This principle should apply however complex the particular structure of finance adopted. Since payments on debt are generally fixed (in contrast to the variable returns on equity), "risk" in this context principally means the risk of non-payment.

A key issue to note is that, since payments on debt are fixed but there is some risk of default, the observed return on debt is not necessarily identical to the expected return from holding the debt. For example, supposing that the whole value of a bond is lost on default, the expected return will be:

$$1 + E(r_D) = (1 + r_D) * (1 - p_d)$$

where, p_d is the probability of default. However, the expected return in CAPM terms considers only systematic risk, i.e.:

[40] Due to equity's role within companies' capital structures, there is generally more divergence between observed and required equity returns than is the case for debt.

$$E(r_D) = r_f + \beta_D * MRP$$

Hence, the relationship between the observed return on debt, debt beta and the probability of default can be expressed as follows:

$$r_D = \left(\frac{1 + r_f + MRP * \beta_D}{1 - p_d}\right) - 1$$

Provided that the probability of default is sufficiently low, the observed return will therefore be a reasonably close estimate of the required return. This provides the justification for thinking of the cost of debt in terms of the risk-free rate and a debt premium. However, these considerations should be borne in mind when interpreting observed returns for bonds with a higher probability of default.

9.5 Inflation and Taxation

Depending on the precise form of regulation, the WACC may need to be adjusted for inflation and/or taxation. Taxation represents a cost to a regulated company, and it is a principle of economic regulation that such costs, when efficiently incurred, ought to be recovered by the company in question.

Some regulators, such as Ofwat in the UK, give companies explicit tax allowances in their charges, effectively treating taxation as an operating expense. Other regulators give companies allowed returns on a pre-tax basis, effectively including an allowance for taxation in the return on capital. We note that this is similar to the case for inflation, with some regulators using a real WACC with an index-linked asset base, and others using a nominal WACC without asset base indexation. ComReg's practice has been to use a nominal pre-tax WACC:

$$WACC_{pre-tax} = g * r_D + \left(\frac{1-g}{1-t}\right) * r_e$$

where g is the level of gearing, t is the tax rate, r_D is the pre-tax cost of debt and r_E is the post-tax cost of equity.

For the controls in question, both taxation and inflation will be allowed for within the cost of capital, so we will estimate a nominal pre-tax WACC.

10 Appendix 2: Alternatives to the CAPM

10.1 Alternatives to the CAPM

CAPM has been the dominant tool for the analysis of the cost of capital in regulation in Ireland (and, indeed, the UK). Given this dominance, and in view of the significant regulatory learning costs that would be associated with a change in methodology, we would need very strong reasons to recommend using an alternative model to CAPM. We note that CAPM's use reflects significant advantages over other finance models. It has clear theoretical foundations, which allow for intuitive engagement by non-technical stakeholders. It is also well integrated with the rest of finance theory, for example the Modigliani-Miller theorem can be proved from the CAPM. Moreover, among possible models, none performs better empirically in explaining asset prices in the long run.

Like any model, CAPM is not without criticisms. Some empirical studies from the 1970s to 1990s identified a "small firm effect", with small firms found to have higher returns than predicted by CAPM, and/or a "value effect", with some firms with low book to market value ratios having higher expected returns than predicted by CAPM. The standard way of empirically estimating CAPM assumes that the equities market as a whole is perfectly diversified, whereas in theory under CAPM diversification takes place across all assets, including non-equity assets such as gold and real estate. Further, CAPM does not explicitly account for investor's preferences about the skewness of returns. In view of these considerations, alternative models of the cost of equity to consider whether there is a justification for shifting away from CAPM are discussed below.

10.2 The Fama-French three factor model

Fama and French (1992)[41] and Fama and French (1996)[42] suggested a model for excess returns incorporating firm size and the ratio of book value to market value as explanatory factors in addition to beta. In this model, the empirical equation for the excess return on portfolio j, $Z_j \equiv r_j - r_f$, is given by:

$$Z_j = \beta_j * Z_m + s_j * SMB + h_j * HML + u_j$$

Where s_j is the size of the firm effect, h_j is the size of the ratio of book to market value effect, SMB is the difference between returns on portfolios of small and large stocks, and HML is the difference between returns on portfolios of high and low book-to-market ratios, Z_m is the market portfolio and u_j is the error term for portfolio *j*.

For most regulated companies the effect of using Fama-French instead of CAPM is expected to be small. For an average firm, β_j will be close to 1 (as is the case in the CAPM) while s_j and h_j will be close to zero (since firms are identified in relative terms, the average must be zero). The main impact of the additional factors would therefore be for firms at extremes, or in cases where the effect is to change materially the estimate of β.

The Fama-French model has been popular in the past, but has also been subject to criticism on the grounds of a lack of clear theory as to why the additional factors included should deliver positive premia. Moreover, it has been argued that the fact of having identified that small firms and firms with high book to market ratios have had higher returns than implied by their systematic risk should itself cause asset prices to adjust to

[41] Fama, Eugene F. and French, Kenneth R. (1992) "The cross-section of expected stock returns" *The Journal of Finance,* 47(2), p. 427-465.

[42] Fama, Eugene F. and French, Kenneth R. (1996) "Multifactor explanations of asset pricing anomalies" *The Journal of Finance,* 51(1), p. 55-84.

eliminate this anomaly. Smithers & Co (2006) found only very limited evidence for the existence of the value effect for utilities in the UK.[43]

In recent UK regulatory determinations the Fama-French model has been used to advocate a small company premium to the cost of capital. The theory, evidence and substantial effect (in terms of there being any "small company premium" to the cost of capital) were rejected comprehensively by the UK Competition Commission in the Bristol Water case.[44] The Competition Commission stated that they "do not consider that there is robust UK empirical evidence of small firms being more risky and hence having a higher cost of capital",[45] and that they "consider that the arguments for a higher cost of equity due to small size in itself are weak".[46]

The Fama-French model therefore lacks the clear theoretical foundations of the CAPM, while its empirical basis is less clear. We do not, therefore, believe it would be appropriate to use in place of the CAPM.

10.3 Dividend Growth Model

According to the dividend growth model, the rate of return required to sustain the value of a share is its current yield plus the expected rate of growth in yield. A simple DGM states that the current value of a stock can be expressed as:

$$P_0 = \frac{D_1}{r - g}$$

where P_0 is the current price of the stock, D_1 is the expected next period dividend, r is the required rate of return, and g is the expected constant long-term growth rate of earnings. Solving for r gives the following approximation of the cost of equity:

$$r = \left(\frac{D_1}{P_0}\right) + g$$

This means that the cost of equity is the prospective dividend yield of a stock plus the constant long-term growth rate of dividends. Clearly, this version of the DGM makes the strong assumption that the dividend growth rate will be constant. A multi-stage DGM allows the dividend growth rate to vary between dividend periods (for example, short and long term).

The DGM has strong theoretical foundations (since it is based on valuation of a share as the stream of future dividends expected by investors discounted at the cost of equity) and was for many years the main working tool in US regulatory determinations. The challenge in applying it relates particularly to estimation of the future path of dividends for specific assets expected by investors. Within a multi-stage DGM, analysts' forecasts can be used for the next few years. Thereafter, there are various proxies that could be used for dividend growth for individual assets, ranging from historic trends in dividends to the long-run sustainable growth rate of GDP or trend growth in regulated assets. However, these typically give different answers and therefore often result in wide ranges in estimates from the DGM. As the UK Competition Commission put it in the Bristol Water case: "We… regard the DGM evidence as consistent with a wide range of figures for the cost of… equity".[47]

The DGM therefore shares a strong theoretical basis with the CAPM, though in practice its estimates are less precise than those given by the CAPM. While it would be perfectly possible to pick one's point estimate

[43] "*Report on the cost of Capital*", Smithers & Co (2006), provided to Ofgem.
[44] See Appendix N of http://webarchive.nationalarchives.gov.uk/+/http://www.competition-commission.org.uk/rep_pub/reports/2010/fulltext/558_appendices.pdf
[45] Ibid. Appendix N paragraph 131.
[46] Ibid. Appendix N paragraph 137.
[47] Ibid., paragraph 143.

of the cost of equity within the DGM range, this should be done on the basis of sound theoretical considerations which would include CAPM in any case. We do not therefore believe it would be appropriate to use the DGM in the place of the CAPM as the main basis for estimating the cost of capital for an individual asset.

Nonetheless, the DGM may have a role in providing a basis for estimating the Total Market Return used in the CAPM model, where dividends and dividend expectations are for the whole market rather than individual stocks, and as such more abundantly available and less prone to biases. In this role the DGM functions not as an alternative model to CAPM but as a complement for it. That is a role it has come to play in recent determinations in the UK, and we offer variants of our models below in which it plays that role.[48]

10.4 Residual Income Model

From an accounting perspective, the assets of a company are equal to the sum of the company's liabilities and equity attributable to shareholders. In any one year, the difference between a company's revenues and its expenses (including interest and taxes) is that company's net income. Any net income – or "residual income" – remaining after settling all in-year expenses accrues to equity holders.

The book value of a company's equity is total assets less total liabilities. Book values of assets and liabilities can be measured in various ways, including historical cost, amortised cost, current cost, settlement value, present value, or fair value. Accounting valuations such as these stand in contrast to the market's valuation of a company's equity. The market's valuation of a company's equity is equal to price of a single share in the company multiplied by the number of shares outstanding. The market value of a company's equity would exceed its book value if investors expected strong future returns on equity relative to similar investment opportunities. Alternatively, the company could simply be overvalued.

The total cost of employing equity in financing business operations is equal to the book value of a company's equity multiplied by that company's cost of capital. If equity shares are viewed as a claim on the future cash flows of a company, then the market value of a company's equity can be determined as the discounted cash flows accruing to equity investors over the company's lifetime. This is summarised as follows:

$$Market\ Value\ of\ Equity = BE_0 + \sum_{t=1}^{\infty} \frac{NI_t - K^e * BE_{t-1}}{(1+K^e)^t}$$

where *BE* is the book value of equity, *NI* is net income, and K^e is the cost of equity, all at time t. In other words, the market value of a company is equal to the current book value of equity and the present value of future residual income accruing to equity holders. The latter term is defined as the net income earned in the present period less the cost of employing last period's equity base in business operations, discounted using the cost of equity. This method of valuing a company's equity is known as the residual income model (RIM).

Although it is conceptually similar to the DGM, in practical application it has the advantage of being less reliant upon analyst forecasts. In other words, whereas the DGM back-loads equity value (including terminal values that may be extremely difficult to predict), the RIM model is frontloaded, using information from that part of the equity value that is captured by its current book value. This reduces the extent to which RIM estimates rely on uncertain future parameters. However, it remains the case that the RIM relies on estimates of future parameters, namely future net income and future equity book values. While these can be proxied by using analysts' forecasts and/or applying plausible future growth rates to current values, there remains uncertainty as to the appropriate choices of these inputs. Thus, although the RIM has significant advantages over the

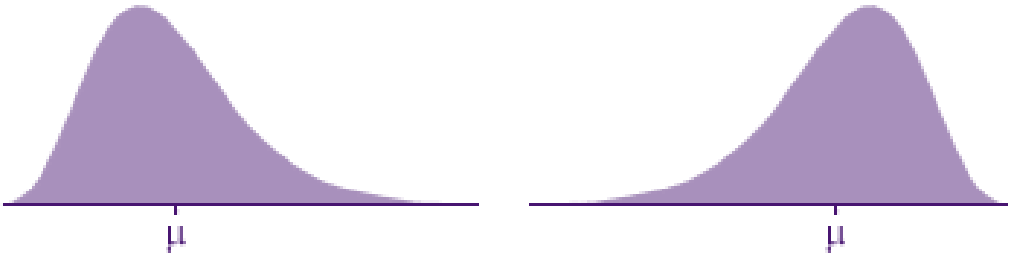
[48] Examples include Ofwat's 2017 "initial view" of the cost of capital of the UK water sector and Ofgem's 2018 RIIO2 determination.

DGM, and retains its strong theoretical foundations, we do not believe in practice that it should replace the CAPM as the primary methodology of estimating the cost of capital.

10.5 Third moment CAPM

The traditional CAPM assumes that investor's investment decisions are based only on the mean and standard deviation of a portfolio of assets. In the third moment CAPM, investors may have preferences over the distribution of returns that go beyond their mean and variance. The third moment of a distribution of returns is its skewness, which describes asymmetry about the mean in a random variable's probability distribution. The probability density functions in Figure 10.1 **Error! Reference source not found.**have the same mean (μ) and same variance, but the left distribution is positively skewed while the right one is negatively skewed.

Figure 10.1: Distributions with the same mean and variance but differing skewness



The standard Arrow-Pratt measure of risk aversion implies that higher moments of the distribution of returns would be of interest to investors, and in particular that they would dislike skewness. The assumption in CAPM that investors are indifferent to skewness is thus a simplification at variance with standard decision theory.

It is possible that some (risk-averse) investors might, for example, prefer distributions of returns with positive skewness (where downside risk is, in some sense, relatively more restricted) over those with negative skewness. As a result, distributions with systematic negative skew would have a higher cost of capital than predicted by standard CAPM, while distributions with systematic positive skew would have a lower cost of capital.

Skewness is of clearest significance in a regulatory context under two circumstances: (a) when the entity is subject to material capacity constraints, in which case upside opportunity is curtailed by the price-cap and the capacity constraint (so creating negative skewness); (b) where technological or related innovative opportunities provide significant upside "blockbuster" opportunity especially with regard to upside risk to volume estimates (so creating positive skewness). Capacity constraints have generally been discussed in a regulatory context in cases where regulated businesses have been prevented from expanding, for example in the case of an airport at capacity. Moreover, given the relative maturity of the telecommunications sectors analysed here, it is not clear that there is a good case for the existence of "blockbuster" opportunities that would generate the sort of upside risk that would generate positive skewness. In view of these considerations, there appears no obvious reason to favour the use of a third moment CAPM, and the cost of capital would be adequately estimated using the standard model.

10.6 Conclusion on Theoretical Approach

The CAPM remains the main tool for determining the cost of capital. CAPM has a number of advantages, including clear theoretical foundations, a history of regulatory precedent and superior performance to other models in explaining asset prices over the long-run. Although it has received some criticisms, like any model, other available models such as the Fama-French model or the Dividend Growth Model, have their own

drawbacks. Given that a move away from CAPM would represent a significant departure from regulatory precedent, we would require significant justification to endorse such a move. In the absence of such justification to do so, and in view of CAPM's advantages, we therefore continue to use the CAPM as our theoretical framework for estimating an appropriate WACC for the sectors where companies have been found to have SMP in relevant markets by ComReg.

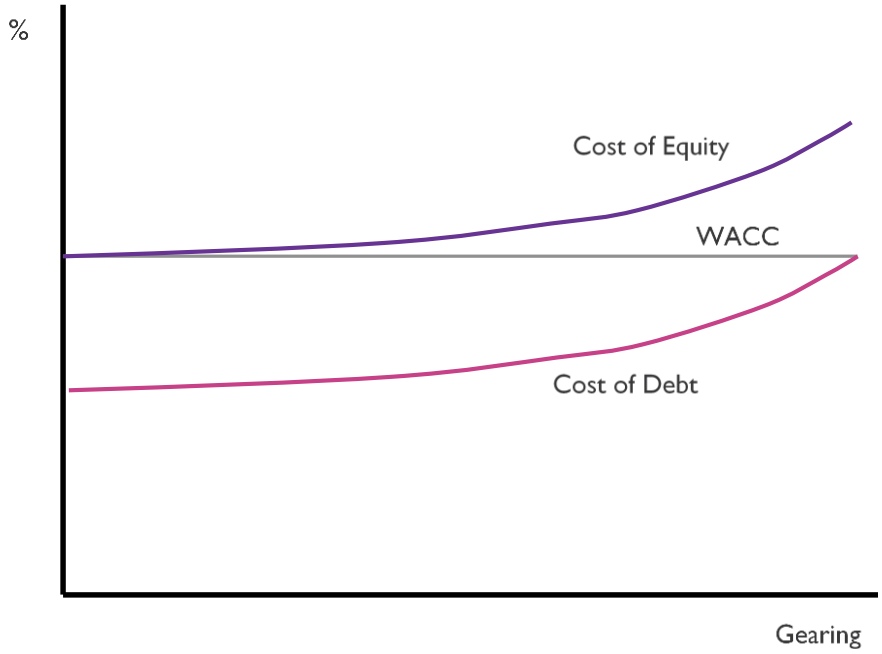
11 Appendix 3: Gearing and the Modigliani-Miller Theorem

Modigliani-Miller Proposition I (MM I) states that that the risk of a company depends on the risk of its real cash-flows, and hence on volatility in costs and demand for its products. This implies that, in the absence of taxes, incentive and information problems, the way a project or firm is financed does not affect its value or its cost of capital, (i.e. the market value of any firm is independent of its capital structure). This is because the overall risk in a company's asset base, its asset beta, does not change with the capital structure of the firm.

A company may be thought of as a bundle of investment projects. A project can be represented as a stream of uncertain future cash flows or net revenues. Each stream of future revenues is equivalent to a certain amount of cash today, the exact amount being obtained by discounting future revenues by the cost of capital to obtain the present value of the project, net of costs to undertake that project. Financiers will invest in the project only if the net present value of future cash flows is positive. If the project is financed up front by a combination of debt and equity, then a fixed amount of future cash flows will accrue to debt lenders and the remainder, or the value of the cash flows less the amount paid out to debt lenders, will accrue to equity investors. The split between debt and equity financing does not matter from the perspective of the financiers; it simply determines how much of the return on capital investment accrues to each party.

Because the risk of an asset is determined by its real features, rather than its method of financing, causality runs from the asset cost of capital, through the capital structure, to the costs of debt and equity. In other words, it is the costs of debt and equity that depend on the level of gearing, and not the asset cost of capital. This is illustrated in the figure below. At zero level of gearing the weighted average cost of capital is equal to the cost of equity. As gearing increases, the weight on the (lower) cost of debt increases. However, cost of equity and debt both adjust such that the combined WACC remains unaltered, until at 100 per cent gearing WACC simply equals the cost of debt.

Figure 11.1: Modigliani-Miller proposition I



To see this within the context of CAPM, note that for financiers to be willing to put up the cost of a project, they must first determine what level of risk they are taking on and, therefore, what level of return they require for their investment. Within the CAPM framework this involves determining the asset beta, i.e. the extent to which net returns on the asset as a whole are correlated with changes in returns in the economy as a whole. The asset beta affects the WACC of the whole company, in contrast to the equity beta, which only affects the cost of equity:

$$WACC = (1 - g) * r_E + g * r_D$$

$$\beta_A = g * \beta_D + (1 - g) * \beta_E$$

If the firm uses no leverage, then the shareholders get all the project revenues and $\beta_A = \beta_E$. If the firm uses debt as well as equity, β_E overstates the risk of the company, and the equity beta must be "un-levered" to get the asset beta. From MM I the value of the company is determined by its future revenues and how those revenues are split between different types of financiers does not matter. This means that the asset beta is constant, so that as the company gears up, the weight on the equity beta decreases relative to the weight of debt beta. Assuming that the risk on the debt providers does not change, the risk on equity holders must increase, so that the risk on the firm's equity is affected by its capital structure as well as the risk inherent in the business as a whole.

Since, according to MMI, the capital structure is irrelevant, we might expect to see that choice of capital structure is random. That we do not see entirely random matters points to a number of matters from which MMI abstracts:

- Differential tax treatment of equity and debt finance may imply that increasing gearing will save tax and increase company value. Specifically, the tax deductibility of interest payments may increase the value of the firm in question. The existence of such a shield lowers the cost of debt and lowers cost of equity as more debt is used.
- In the absence of other distortions, the expected costs of financial distress rise with the level of gearing.

- Financial structures may affect the incentives that managers face to maximise the net present value of the company.
- The information that different market participants have access to at different times may vary.
- There may be transaction costs, for example in varying the level of gearing.

Taking these considerations together suggests that there may be an optimal (value maximising) level of gearing. For example, considering the effect of taxation suggests that the market value of a company may rise with gearing, but as the risks and expected costs of financial distress and the extent of incentive problems rise with gearing, there may be a point at which increased gearing causes value to fall.

12 Appendix 4: Alternative approach

12.1 Different ways to implement CAPM

It will be useful to distinguish between two approaches we adopt, in this report, to the implementation of CAPM. These are Approach A and Approach B. Approach A has been presented in the main body of the report and closely mirrors the CAPM implementation approach adopted by ComReg in its 2014 price review. Approach B closely mirrors the approach that has come to be adopted by UK regulators over the past 18 months. Roughly speaking, Approach A can be seen as a judgement-based approach whereby the WACC is regarded as an underlying equilibrium parameter in the economy that is inferred rather than observed and judgement is required to take account of various distortions in the observed data that might arise from factors such as quantitative easing. Approach B, by contrast, takes a much more "let the data speak" approach, treating the WACC as a concrete observable rather than inferred equilibrium feature. We shall now explain the difference between Approaches A and B in more detail, and in particular how they affect the estimation of the risk-free rate, Total Market Return and the cost of debt.

One important point to emphasize is that Approaches A and B should be adopted consistently between the TMR, the risk-free rate and the cost of debt. For example, to adopt Approach B to the TMR but Approach A to the risk-free-rate would risk producing an artificially high WACC

12.1.1 Estimation of risk-free rate

Calculation of the risk-free rate has been a particular challenge in recent years, both conceptually and in terms of execution.

The key conceptual challenge has been whether the risk-free rate should be thought of as an underlying equilibrium parameter in the actual economy — akin to economic concepts such as the "output gap" or "marginal cost" or "the rate of technical progress" — or as a modelling claim (namely, that there is a risk-free asset) to which some asset in the world might more or less approximate. We can refer to the first of these options as the "equilibrium parameter" concept of the risk-free rate, and the latter as the "approximate asset" concept.

The approximate asset concept is more concrete and perhaps easier to grasp immediately. The idea here is that the CAPM should be understood as requiring an actual risk-free asset to exist, and so to the extent that the CAPM is an accurate model of the world, there should be some risk-free asset out there. We should therefore go and find the asset that is closest to risk-free that we can, and the returns on that asset will be our risk-free rate. Questions of returns on our best-proxy for a risk-free asset being "distorted" are only of relevance insofar as they tell us that CAPM as a whole is an imperfect model. The "risk-free" return, in this approach, is therefore simply the return on the nearly-risk-free asset. It is what it is.

The closest Irish approximation to a risk-free asset is government bonds. So in this approach we simply find what the latest up-to-date yield on government bonds of the appropriate maturity (typically 10 years, though some cross-checking from other maturities, such as 5 or 20 years might be appropriate). Then that is the risk-free rate. Debates of quantitative easing or other monetary measures depressing yields, or bank liquidity requirements driving bond purchases, or pensions rules forcing the buying of government bonds would all be irrelevant. The return is the return. This is Approach B.

In the alternative approach, Approach A (which has been standard in most price controls in Ireland and other jurisdictions such as the UK over the past ten years — though as we shall see the UK has moved away from this over the past 18 months) the risk-free rate is to be understood as an underlying equilibrium parameter,

from which actual yields, even on assets that are very close to risk-free, might deviate at any one time, much as the competitive equilibrium price in a market might be different from the price that happens to prevail today. On this understanding, it might be necessary to consider more than simply the latest yield on the most risk-free asset. Rather, we might need to consider whether, and if so to what extent, there is reason to believe that market yields might currently be away from equilibrium. More specifically, advocates of this approach argue that government bond yields are likely to have become a poor proxy for risk-free returns, following the financial crisis of 2008/09 and the Eurozone crisis of 2010-2012, with associated significant distortions in yields from market distortions, regulatory requirements and quantitative easing.

A particular challenge in taking such an equilibrium parameter approach is how to determine how big any distortions might be, even if one is convinced they exist. The main way that regulators have attempted to do this has been through the use of longer-term averages — for example, by taking the average of the past 5, 10 or 20 years of yields. An obvious problem with that approach is that it involves using data on risk-free returns from a very different economy from that we have today. Over the medium term, standard economic growth models suggest that there is a relationship between the risk-free rate and the long-term sustainable growth rate of the economy. (When the sustainable growth rate is lower, the risk-free rate will be lower, and vice versa.) It should be observed that although the long-term sustainable growth rate of an economy is quite different from the annual rate of growth (an economy could contract by 5 per cent whilst still having a long-term sustainable growth rate of 2 per cent, say), there is likely to be some relationship in that a key driver of recessions and booms is changes in the actual or expected sustainable growth rate of an economy. For example, a period of recession might reflect a reduction in that sustainable growth rate.

It is vey likely that the sustainable rate of growth in Eurozone economies today is very different from the sustainable growth rate 10 or 20 years ago. So the use of long-term averages is rather a poor way to attempt to infer the underlying equilibrium sustainable growth rate.

On the other hand, the spot data upon which Approach A focuses is also likely to produce a poor estimate of the underlying equilibrium parameter, for various well-known reasons.

- Monetary policy, in which central banks purchase government bonds, may affect yields by creating additional demand. However, since this demand is a policy instrument and is not for the purpose of generating a return, the extent to which government bonds remain an appropriate proxy for a risk-free asset is questionable.
- Flight to quality effects may reduce yields but these might not necessarily be expected to continue into the future.
- The risk-free rate reflects underlying tastes, which, though they may evolve through time, are probably not subject to rapid short-term fluctuations. Yet gilt yields can be subject to quite large short-term fluctuations. Hence it seems likely that, at least to some degree, movements in gilt yields "over-measure" changes in tastes.
- It is sometimes argued that since investors are likely to consider other regulatory judgements in choosing whether to purchase any one regulated utility stock, there is a reasonable expectation that the generic parameters (the risk-free rate and the MRP) should not differ too much between regulators, and hence regulatory precedent increases its weight relative to the latest data. (This is, of course, an argument that invites the response that the specific utility regulator might have been quite clear that its judgement would be based on the latest data, so that regulatory consistency involves use of the latest data rather than past regulatory judgement.)

A number of regulators in Ireland, along with ARCEP in France, have experimented, in recent years, with using an approach Europe Economics recommended, based on attempting to infer the equilibrium value of the risk-free rate from forecasts of the sustainable growth rate. As one would expect, given that most of the assumed distortions to bond market yields are believed to have reduced yields, such an equilibrium parameter approach tends to produce a materially higher risk-free rate than does the use of spot yields data. In practice

this may have affected the assigned cost of equity by less than one might initially presume. For a given total market return (on which, see more below), the risk-free rate will only change the cost of equity to the extent that betas differ from 1. We can see this by re-visiting the basic CAPM equation.

$$r = r_f + (TMR - r_f) \times \beta$$

Suppose that $\beta = 1$. Then that equation becomes

$$r = r_f + (TMR - r_f) = TMR$$

That is to say, if $\beta = 1$ then the risk-free rate is irrelevant, because the cost of equity is simply the total market return. So, for example, in the December 2016 parameter update for ComReg, the Fixed Line equity beta was estimated at 1.0. So in that case, for a given total market return, the risk-free rate was irrelevant. On the other hand, in January 2018 the Mobile equity beta was estimated at 0.75. So because that was materially below 1, the use of a higher risk-free rate tended to increase the cost of equity for a given total market return. If equity betas were to be above 1, a higher risk-free rate will mean a lower total cost of equity, for a given TMR.

The reviews conducted in the 2014 ComReg review depended on Eurozone-crisis-affected market data that was potentially subject to very large distortions, not least the large fluctuations in Irish domestic government bonds. There was therefore a considerable advantage in having a method available for estimating the risk-free rate that did not depend on government bond data.

Whether that remains the case today is less certain. Our view is that the use of longer-term averaging approaches to the risk-free rate such as a ten or fifteen year averages of bond yields remains a fairly poor way to estimate equilibrium parameters. On the other hand, the Europe Economics model depended on estimation and calibration of relationships between the risk-free rate and the underlying growth rate of economies that also went back to before 2010. Such an underlying relationship is less likely to be subject to rapid change over time, but whereas in 2014 that was only a few years early, at the time of writing we are now in 2019, and there is an increasing risk of even our modelled relationships now being obsolete.

Attempting to use approaches other than the latest data, to correct for distortions, will not be wise if the adjustments themselves are subject to uncertainties and potential inaccuracies that are just as large, if not larger than, the distortions for which they are attempting to correct. That is especially so insofar as the parameter in question may have only a modest impact on the cost of equity. There may therefore be a pragmatic advantage in switching to a more concrete "let the data speak" approach, if indeed the data can "speak" clearly. The approach we set out in this appendix seeks, as far as possible, to let the data speak. However, as we shall see, in the case of Ireland the task of letting the data "speak" is far from straightforward and the data's message is far from unambiguous. We therefore believe that, in the case of Ireland, the approach we set out in the main text should carry the greatest weight, though it is relevant to consider the approach we set out in this appendix as a cross-check.

12.1.2 Estimation of total market return and equity risk premium

Estimating the total equity market return or ERP are not straightforward. It is in the nature of total returns that they are risky, so actual returns observed in any one year are unlikely to provide a good proxy for what returns were expected. Even longer periods such as 10 years can give a poor indication and can be highly sensitive to the exact year chosen. Traditional approaches have built on the famous study by Dimson, Marsh and Staunton (2001) (DMS). This originally used 101 years of data, and established a number of ranges within which the ERP was likely to lie. The rationale for using such long periods was that equity returns vary significantly over time, so a very long time period was necessary in order to ensure that all of the distribution was sampled.

One way to conceive of the DMS results is that the exercise is to attempt to assess, on a forwards-looking basis, what the distribution of possible returns is that equity investors face. The historic data is then conceived of as a set of draws from the entire range of possibilities. That then creates a sample distribution (containing 101 or however many points) for expectations of the future. If we believe the future may differ in some way from the past, we can tweak the distribution — for example, a number of regulators using this DMS approach have adjusted returns upwards in periods of significant recession, drawing on a Bank of England study that suggested that the ERP is 20 per cent higher in recessions. But the principle remains the same: the past is being used to create a sample distribution of the possibilities in the future, from which we then obtain the expected value to derive our TMR or ERP.

One important point to note here is that, under this sample distribution conception, it is straightforward to see that it is the arithmetic average return that is relevant, because the expected value of a sample distribution is the arithmetic average return.[49] Approach A has tended to place most weight upon DMS-type results, albeit making some adjustment for factors such as recessions.

Regulators that have adopted Approach B have continued to place some weight upon DMS-type information, but have sought to complement it with more fully forwards-looking approaches to be consistent with the "let the data speak" philosophy of Approach B. The most important of these have been Dividend Growth Models (DGM) of total equity market returns. Discussions of the relative merits of DMS-type data and DGM approaches in the UK have tended to focus on the view that the Great Recession has involved a step change in returns, with a lower-growth global economy, rendering historical data much less relevant to the assessment of forwards-looking returns. In our view that discussion is potentially much more relevant in a country such as the UK, where growth has been poor for much of the past decade, than in a country such as Ireland where in some recent years growth has been very rapid. Indeed, as we shall see, the same "let the data speak" principle tends to produce a higher TMR for Ireland at present than the DMS-type approach.

The estimation results we obtain for the risk free rate and the TMR/ERP under approach B are reported are reported further below.

12.1.3 Estimation of the debt premium

Two traditional approaches to the cost of debt have been the "all-in" approach and the "debt premium" approach. Under the all-in approach yields are estimated from the yields of regulated entities or comparators for them. Under the debt premium approach, by contrast, the yields of regulated entities or comparators have been used to estimate spreads versus government bonds to produce estimates of the debt premium. That debt premium is then added to the determined risk-free rate.

It is important to note that if the risk-free rate is estimated as simply the yield on domestic government bonds and the debt premium is estimated as the spread of domestic debt over domestic government bonds, the two methods collapse into one — the "debt premium" is simply the difference between the all-in cost of debt and the risk-free rate.

Under Approach B we use the all-in cost of debt for Irish bonds and comparators, and for international comparators we estimate the spread relative to those bonds' domestic benchmarks, draw a conclusion as to the spread, then add that spread to the Irish risk-free rate.

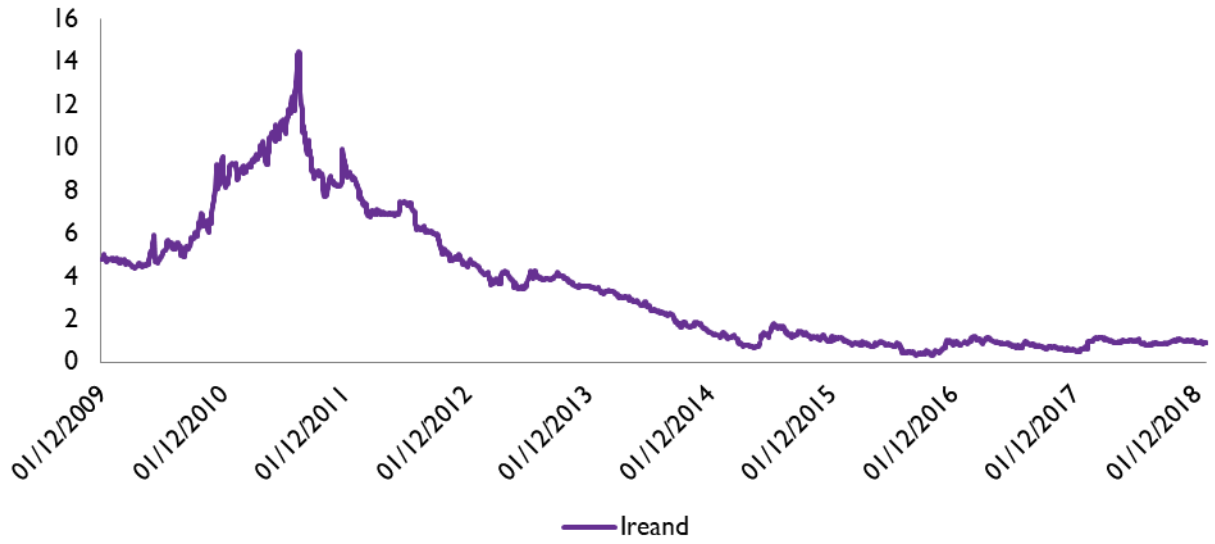
The approach set out in the main body was importantly different. Instead of the spreads of euro area bonds being calculated relative to domestic benchmarks, they were estimated relative to German government bond yields. Those spreads were then added to our estimate for the risk-free rate.

[49] DMS reports both arithmetic and "geometric" average returns. The arithmetic average is the sum of all annual returns divided by the number of years. The "geometric average" return is the compound average growth rate required to get us from the opening value to the closing value.

12.2 The risk-free rate

Under Approach B, we estimate the risk-free rate less judgementally, seeking to observe the Irish risk-free rate directly from Irish government bond yields. The figure below shows the nominal yields on 10 year Irish government bonds.

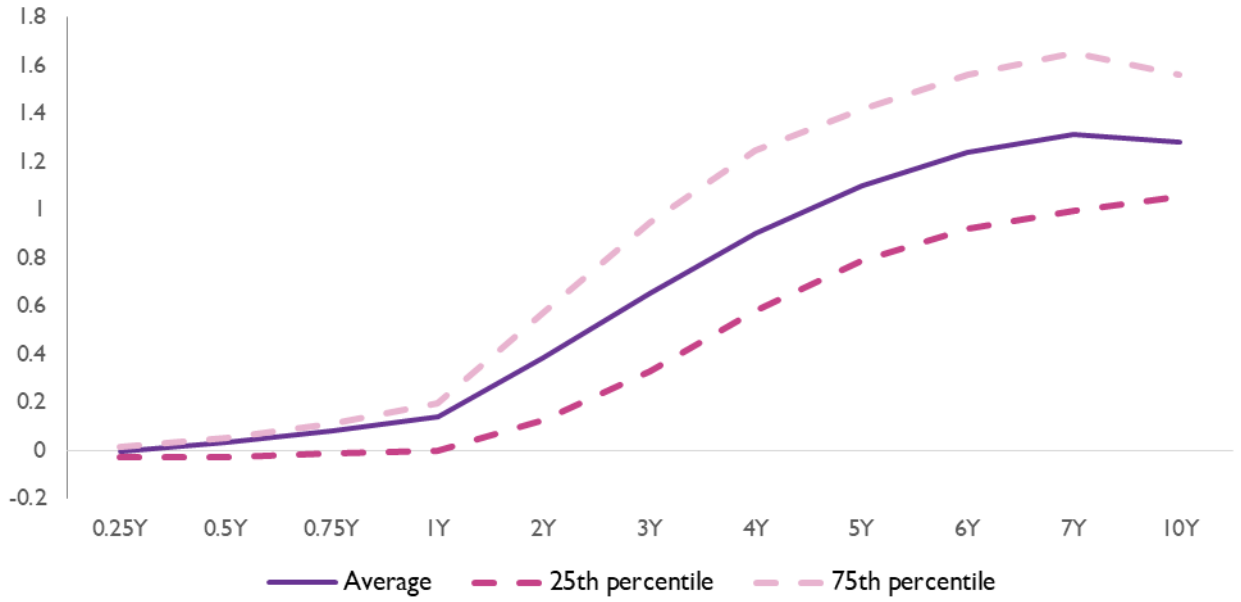
Figure 12.1 Nominal yield on Irish sovereign 10 year bond



Source: Thomson Reuters.

The nominal yields on the Irish government bonds over the last few months has been fairly stable at around 0.9 per cent. In order to estimate the risk-free rate for period 2020-2025, we need to adjust the currently observed yields by the expected rise in interest rates. The expected rise in interest rate can be estimated by subtracting nominal spot rates from nominal instantaneous forward rates for each maturity horizon respectively. The figure below shows the forward minus spot curves for Europe. We note that the ECB data on forward minus spot curves suggest a range of 0.7 to 0.9 for 3 to 4 years ahead. We take the midpoint of this range as the point estimate for the forward minus spot rate i.e. 0.8.

Figure 12.2 Forward minus spot based on the distribution of monthly estimates



Source: ECB.

Forwards curves typically contain an underlying term premium, sometimes thought to reflect liquidity risk or changes in the extent to which investors bear inflation risk over different horizons. Since this premium would be captured by the forward curves even if no rise in interest rates is expected, it should be subtracted from the above estimates. We therefore deduct 0.2 for the underlying liquidity effect from our point estimate to get 0.6. This 0.6 is the added to the nominal yields on the Irish bonds to get 1.5.

We then deflate this 1.5 figure using the latest Irish inflation figure (0.6) to get a real risk-free rate under Approach B of **0.9** per cent.

12.3 Total Market Returns and the Economic Cycle

Total market returns expressed in CAPM terms represent the sum of the risk-free rate and the market risk premium. Total market returns are generally considered to be more stable than their individual components. During economic downturns, the risk-free rate tends to be depressed, while equity risk premia are elevated. Conversely, when the economic outlook is more positive, risk premia are generally lower and the risk-free rate higher.

The net effect is likely to depend on what sort of boom or downturn we are in. Suppose, for simplicity, that the underlying long-term average growth rate of the economy is unchanged but we are currently in a cyclical downturn, so there is an output gap. Then when the economy is in a downturn, long-term growth is expected to be faster than average because there is catch-up growth as well as the underlying average. So, other things being equal, in a cyclical downturn we might anticipate expected returns being higher than their long-term average, and vice versa. If, by contrast we are in a structural downturn — eg a recession caused by a downgrade in expectations for the long-term average growth rate for the economy — then expected returns will be lower in the downturn period than they were in the past.

Either way, variations in overall returns are likely to be lower than variations in the risk-free rate and equity risk premium.

12.3.1 Precedent

In **Error! Reference source not found.** we report past regulatory precedent for the risk-free rate and ERP in Ireland since 2000. The real risk-free rate has varied between 1.5 and 3.0, while the ERP has ranged from 4.75 to 6.0. Total market returns have, in general, been falling since the early part of the 2000s. The highest total market returns figure is 8.6 per cent, used in 2001-2002 and 2005, each time in the context of aviation regulation.

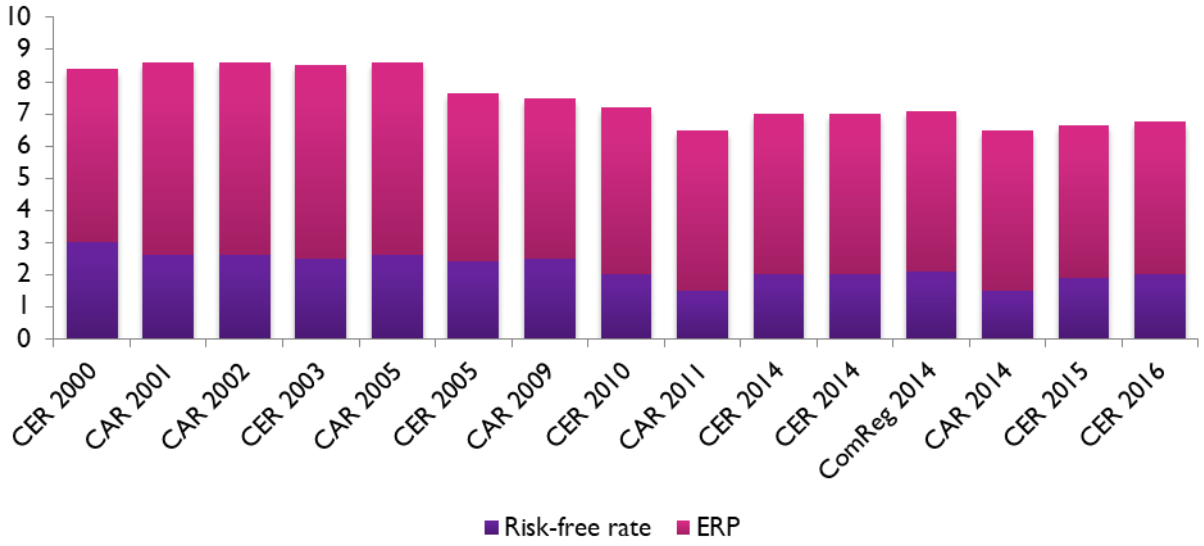
Table 12.1: Total market returns in Irish regulatory determinations, 2000-2016

Regulator	Subject	Year	Real risk-free rate	Implied nominal risk-free rate	ERP	Real total market return
CER	ESB PG	2000	3.0	5.6	5.4	8.4
CAR	Aer Rianta	2001	2.6	5.2	6.0	8.6
CAR	Irish Aviation Authority	2002	2.6	5.2	6.0	8.6
CER	Bord Gáis Éireann	2003	2.5	5.1	6.0	8.5
ComReg	Eircom	2003	n/a	4.45	6.0	-
CAR	Dublin Airport Authority	2005	2.6	5.2	6.0	8.6
CER	ESB PG	2005	2.4	4.9	5.25	7.7
ComReg	Eircom	2008	n/a	4.75	6.0	-
CAR	Dublin Airport Authority	2009	2.5	n/a	5.0	7.5
CER	EirGrid and ESB	2010	2.0	n/a	5.2	7.2
CAR	Irish Aviation Authority	2011	1.5	n/a	5.0	6.5
CER	EirGrid and ESB	2014	2.0	n/a	5.0	7.0
CER	Irish Water	2014	2.0	n/a	5.0	7.0
ComReg	Eircom	2014	2.1	3.63	5.0	7.1
CAR	Dublin Airport	2014	1.5	n/a	5	6.5
CER	Eirgrid and ESB	2015	1.9	n/a	4.75	6.65
CER	Irish Water	2016	2.0	n/a	4.75	6.75

Source: Various regulatory determinations.

In **Error! Reference source not found.** we see that total market returns were higher in Ireland in the early 2000s, when growth in Ireland was consistently rapid, fell back during the Great Recession and subsequent Eurozone crisis, and have been fairly consistent since that time.

Figure 12.3: Total market returns in Irish regulatory determinations, 2000-2016



Source: Various regulatory determinations.

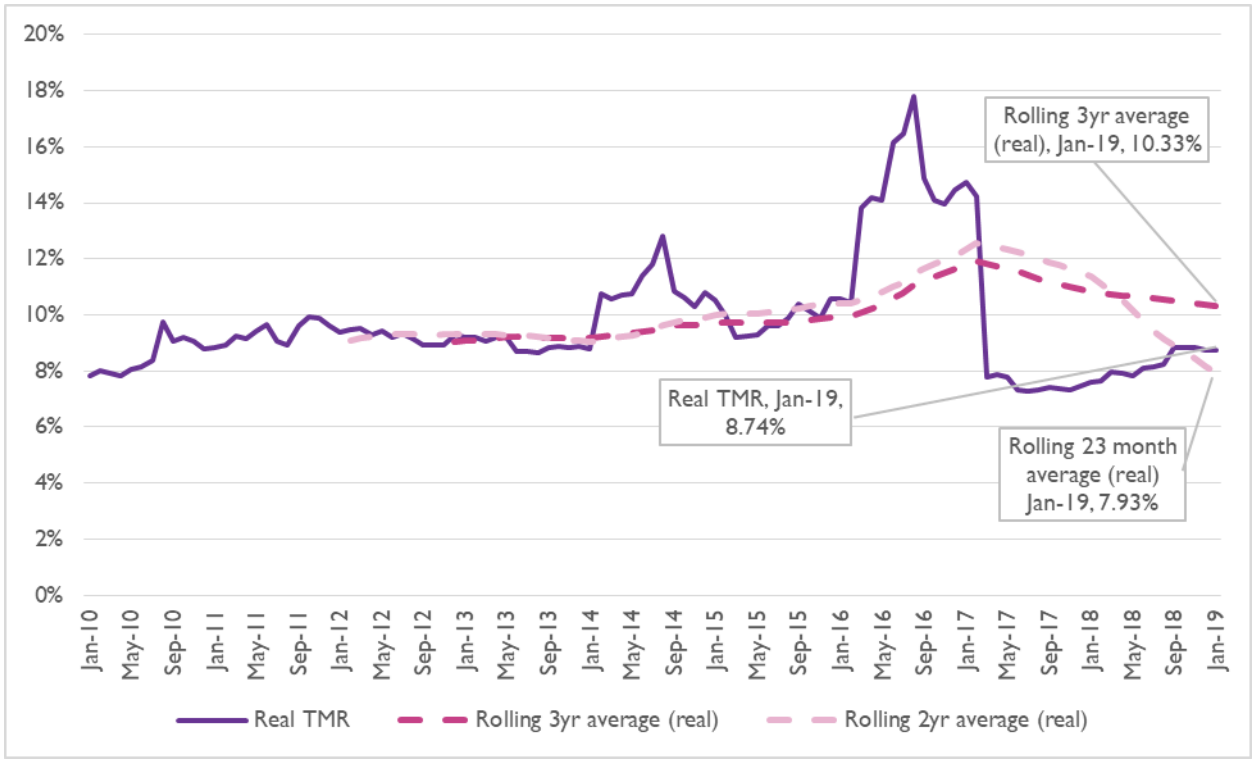
12.4 The TMR and ERP

A forward looking TMR for Ireland is calculated using the Dividend Growth model. This forward looking approach gives us a range of 7.93 to 8.74 for the TMR and a point estimate of 8.34. Combining this with our Approach B risk-free rate assumption we get an ERP range of 7.03 – 7.84 and a point estimate of 7.44.

Our version of multi-stage DGM model where capital growth expectations are based on dividend growth rates, produces a real TMR spot estimate of 8.74 per cent (as of January 2019), a 3-year average of 10.33 per cent and a 23 month average of 7.93 per cent (see Figure 12.4**Error! Reference source not found.**). Although the academic literature and tests in other countries suggest that the 3-year rolling average DGM result is a better predictor of future actual total market returns than the spot value DGM, in the case of Ireland, given that the 3-year average is strongly influenced by a spike during 2016 and 2017 that may have been artificially influenced by the 2015 relocations[50], we also consider the 23 month average (i.e. the period of data available since that spike) as a lower bound. Hence our overall range is 7.93 to 10.33 per cent. For our point estimate we use the latest spot estimate, 8.74 per cent.

[50] Official Irish GDP grew 25.6 per cent in 2015.

Figure 12.4 Multi-stage DGM based on dividend growth (up to January 2019)



Source: Thomson Reuters and Europe Economics' calculations.

Using Approach B we obtain a range for the real TMR between 7.93 per cent (rolling 23 months average) and 10.33 per cent (three years rolling average), with a point estimate of 8.74 per cent (spot value). The risk-free rate and TMR estimates obtained under Approach B result in the following common WACC components. We observe that a TMR at 8.74 would be roughly consistent with the TMRs in Ireland in regulatory determinations in the 2000-2005 period, as we saw in Table 12.2.

Table 12.2: Ranges for the risk-free rate and ERP (Approach B)

	Low (%)	High (%)	Point (%)
Real risk-free rate	0.90%	0.90%	0.90%
Real TMR	7.93%	10.33%	8.74%
Real ERP	7.03%	9.43%	7.84%
Inflation	1.10%	1.80%	1.30%
Nominal risk-free rate	2.01%	2.72%	2.21%
Nominal ERP	7.11%	9.60%	7.94%

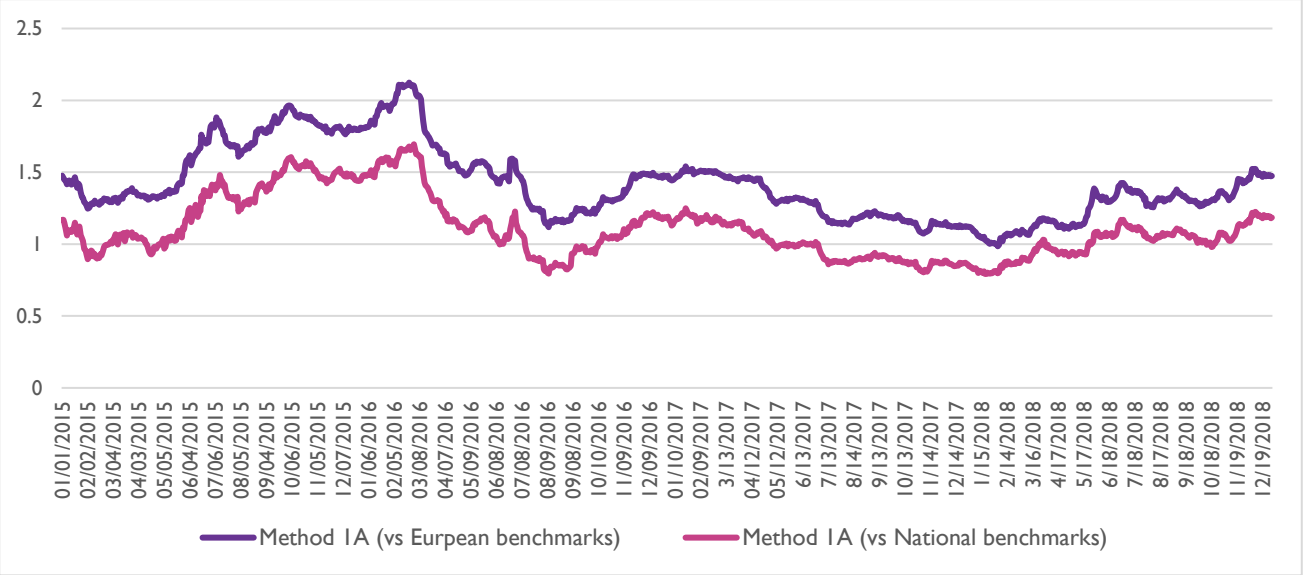
We note that the range of possibilities from this TMR model is considerable. Plausible arguments could be made for values from 7.93 to 10.33 per cent. That suggests that, for Ireland, the task of "letting the data speak" is challenging, since what the data tells us involves such a wide range of possibilities that very considerable judgement is required in coming to a conclusion. That means that the key supposed advantage of this approach — the ability to rely upon data rather than judgement — is (at least for Ireland) largely absent.

12.5 Debt premium

12.5.1 Mobile

We report below the mobile debt premium calculated under our preferred weighting approach (approach A1) with spreads calculated versus national government bonds. Since German government bonds yields are generally lower than those of other European countries, the debt premium versus national government bonds is lower than that calculated versus the Eurozone benchmark. By December 2018 the (weighted average) spread versus national bonds was 1.19 per cent, i.e. approximately 30 basis points less than the spread versus the Eurozone benchmark).

Figure 12.5: Debt premium over national bond, mobile



Source: Thomson Reuters EIKON; Europe Economics' calculations.

Source: Thomson Reuters EIKON; Europe Economics' calculations.

The average spread for each company are reported in the table below

Table 12.3: Average spread over National benchmarks for each company

	Credit Rating	Benchmark	Average spread at December 2018
BT	BBB	10-years UK government bond	1.94%
Deutsche Telekom	BBB+	10-years DE government bond	1.38%
KPN	BBB	10-years NL government bond	1.38%
Swisscom	A	10-years CH government bond	0.71%
Telefonica	BBB	10-years ES government bond	0.63%
Vodafone	BBB+	10-years UK government bond	1.57%

Source: Thomson Reuters EIKON

Evidence suggests that a generic mobile operator's debt premium would be around 120bps above the appropriate national government bonds. Looking at the three different averages methods, we note that, at the end of December 2018 the debt premium is within a range of 120-130bps.

Our estimates for this cross check model suggest that the generic mobile operator's debt premium would be around 120 bps above the national government bond.

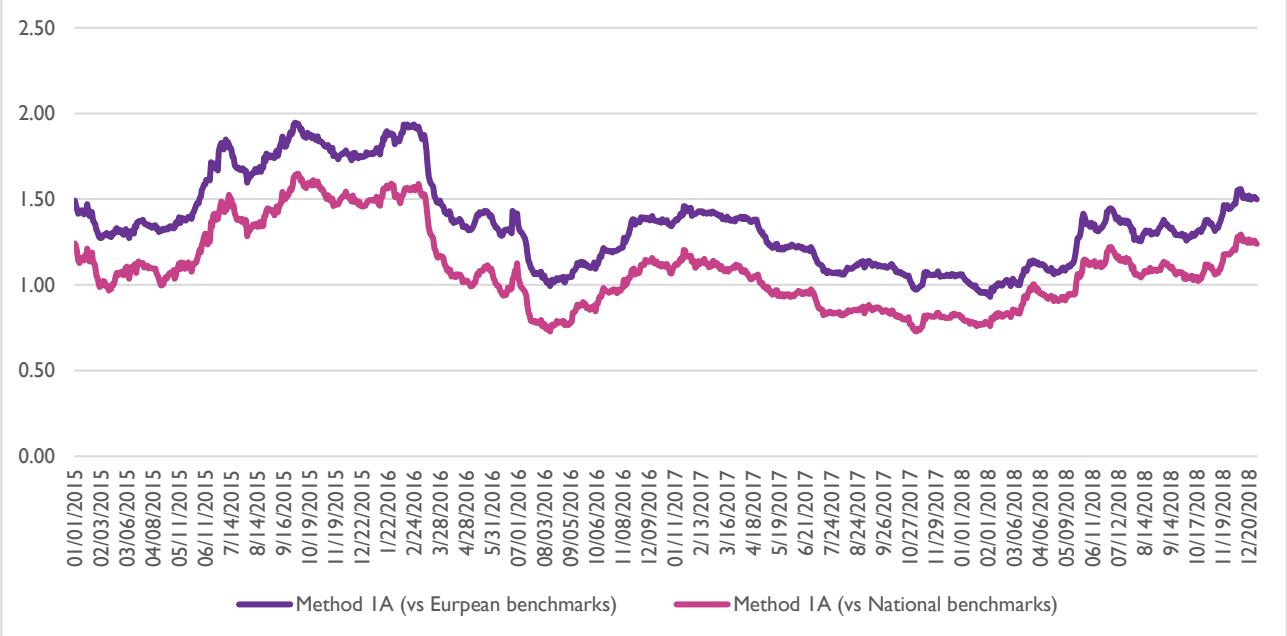
Figure 12.6: Debt premium under various averaging methods

Source: Thomson Reuters EIKON; Europe Economics' calculations

12.5.2 Fixed line

In the graph below reports the weighted average debt premium calculated versus national government bonds and compares it with the debt premium calculated against European benchmarks. As we would expect the debt former is lower than the latter. As of December 2018 the debt premium versus national bonds is 125bps whilst that versus European benchmarks is 152bps.

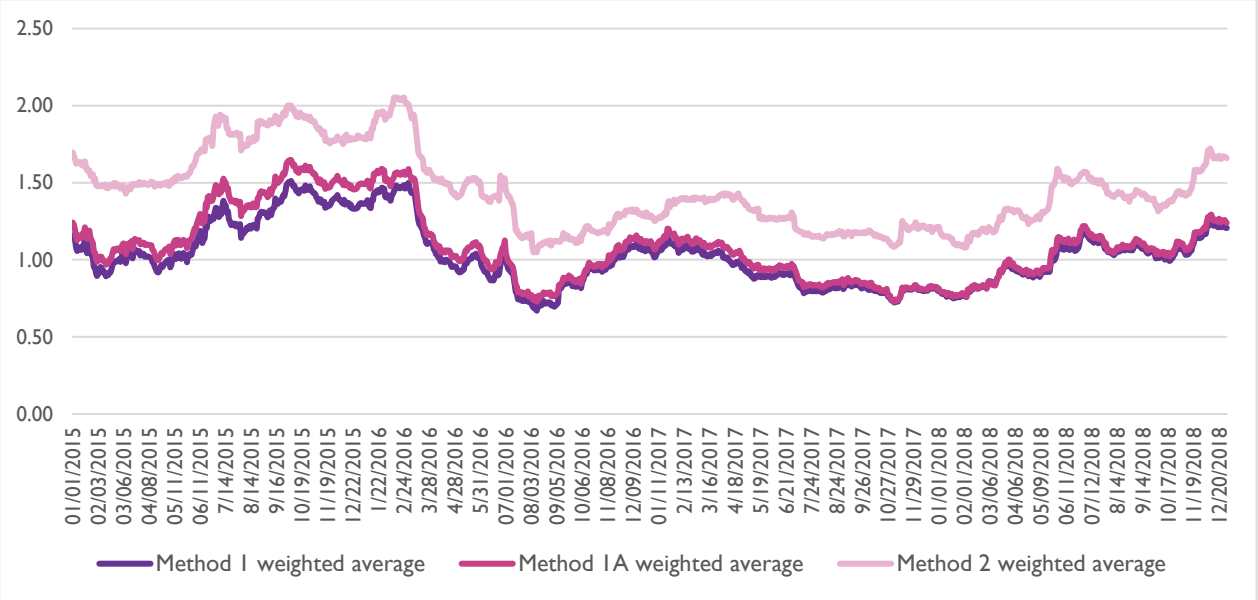
Figure 12.7: Weighted average of Debt premia over national government bond



Source: Thomson Reuters EIKON; Europe Economics' calculations

Takin into account evidence form all three averaging methods we can see from Figure 12.8 that — as of December 2018 — the debt premium over national benchmarks ranges from 120bps to 165bps. We adopt a value of 1.25, reflecting the higher weight given to averaging Method 1A.Figure 12.8: Averages of debt premia over National Government bond

Figure 12.8: Averages of debt premia over National Government bond



Source: Thomson Reuters EIKON; Europe Economics' calculations

12.6 WACC under alternative Approach B

We report below the WACC estimates form mobile, fixed-line, and broadcasting sectors obtained under Approach B.

Table 12.4: Mobile WACC under Approach B

	Low	High	Point Estimate
Real risk-free rate	0.90%	0.90%	0.90%
Real ERP	7.03%	9.43%	7.84%
Inflation	1.10%	1.80%	1.30%
Nominal risk-free rate	2.01%	2.72%	2.21%
Nominal ERP	7.11%	9.60%	7.94%
Unlevered beta	0.42	0.44	0.43
Notional gearing	35%	35%	35%
Notional equity beta	0.65	0.68	0.66
Nominal cost of equity (post-tax)	6.60%	9.21%	7.47%
Tax rate	12.50%	12.50%	12.50%
Nominal cost of equity (pre-tax)	**7.55%**	**10.53%**	**8.53%**
Debt premium	1.20%	1.30%	1.20%
Nominal cost of debt (pre-tax)	**3.21%**	**4.02%**	**3.41%**
Nominal vanilla WACC	**5.41%**	**7.40%**	**6.05%**
Nominal WACC (pre-tax)	**6.03%**	**8.25%**	**6.74%**

Table 12.5: Fixed-line WACC under Approach B

	Low	High	Point Estimate
Real risk-free rate	0.90%	0.90%	0.90%
Real ERP	7.03%	9.43%	7.84%
Inflation	1.10%	1.80%	1.30%
Nominal risk-free rate	2.01%	2.72%	2.21%
Nominal ERP	7.11%	9.60%	7.94%
Unlevered beta	0.38	0.41	0.40
Notional gearing	40%	40%	40%
Notional equity beta	0.63	0.68	0.67
Nominal cost of equity (post-tax)	6.51%	9.28%	7.51%
Tax rate	12.50%	12.50%	12.50%
Nominal cost of equity (pre-tax)	**7.44%**	**10.60%**	**8.58%**
Debt premium	1.20%	1.65%	1.25%
Nominal cost of debt (pre-tax)	**3.21%**	**4.37%**	**3.46%**
Nominal vanilla WACC	**5.19%**	**7.31%**	**5.89%**
Nominal WACC (pre-tax)	**5.75%**	**8.11%**	**6.53%**

Table 12.6: Broadcasting WACC under Approach B

	Low	High	Point Estimate
Real risk-free rate	0.90%	0.90%	0.90%
Real ERP	7.03%	9.43%	7.84%
Inflation	1.10%	1.80%	1.30%
Nominal risk-free rate	2.01%	2.72%	2.21%
Nominal ERP	7.11%	9.60%	7.94%
Unlevered beta	0.30	0.50	0.40
Notional gearing	25%	25%	25%
Notional equity beta	0.40	0.67	0.53
Nominal cost of equity (post-tax)	4.85%	9.12%	6.45%
Tax rate	12.50%	12.50%	12.50%
Nominal cost of equity (pre-tax)	**5.55%**	**10.42%**	**7.37%**
Debt premium	1.40%	1.80%	1.50%
Nominal cost of debt (pre-tax)	**3.41%**	**4.52%**	**3.71%**
Nominal vanilla WACC	**4.49%**	**7.97%**	**5.76%**
Nominal WACC (pre-tax)	**5.01%**	**8.94%**	**6.45%**

13 Appendix 5: European Commission approach

In this Appendix we consider the WACC estimates that we would obtain by applying the methodology recommended by the European Commission.[51]

13.1 Risk-free rate

The EC main recommendations on how to estimate the risk-free rate can be summarised as follows;

- Calculating a weighted average yield based on a sufficiently large number of EU Member States (e.g. with weights proportional to GDP);
- Using sovereign government bonds with 10-year maturity.
- Using a five-year averaging period based on weekly yields data.
- Ensuring consistency with the approach used to determine the ERP. For example, if the ERP is estimated on the basis of DMS long-term arithmetic averages, the following considerations should be taken into account:
  - DMS's historical series are based on 20-year maturity bonds, and therefore it might be appropriate to adjust upwards the yields on 10-year maturity bonds used to derive the risk-free rate in order to reflect the average difference in yields between 10-year and 20-year maturity bonds. The EC suggests such uplift to be of the order of 40bps.
  - There is some potential inconsistency, in that our risk-free rate estimate is based on a basket of EEA/EFTA countries[52] whereas, as we shall see below, the DMS ERP estimate recommended by the EC includes a small weight for Russia. We do not consider this a material issue.

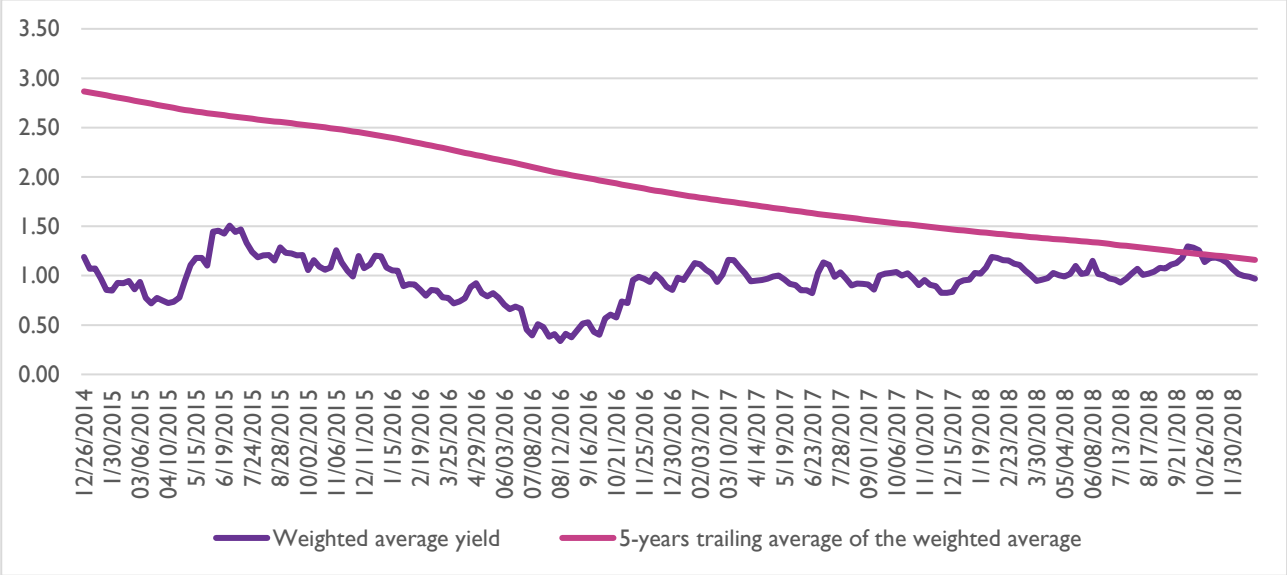
Following the above recommendations we have estimated the 5-years trailing average of the weighted average yields[53] of the 15 European countries used by DMS. This is reported below:

[51] See http://ec.europa.eu/information_society/newsroom/image/document/2018-27/05-07-2018_wacc_background_document_60A8BB89-B677-CE6F-C44D838BD437C73D_53397.pdf

[52] In the Credit Suisse Global Investment Return Yearbook (2018) these are: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the UK.

[53] Weights are based on the countries' GDP figures obtained from Eurostat.

Figure 13.1: Risk-free rate following the EC approach



At 28-December-2018, the 5-years trailing average yield was 1.16 per cent, which, with after the recommended uplift of 40bps results in a nominal risk-free rate of 1.20 per cent.

13.2 ERP

The European Commission recommends the use of long term average ERP estimates based on the arithmetic mean. The arithmetic average (nominal) ERP figure for Europe sourced from the DMS's Credit Suisse Global Investment Return Yearbook (2018) is 4.3 per cent.[54]

13.3 Inflation

The European Commission recommends using the ECB's long term (5-year) EU-wide inflation forecast to form a view on the inflation to be used to determine the real WACC. In the first quarter of 2019 the long term inflation forecast for the Euroarea is 1.8 per cent.[55]

13.4 Beta and gearing

Betas should be estimated based on weekly data covering a period of five year. Consistently with the approach taken for the ERP and the risk free rate, betas should be estimated against a European stock market index.

With regards gearing, the European Commission notices that, although in theory the value of debt used in gearing calculations should be measured at market value, the use of book value of net debt is more practical and appropriate. The approach recommended by the European Commission is therefore in line with the one we have adopted.

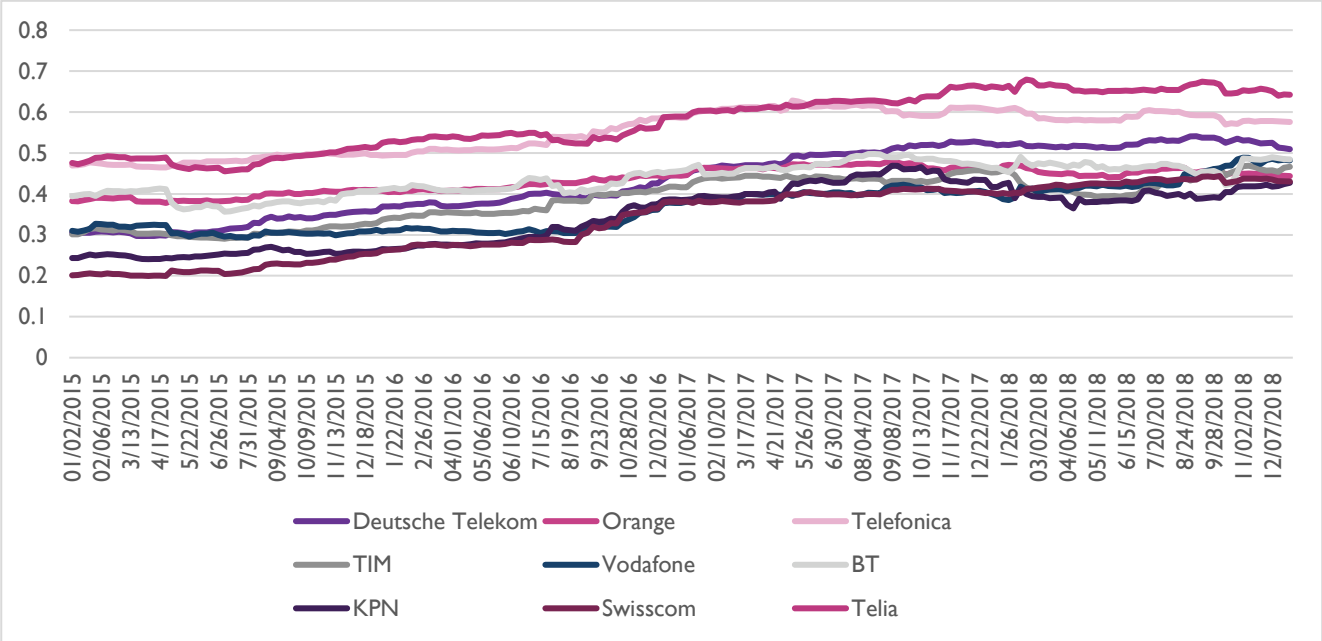
We report below the five years rolling beta estimated on weekly data. Since some of our broadcasting comparators are US-based firms, the index used to estimate their betas is a broad US-equity index[56].

[54] We note that the DMS ERP figure for "Europe" includes returns for Russia.

[55] https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/table_hist_hicp.en.html

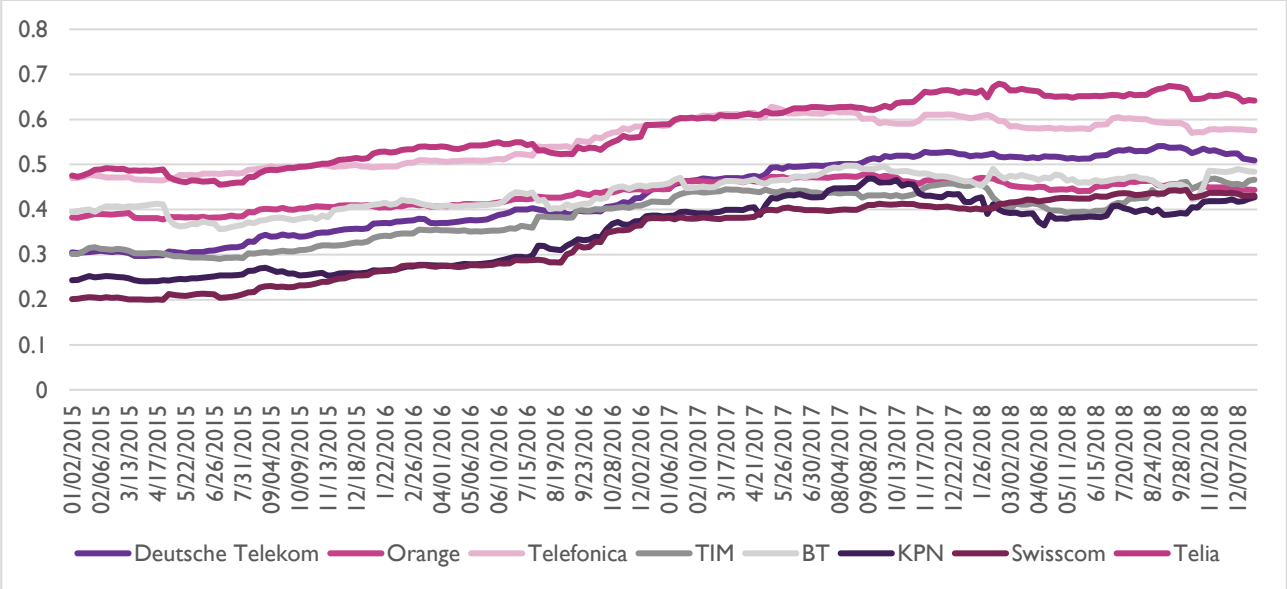
[56] The indices used are: Thomson Reuters US Total Return Index for US-based companies, and the Thomson Reuters Europe Total Return Index for European companies.

Figure 13.2: Five-year weekly beta for mobile comparators



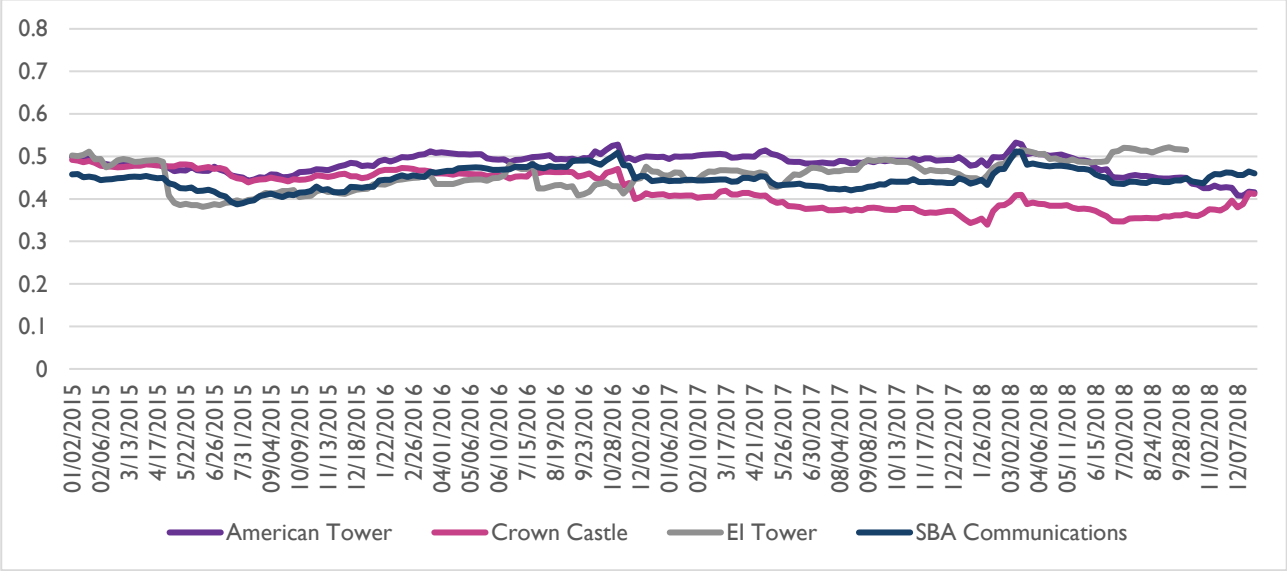
Five years betas estimated on weekly data are generally higher than two-years beta estimated on daily data. At the end of 2018, the arithmetic of the mobile comparators betas reported in Figure 13.2 was 0.5.

Figure 13.3: Five-year weekly beta for fixed line comparators



At the end of 2018, the arithmetic average of the fixed-line comparators betas reported in Figure 13.2 was also 0.5.

Figure 13.4: Five-year weekly beta for broadcasting comparators



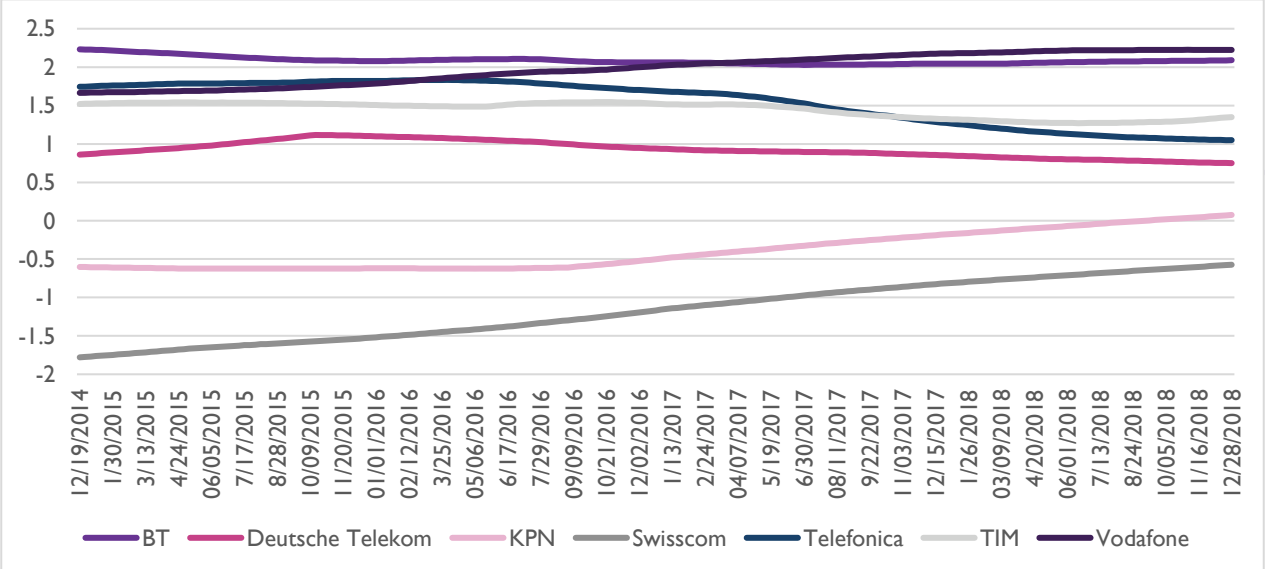
The arithmetic average of broadcasting comparators' betas at December 2018 was 0.43 (excluding El Tower), or 0.45 (including the latest available data available for El Tower).

13.5 Debt premium

The European Commission recommends estimating the debt premium using corporate bonds with 10-year maturity (or close to 10-year) and using data with a weekly frequency. Consistently with the approach used to estimate the risk free-rate the debt premium should be calculated using a 5 year trailing average.

One of the criteria we have used to select corporate bonds in our approach is a maturity between 7 and 13 years (i.e. close to 10 years). Therefore, in order to implement the European Commission's approach use the same set of corporate bonds we have used in our main approach. We report below the five-year trailing average debt premium for each mobile and fixed-line comparator. For each comparator the debt premium is calculated as the difference between the average yields across each company's eligible bonds and the risk free rate calculated in Figure 13.1.

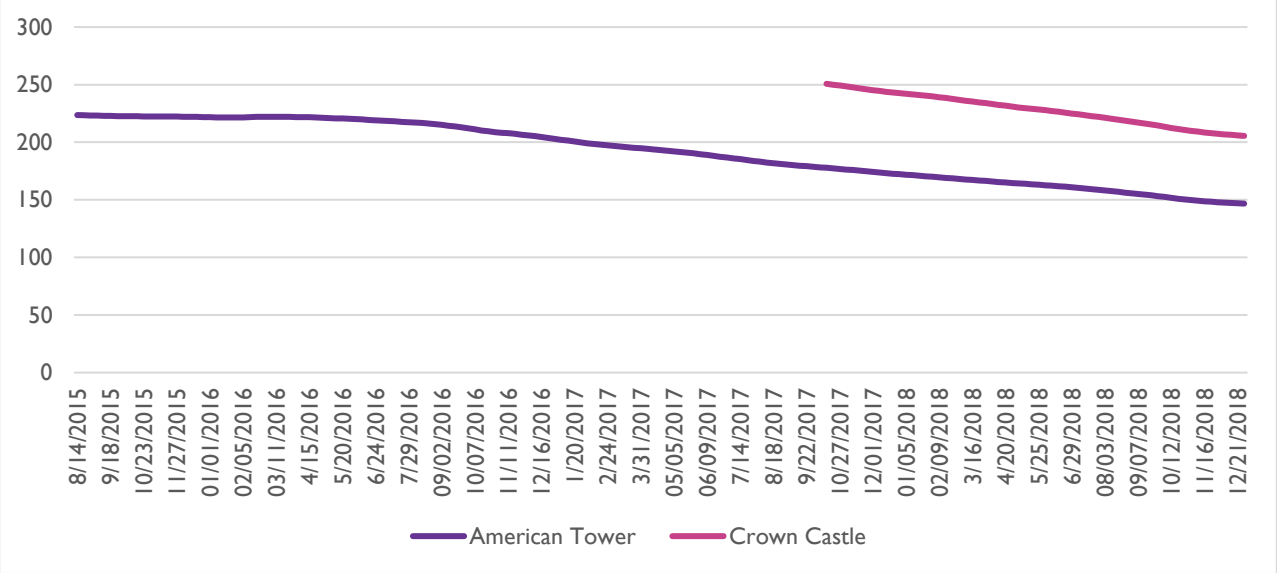
Figure 13.5: Debt premium of mobile and fixed line operators following the EC approach



We see that five year trailing average debt premium calculated using the European Commission's approach is negative for some companies (namely Swisscom and KPN). The five year trailing average debt premiums for the other operators range between 0.75 per cent and 2.22 per cent. If we exclude Swisscom and KPN (on the ground that they have on average a negative debt premium), the average debt premium across mobile other operators (i.e. including Vodafone) is 1.49 per cent, whilst the debt premium across fixed-line operators (i.e. excluding Vodafone) is 1.30 per cent.

The corporate bonds we have used to determine the debt premium for the broadcasting have been issued by US-based companies (i.e. Crown Castle and American Tower, see Section 7.4.2), and therefore it would be inappropriate to calculate spreads of these companies against a basket of European government bonds (as recommended by the European Commission). However, in the spirit of the European Commission's approach, we have calculated the 5-yeartrailing average spreads (against the appropriate US government benchmark) based on weekly data. The results are illustrated below.

Figure 13.6: Debt premium broadcasting operators following the EC approach



As we can see the 5 year trailing average debt premium of the two broadcasting operators ranges between 1.46bps and 205bps, and the average between the two (at the end of 2018) is 1.76 per cent.

13.6 Overall WACC

For completeness we report below the WACC estimates that would be obtained following the approach recommended by the European Commission. We observe that the values here are markedly lower than those produced by either the method set out in the main report or the UK regulator-style method set out in Appendix 4. The key reason for this is the extraordinarily low TMR figure produced by the way the EC method recommends the risk-free rate and ERP be obtained — a method producing a TMR nearly 3 percentage points lower than that we report in the main text above and that estimated by the main UK regulators for the UK.

Table 13.1: Overall WACC under the European Commission's approach

	Mobile	Fixed-line	Broadcasting
Real risk-free rate	-0.59%	-0.59%	-0.59%
Real ERP	4.22%	4.22%	4.22%
Inflation	1.80%	1.80%	1.80%
Nominal risk-free rate	1.20%	1.20%	1.20%
Nominal ERP	4.30%	4.30%	4.30%
Unlevered beta	0.50	0.50	0.43
Notional gearing	35%	40%	25%
Notional equity beta	0.77	0.83	0.57
Nominal cost of equity (post-tax)	4.51%	4.78%	3.66%
Tax rate	12.50%	12.50%	12.50%
Nominal cost of equity (pre-tax)	**5.15%**	**5.47%**	**4.19%**
Debt premium	1.50%	1.30%	1.76%
Nominal cost of debt (pre-tax)	**2.70%**	**2.50%**	**2.96%**
Nominal vanilla WACC	**3.87%**	**3.87%**	**3.49%**
Nominal WACC (pre-tax)	**4.29%**	**4.28%**	**3.88%**