

The Brattle Group

The WACC for Wholesale Broadband and FttO

29 May 2013

Dan Harris
Cosimo Fischietti

Prepared for ACM

Contents

1.	Introduction and Summary	1
2.	Current WACC for Wholesale Broadband	5
2.1.	Cost of Debt.....	5
2.2.	Gearing	6
2.3.	The Risk-Free Rate	8
2.4.	Beta	9
2.5.	The Equity Risk Premium	13
2.6.	Summary of Current Wholesale Broadband WACC	16
3.	2011 WACC for Wholesale Broadband	17
3.1.	Cost of debt.....	17
3.2.	Gearing	17
3.3.	The Risk-Free Rate	17
3.4.	Beta	18
3.5.	The Equity Risk Premium	19
3.6.	Summary of 2011 Wholesale Broadband WACC	20
4.	WACC for Fibre-to-the-Office	21
4.1.	The Search for an FttO Peer Group	22
4.2.	Precedent from Regulatory Decisions	22
4.3.	Estimate of the Current FttO WACC.....	23
4.4.	FttO WACC for 2005 to 2045	27
	Appendix I – Statistical Adjustments to the Peer Group	30
	Appendix II – Details on KPN’s Leverage	32
	Appendix III – FttO Peer Group Analysis	33
	Appendix IV – Investments by Telecoms Firms	36

1. INTRODUCTION AND SUMMARY

OPTA, the Independent Post and Telecommunication Authority in the Netherlands, regulates the price of wholesale broadband services, including the sale of wholesale broadband over fibre. To arrive at the regulated price, OPTA must calculate the Weighted Average Cost of Capital (WACC) for these activities. In this context, OPTA has commissioned *The Brattle Group* to calculate the WACC for:

1. Wholesale Broadband services, which in practice will be set equal to the WACC of KPN Telecom;
2. Fibre-to-the-Office (FttO);

In estimating the WACC for the different activities, OPTA has asked us to apply a WACC methodology which it has developed together with the NMa. In broad terms, the methodology estimates the WACC by applying the Capital Asset Pricing Model (CAPM) to calculate the cost of equity. The CAPM expresses the cost of equity for a business activity as the sum of a risk-free rate and a risk premium. The size of the risk premium depends on the systematic risk of the underlying asset, or project, relative to the market as a whole.¹

The risk-free rate is calculated based on the three-year average yield on 10-year Dutch and German government bonds. The ERP is calculated using long-term historical data on the excess return of shares over long-term bonds, using data from European markets. In more detail, the methodology specifies that the projected ERP should be based on the average of the arithmetic and geometric average realised ERP. The methodology also takes note of other estimates of the ERP, for example from dividend growth models, when deciding whether any adjustments need to be made to the final ERP. In the current case, we have applied the ‘raw’ historical ERP without making any of the standard downward adjustments. Hence, in effect we have increased our estimate of the ERP because of evidence from dividend growth models, relative to a situation where we apply the standard downward adjustments. The methodology specifies that the equity betas are estimated using daily returns over three years and tested for liquidity and statistical robustness.

OPTA have asked us to estimate the WACC for wholesale broadband based on the latest data available. We refer to this as the ‘current WACC’. We also calculate a wholesale broadband WACC that would have been applied starting with 2011. We refer to this as the ‘2011 WACC’. For the FttO WACC, OPTA have requested that the WACC should be suitable for use in a discounted cash flow (DCF) model which runs from 2005 to 2045. We refer to this as the ‘FttO DCF WACC’.

WACC for Wholesale Broadband

OPTA has specified that the WACC for wholesale broadband should be measured by reference to KPN’s WACC. There are several issues involved in measuring KPN’s current WACC. First, there has been a significant increase in KPN’s gearing² over the period during which we measure beta.

¹ Further information on assumptions and theory underlying the CAPM can be found in most financial textbooks; see Brealey, Richard; Myers, Stewart; Allen, Franklin; “*Principles of Corporate Finance*.”

² While gearing is sometimes referred to as the ratio of a firm’s debt to equity (D/E), in this report we define gearing as the ratio of debt to the sum of debt plus equity. We refer to the ratio of debt to equity as leverage.

This increase in gearing has been largely due to the decline in KPN's share price – and implicitly in market capitalisation – rather than to an increase in debt. Hence, we have been careful to take KPN's average gearing over the last three-years and use this when converting KPN's observed equity beta to an asset beta.

We have also accounted for the effect of KPN's recently announced €4 billion rights issue. We have estimated the effect that this would have on KPN's future gearing, and use this as our forward-looking estimate of gearing when we re-lever KPN's asset beta to an equity beta.

When estimating KPN's beta, we noted that KPN's share price over the last two-three years might have been driven in large part by events specific to KPN, rather than by changes in the market in general. These events ultimately resulted in the rights issue, and will have depressed KPN's beta. It also seems likely that over the next three years, KPN's *future* beta will be more similar to the historical betas of its peers, and less like the beta of KPN estimated over the last three years. Accordingly, using KPN's actual beta risks underestimating KPN's true forward-looking beta. To account for this, we have estimated KPN's future asset beta by using the average asset beta of KPN's peers, rather than KPN's actual beta.

The factors discussed above that may have depressed KPN's beta were less influential in the period 2008-2010. Nevertheless, to maintain consistency with the current WACC estimate, we have used the same peer group to estimate KPN's 2011 beta. Table 1 below summarises the parameters that we have used to estimate both the current and 2011 WACC for KPN, which is the WACC for wholesale broadband.

Table 1: KPN's Current WACC and the 2011 WACC

		Current WACC	2011 WACC	
Risk free rate	[1]	2.52%	3.62%	Section 2.3; 3.3
Equity beta	[2]	0.81	0.64	Section 2.4; 3.4
ERP	[3]	5.00%	5.4%	Section 2.5; 3.5
After-tax cost of equity	[4]	6.56%	7.08%	$[1]+[2]\times[3]$
Pre-tax cost of debt	[5]	5.20%	5.32%	Section 2.1; 3.1
Tax rate	[6]	25%	25.5%	KPMG
After-tax cost of debt	[7]	3.90%	3.96%	$[5]\times(1-[6])$
Future gearing (D/A)	[8]	55%	44%	Section 2.2; 3.2
Gearing (D/E)	[9]	120%	78%	$[8]/(1-[8])$
Nominal after-tax WACC	[10]	5.11%	5.72%	$(1-[8])\times[4]+(1-[6])\times[5]\times[8]$
Nominal pre-tax WACC	[12]	6.81%	7.68%	$[10]/(1-[6])$
Inflation	[11]	2.00%	1.7%	Brattle analysis
Real pre-tax WACC	[13]	4.72%	5.88%	$(1+[12])/(1+[11])-1$

WACC FOR FttO

To calculate a specific WACC for FttO services, we have investigated if it is possible to find one or more listed firms that earn the majority of their revenue from FttO activities. If such firms existed, we could then estimate a beta for the FttO activity. Specifically, we have reviewed the annual reports

and quarterly presentations of 24 listed telecommunications companies worldwide to find the percentage of revenues and EBITA from FttO activities. However, none of the firms surveyed reported separate earnings from fibre activities. Hence we are not able to identify a peer group for the FttO activity.

As an alternative to finding a peer group from which we can estimate a beta, we have investigated reasonable ways to modify the Wholesale Broadband WACC to make it suitable for the FttO activity. In our view, there are two possible reasons to believe that the beta, and hence the WACC for FttO could differ from the WACC for wholesale broadband.

The first concerns the ratio of fixed to variable costs in a newer fibre network relative to a mature and partially depreciated copper network. A fibre network might have a relative high proportion of fixed costs relative to the networks which we used to estimate beta for the wholesale broadband activity. High fixed costs can have a similar effect to debt, in that they make profits – and therefore the share price – more sensitive to changes in revenues. We estimate the effect that the higher proportion of fixed costs could have on the beta, by comparing the fibre network to a copper network with a higher level of debt. We estimate that it would be reasonable to increase the WACC for fibre by around 1 percentage to the nominal pre-tax WACC for wholesale broadband to account for the potential for higher operating leverage.

The other factor that we could increase the WACC for FttO relative to wholesale broadband is if demand for FttO proved to be more or less sensitive to changes in macroeconomic conditions than demand for copper networks. In this case we would expect the beta for FttO to differ from the beta for copper networks. We conclude that it is not clear that OPTA needs to make an additional adjustment to the wholesale broadband WACC to account for the different sensitivity of FttO demand to the economy relative to demand for copper-based telecoms services.

To calculate the FttO DCF WACC, we use the higher estimate of the beta described above, and calculate a risk-free rate for each year for the period 2005 to 2012 inclusive. For the period for 2013 to 2045, the method specifies the use of the risk-free rate adopted for the computations of the current WACC. Table 2 summarizes the results.

Table 2: FttO DCF WACC for 2005 to 2045

			FttO WACC	FttO WACC	FttO WACC	FttO WACC	FttO WACC
			2005	2006	2007	2008	
Risk free rate	[1]	Section 2.3	4.43%	3.93%	3.80%	3.84%	
Equity beta	[2]	Section 2.4	1.17	1.17	1.17	1.17	
ERP	[3]	Section 2.5	5.00%	5.00%	5.00%	5.00%	
After-tax cost of equity	[4]	[1]+[2]x[3]	10.27%	9.77%	9.64%	9.68%	
Pre-tax cost of debt	[5]	Section 2.1	5.20%	5.20%	5.20%	5.20%	
Tax rate	[6]	KPMG	25%	25%	25%	25%	
After-tax cost of debt	[7]	[5]x(1-[6])	3.90%	3.90%	3.90%	3.90%	
Future gearing (D/A)	[8]	Section 2.2	55%	55%	55%	55%	
Gearing (D/E)	[9]	[8]/(1-[8])	120%	120%	120%	120%	
Nominal after-tax WACC	[10]	(1-[8])x[4]+(1-[6])x[5]x[8]	6.8%	6.6%	6.5%	6.5%	
Nominal pre-tax WACC	[12]	[10]/(1-[6])	9.1%	8.8%	8.7%	8.7%	
Inflation	[11]	Section 7	2.00%	2.00%	2.00%	2.00%	
Real pre-tax WACC	[13]	(1+[12])/(1+[11])-1	6.92%	6.62%	6.55%	6.57%	

			FttO WACC	FttO WACC	FttO WACC	FttO WACC	FttO WACC
			2009	2010	2011	2012	2013-2045
Risk free rate	[1]	Section 2.3	4.11%	4.05%	3.62%	3.18%	2.52%
Equity beta	[2]	Section 2.4	1.17	1.17	1.17	1.17	1.17
ERP	[3]	Section 2.5	5.00%	5.00%	5.00%	5.00%	5.00%
After-tax cost of equity	[4]	[1]+[2]x[3]	9.95%	9.90%	9.46%	9.03%	8.37%
Pre-tax cost of debt	[5]	Section 2.1	5.20%	5.20%	5.20%	5.20%	5.20%
Tax rate	[6]	KPMG	25%	25%	25%	25%	25%
After-tax cost of debt	[7]	[5]x(1-[6])	3.90%	3.90%	3.90%	3.90%	3.90%
Future gearing (D/A)	[8]	Section 2.2	55%	55%	55%	55%	55%
Gearing (D/E)	[9]	[8]/(1-[8])	120%	120%	120%	120%	120%
Nominal after-tax WACC	[10]	(1-[8])x[4]+(1-[6])x[5]x[8]	6.6%	6.6%	6.4%	6.2%	5.9%
Nominal pre-tax WACC	[12]	[10]/(1-[6])	8.9%	8.8%	8.6%	8.3%	7.9%
Inflation	[11]	Section 7	2.00%	2.00%	2.00%	2.00%	2.00%
Real pre-tax WACC	[13]	(1+[12])/(1+[11])-1	6.73%	6.70%	6.44%	6.18%	5.79%

2. CURRENT WACC FOR WHOLESALE BROADBAND

2.1. COST OF DEBT

OPTA specified that, consistent with the last estimate of KPN's WACC, we should use KPN's actual or 'embedded' cost of debt when estimating the WACC. This is in contrast to the alternative approach of estimating KPN's cost of debt based on current or forecast market rates. Accordingly, as with the previous methodology, we have calculated KPN's cost of debt as the weighted average coupon cost of all Euro denominated KPN bonds outstanding as of 1st March 2013. Following the previous methodology, we do not account for the cost of non-Euro denominated debt. The logic is that bonds issued in non-Euro currencies are for KPN's own risk, and that if the interest rate on these bonds is higher or lower than that on Euro nominated bonds, then the cost or benefit of this should not be reflected in the WACC that OPTA will apply for regulatory purposes. This results in a cost of debt of 5.05%. Table 3 illustrates.

Table 3: KPN's Embedded cost of debt as of 31/03/2013

Issue Date	Maturity	Coupon, %	Face Value, Mn
16/03/2006	18/03/2013	4.50%	850
16/09/2008	16/09/2013	6.25%	850
04/02/2009	04/02/2014	6.25%	750
29/05/2007	29/05/2014	4.75%	650
22/06/2005	22/06/2015	4.00%	1,000
02/04/2008	15/01/2016	6.50%	925
13/11/2006	17/01/2017	4.75%	1,000
04/02/2009	04/02/2019	7.50%	750
21/09/2010	21/09/2020	3.75%	1,000
15/09/2011	04/10/2021	4.50%	500
30/09/2009	30/09/2024	5.63%	700
01/08/2012	01/02/2021	3.25%	750
01/03/2021	01/03/2022	4.25%	750
Total			10,475
Weighted Average Coupon Cost			5.05%

Notes and sources:

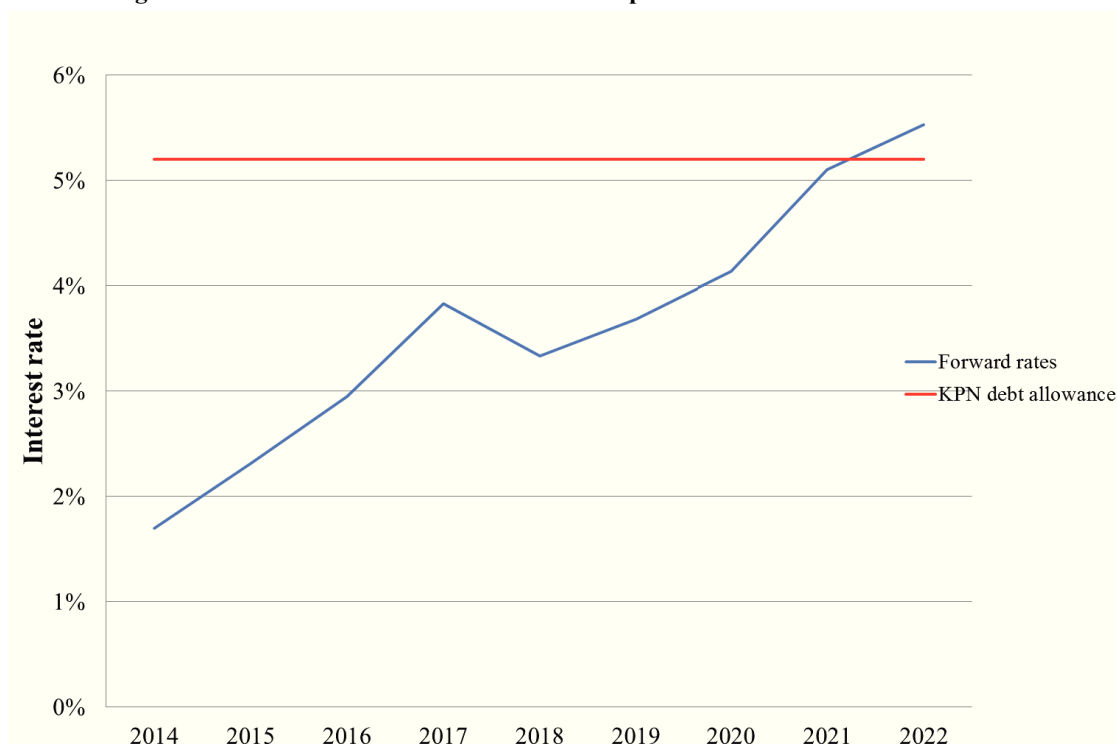
Brattle Analysis of Bloomberg data; KPN, Annual report 2012, p. 122.

The methodology specifies an additional allowance of 15 basis points to cover the costs of issuing debt, for example banking, legal and agency fees. Hence, we add 15 basis points to the cost of debt calculated in Table 3.

Table 3 also illustrates that about €1.7 billion of debt may be re-financed in 2013, €1.4 billion in 2014, and €1.0 billion in 2015 – about €4.1 billion in total. In practise, KPN has announced a rights issue, the intention of which is to reduce the level of debt. We discuss the effect of the rights issue on KPN's gearing in the next section, but it seems that KPN may in fact not be refinancing large amounts of debt during the next few years, but rather retiring debt. Nevertheless, we have derived a forward curve for the current cost of debt for Eurozone firms with a Standard & Poors (S&P) Credit

rating of BBB, similar to KPN's rating. Figure 1 illustrates that an allowed cost of debt of 5.20% would allow KPN to make a financial gain from refinancing debt until 2020, well after the end of the next regulatory period.

Figure 1: Forward cost of BBB-rated debt compared to KPN's allowed cost of debt



2.2. GEARING

We have calculated KPN's gearing – the ratio of net debt to net debt plus equity – using data from Bloomberg. We follow standard practise by calculating net debt as the sum of long-term and short-term debt, less cash and cash equivalents.

We also account for the presence of KPN's long-term operating leases, which can affect the apparent gearing of the firm. In essence, a firm can chose to borrow money and build its own network of masts, transmitters etc. Or, it can sign a long-term operating lease to use a third-party's network. The operating lease would commit the mobile firm to make fixed payments for a period of perhaps 10 or 20 years. The latter arrangement of using an operating lease instead of debt will appear to give the firm less debt and, hence, a lower gearing on its balance sheet. However, from an economic perspective, a firm which has borrowed €1 billion to build a network or a firm that has signed an operating lease with payments with a present value of €1 billion are the same. The operating lease will have the same effect as debt on the observed equity beta. Therefore, when calculating the gearing we should account for the presence of operating leases. Specifically, we discount the commitments under the operating lease at the firm's cost of debt, and then treat the present value of the commitments as debt in the gearing calculation. Failure to account for the

operating leases could give the impression that some firms have higher gearing than others, whereas in practice this only reflects a different choice between the use of debt or an operating lease.³

Since the method requires the use of a three-year beta, we have examined KPN's gearing level over the period 2010 to 2012 inclusive. KPN's gearing has increased significantly over this period, from 40% at the beginning of 2010 to nearly 75% at the end of 2012. While KPN's net debt has increased over the period – from about €11 billion to €13 billion – the increase in gearing has mainly been caused by a reduction in KPN's market capitalisation.

In its 2012 Annual Report, KPN announced a €4 billion rights issue, the aim of which was to reduce KPN's gearing and maintain its credit rating. KPN noted that the rights issue “will strengthen KPN's balance sheet and is intended to provide a stable financial position in the coming years. We believe that the capital raise will support KPN's commitment to maintain an investment grade credit profile.”⁴ KPN also notes that “[t]he [rights issue] would lower KPN's reported net debt / EBITDA at the end of 2012 by approximately 0.9x.”⁵ In Table 4 we confirm that this corresponds to a reduction in debt of about €4 billion.

Table 4: Estimated reduction in KPN debt as a results of the rights issue

Net Debt end 2012	[1]	KPN Annual report 2012 p.134	12,033
EBITDA	[2]	KPN Annual report 2012 p.134	4,403
Ratio, Net Debt to EBITDA end 2012	[3]	[1]/[2]	2.7
Claimed reduction in ratio	[4]	KPN Annual report 2012 p.134	0.9
Ratio, Net Debt to EBITDA post Rights Issue	[5]	[3]-[4]	1.8
Implied debt	[6]	[5]x[2]	8,070
Reduction in net debt	[7]	[1]-[6]	3,963

KPN's main shareholders have approved the rights issue. Accordingly, any forward looking WACC estimate should account for the effect of the rights issue on KPN's gearing. In Table 5 we estimate that KPN's gearing after the rights issue will be around 55%, and this is the number we use for our WACC estimate.

In general we note that KPN's WACC calculated according to OPTA's methodology will be relatively insensitive to the assumed level of debt. Assuming a higher degree of debt, and hence giving more weight to the relatively low cost of debt, will be offset by the increase in equity which results from the higher gearing. Moreover, KPN's is allowed its actual cost of debt. Hence a credit downgrade, and an increase in the market cost of KPN's debt, would not affect KPN's allowed cost of debt. However, it is conceptually important to choose a level of gearing that is consistent with the assumed credit rating, if only to carry out the financeability test illustrated in Figure 1.

³ Note that if all mobile firms applied the same approach and uniformly used operating leases, we would not need to worry about this issue. The operating lease would simply be another fixed cost. It is the flexibility to choose between debt and operating leases which creates the potential problem.

⁴ KPN 2012 Annual report p.28.

⁵ *Ibid.* p.134.

Table 5: Effect of rights issue on KPN's Gearing – all numbers in millions of Euro

Market Cap, adjusted for rights issue	[1]	See note	9,320
ST Debt	[2]	Appendix II	2,124
LT Debt, adjusted for rights issue	[3]	See note	8,387
Total Debt	[4]	[2]+[3]	10,511
Cash Items	[5]	Appendix II	1,495
Net Debt	[6]	[4]-[5]	9,016
Present Value of Operating Leases	[7]	Appendix II	2,183
Net Debt including Operating Leases	[8]	[6]+[7]	11,199
D/E, post rights issue	[9]	[8]/[1]	120%
Gearing	[10]	[8]/{[8]+[1]}	55%

Notes

[1]: Market Cap in Appendix II plus €4000 million

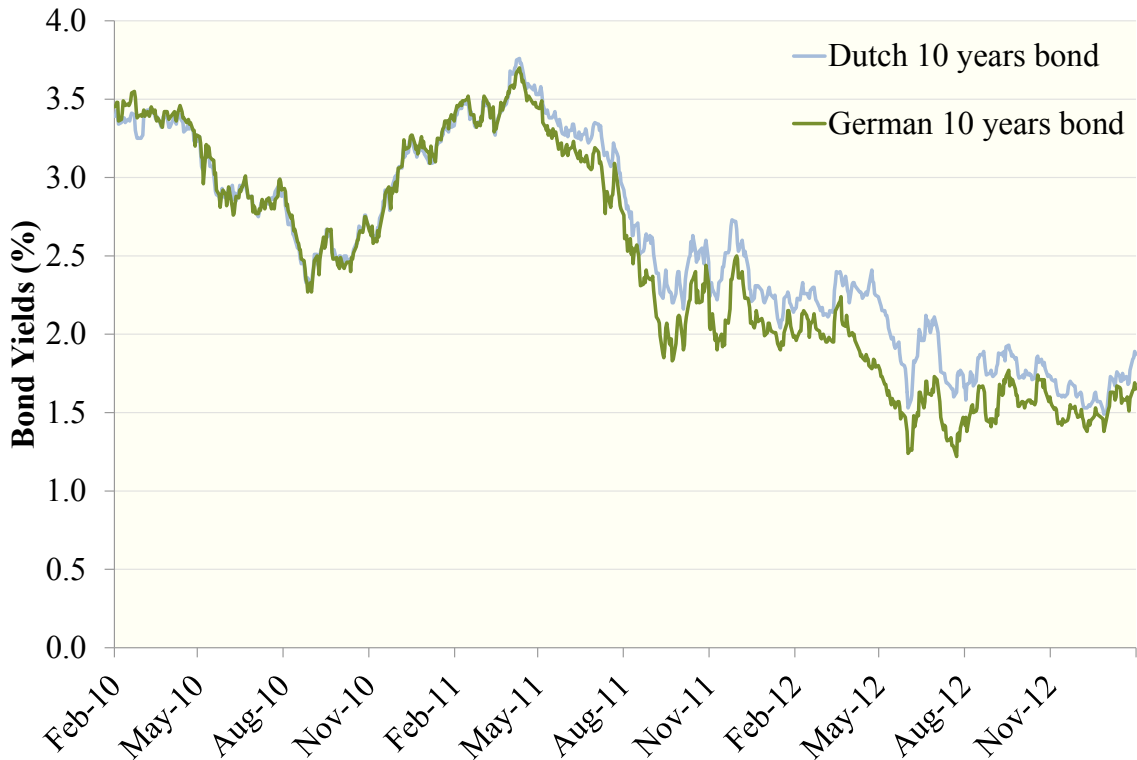
[3]: LT Debt in Appendix II minus €4000 million

2.3. THE RISK-FREE RATE

The methodology specifies a risk-free rate based on a three-year average of the 10 year German and Dutch government bonds. As discussed in the Phase 1 report for the NMa, the method uses a simple average between Dutch and German bonds because this reflected a fair trade-off between choosing a truly risk-free rate on the one hand and considering the extra information that Dutch bonds give about country-risk on the other. Figure 2 below shows the movement of the bond yields over the prior three years. We note that, as a result of the economic crisis and subsequent easing of monetary policy, the risk free rate has declined substantially over the three year reference period.

The three-year average yield is 2.59% for the 10-year Dutch government bond and 2.46% for the 10-year German government bond. This yields a simple average risk-free rate of 2.52%.

Figure 2: Yield on Dutch and German Government 10 Year Bonds



2.4. BETA

The method specifies that KPN's beta must be measured as the covariance between the company returns and the returns of an index representing the overall market. The methodology specifies a broad Eurozone index. Our recent report for the NMa discusses the reasons for the use of a Europe wide index in more detail, but, in essence, the idea is that the typical investor in a Dutch telecoms firm would be diversified across Europe.⁶ Therefore a European index is the correct reference point for measuring the systematic risks of the activity. Since the Phase I report, we have refined the methodology to say that the investor would be diversified in particular across the Eurozone, because this would eliminate exchange rate risk. Therefore, a Eurozone index is the correct reference point for measuring the systematic risks of the activity.

The methodology specifies a three year daily sampling period for the beta. The simple Ordinary Least Squares (OLS) three year daily equity beta estimate is 0.45. This equity beta measures the risk of KPN's equity, which will reflect its financing decisions. As debt is added to the company, the equity will become riskier as, each year, more cash from profits goes towards paying debt instead of distributing dividends to equity. With more debt, increases or decreases in firm profit will have a larger effect on the value of equity. Hence, if two firms engage in exactly the same activity but one firm has a higher gearing, that firm will also have a higher beta than the firm with lower gearing.

⁶ *Loc. Cit.* footnote 1.

In section 2.2 we explained that the average gearing during the three-year period over which we measured KPN's beta was 50.3%, whereas our estimate of KPN's future gearing is 55%. Accordingly, in Table 6 we un-lever KPN's beta imagining that the firm is funded entirely by equity. The resulting beta is referred to as an asset beta or an unlevered beta. To accomplish the un-levering, the methodology specifies the use of the Modigliani and Miller formula.⁷ This results in an asset beta for KPN of 0.24.

Table 6: Un-levering KPN's beta

Adjusted Equity Beta Estimate	[1] Brattle estimate	0,45
Average D/E	[2] Appendix II	112%
Tax Rate	[3] KPMG	25%
Asset Beta	[4] $[1]/(1+(1-[3])\times[2])$	0,24

In a recent report for OPTA, we estimated an average asset beta for fixed-line operators of 0.39 and an average asset beta for mobile operators of 0.49.⁸ Table 7 illustrates. Hence, KPN's asset beta is significantly lower than that of its peers. Our concern is that the reason KPN's beta is low is because of events which are particular to KPN, and that might not be repeated in the future. In particular, KPN's share price has fallen over the last 2-3 years, relative to other telecom firms in the EU. One article noted that said "KPN's financial distress had been partially self-inflicted" implying that the reasons were specific to KPN rather than the telecoms sector more generally.⁹ The article also notes that KPN had paid out too much money to shareholders in the form of share buy backs and dividends, leaving insufficient funds for investment in the business. This means that KPN's share price might have been driven in large part by events specific to KPN, rather than by changes in the market in general. Figure 3 illustrates the relationship between KPN's share price and two other large telecoms firms, BT and Vodafone, over the period for which we estimate beta. For ease of comparison, the chart re-bases all of the share prices to 100 at the start of the period. While the share prices of BT and Vodafone increased over the period, KPN's share price fell by more than 50%. If factors specific to KPN drive its share price, then this will have weakened the correlation between the market index and KPN's share price. As a result, KPN's beta would decrease.

⁷ The specific construction of this equation was suggested by Hamada (1972) and has three underlying assumptions: A constant value of debt; a debt beta of zero; that the tax shield has the same risk as the debt.

⁸ The WACC for mobile, fixed-line and cable termination rates, *The Brattle Group*, 28 December 2012, Table 13 p.21.

⁹ 'KPN to Raise 4 Billion Euros to Fend Off Rivals' Kevin O'Brien, *The New York Times*, February 5 2013. http://www.nytimes.com/2013/02/06/technology/kpn-to-raise-4-billion-euros-to-fend-off-rivals.html?_r=0

Figure 3: Index of KPN, BT and Vodafone share prices



KPN has since revised its financial policies, and is planning a large rights issue, discussed above. Hence it seems likely that over the next three years, KPN's *future* beta will be more similar to that of its peers, and less like the beta of KPN estimated over the last three years. Using KPN's actual beta risks underestimating KPN's true forward-looking beta.

Table 7: Asset Betas of Fixed and Mobile Firms

Firm	Country	Gearing (D/E) [A] Bloomberg	Equity Beta [B] Brattle Estimation	Tax Rate [C] KPMG	Asset Beta [D] See Note
Fixed Line Operators Peer Group					
BT	UK	78.5%	0.82	28.0%	0.52
Iliad	France	16.4%	0.46	33.3%	0.42
TDC	Denmark	74.4%	0.37	25.0%	0.24
Average					0.39
Mobile Operators Peer Group					
Vodafone	UK	48.8%	0.47	28.0%	0.35
Mobistar	Belgium	24.6%	0.49	34.0%	0.43
Sonaecom	Portugal	59.4%	0.72	25.0%	0.50
Telenor	Norway	25.4%	0.82	28.0%	0.69
Average					0.49

Notes and Sources

$$[D]=[B]/(1+(1-[C])\times[A])$$

Because of these factors, we think that using the average beta of KPN's peers will give a more reliable forecast of KPN's beta over the next few years. Specifically, Table 25 in Appendix III illustrates that KPN earns around one-third of its revenues from mobile services, and two-thirds from other mainly fixed-line services. Hence, we have estimated an asset beta for KPN based on the asset betas of fixed-line and telecoms firms using this ratio. Table 8 illustrates that this results in an estimated asset beta for KPN of 0.42. In July 2012 consultants for OPTA estimated a (Blume adjusted) five-year asset beta for KPN of 0.37.¹⁰ Hence, our beta estimate is similar, though slightly higher than, the July 2012 estimate. We then re-lever the beta using the estimate of KPN's future debt levels to get an equity beta of 0.81.

Table 8: Deriving KPN's beta

Mobile Asset Beta	[1]	Table 7	0.49
Fixed Asset Beta	[2]	Table 7	0.39
Percentage of KPN Revenues from Mobile	[3]	Appendix III	32%
Percentage of KPN Revenues from Fixed line or other	[4]	Appendix III	68%
Estimated KPN Asset Beta	[5]	[1]x[3]+[2]x[4]	0.42
D/E	[6]	Appendix II	120%
Tax Rate	[7]	KPMG	25.0%
Future Equity Beta	[8]	[5]x(1+(1-[7])x[6])	0.81

Adjustments to the Peer Group Betas

We have made a number of adjustments to the peer-group betas in Table 8, which account for various issues that occur when estimating betas. First, when calculating betas using daily returns,

¹⁰ The Cost of Capital for KPN's Wholesale Activities, A Final Report for OPTA, NERA, 9 July 2012, Table 5.1 p.27.

there is a risk that a firm's share price may appear to react to the market index the day before or the day after. This could occur because of differences in market opening times and trading hours, or differences in the liquidity of the firm's shares vs. the average liquidity of the market. If such an effect is present, it could affect a beta which is calculated using only the correlation between the return on the firm's share on day D and the return on the market index on the same day.

The "Dimson" adjustment is a standard test which deals with this effect. The Dimson adjustment estimates betas by performing the same regression against the market index as for a standard beta, but includes also the company returns from either one day ahead or one day before that of the market (or both).¹¹ If the market is perfectly efficient, then all information should be dealt with on the same day, so that a beta measured using the company returns from either one day ahead or one day before that of the market index return should be zero. A beta significantly different from zero¹² suggests that information about the true beta may be contained in returns from the day before or the day after the market return is calculated.

The Dimson beta adjustment combines the beta estimates from the day ahead and day before with the original beta estimate to give an overall beta which includes the information provided in the adjacent days. We apply this test to the peer group.

We perform a further series of standard diagnostic tests to assess if the peer group beta estimates satisfy the standard conditions underlying ordinary least squares regression, which are outlined in the Appendix. Once we have applied the corrections the betas should be robust to autocorrelation and heteroskedasticity.

The methodology requires that we apply the Vasicek adjustments to the observed equity betas. This adjustment takes account of a prior expectation of the equity beta. In this case, we have used a prior expectation of the beta of 1.0, which is the market average. We considered applying the critique of Lally,¹³ which among other things argues for using a prior expectation of the beta which is specific to the activity in question. However, if we applied this technique to the peer group, it would simply move each individual beta closer to the average beta, but it would not change the peer group average. Accordingly, when applying this technique to a peer group we think it is more meaningful to apply a prior expectation of beta of 1.0. For the prior expectation of the standard error we use the standard error on the overall market.¹⁴ Appendix II illustrates the effects of the adjustments discussed above.

2.5. THE EQUITY RISK PREMIUM

The methodology specifies a 'European' ERP. That is, it uses an ERP based on the excess return of stocks over bonds for the major economies of Europe, rather than the ERP based on only the excess return of shares in the Netherlands. More specifically, the methodology uses the simple

¹¹ More days of leads and lags can be applied, but in this case we look at only one lead and one lag.

¹² Significance is taken at the 5% level.

¹³ Lally, Martin; "An Examination of Blume and Vasicek Betas". Financial Review, August 1998.

¹⁴ The standard error on the FTSE 100 index is used as a proxy for the European market, and is reported by LBS. Valueline reports the standard deviation of all stocks in the US market. As we are using the market average beta for our prior expectation, it is consistent to use the standard deviation of the distribution of the betas underlying the market population as the prior expectation of the standard error.

average of the long-term arithmetic and geometric ERP as the anchor for the ERP estimate. We also present evidence on the long-term ERP in Europe using both the arithmetic and geometric realised ERP.

Table 9 illustrates the realised ERP derived from the Dimson, Marsh and Staunton (DMS) study for individual European countries.¹⁵ This report contains ERP estimates using data up to and including 2012. Table 9 also shows the simple and weighted average ERP for the Eurozone. All the ERPs are calculated relative to long-term bonds and the weighting is based on current market-capitalisation of each country's stock market. Hence, the ERPs of larger markets are given more weight, assuming that a typical investor would have a larger share of their portfolio in countries with more investment opportunities.

Table 9: Historic Equity Risk Premium Relative to Bonds: 1900 - 2012

	Geometric Mean [1]	Arithmetic Mean [2]	Average [3]	Standard Error [4]	Current Market Cap (\$mm) [5]
Belgium	2.3%	4.3%	3.3%	2.0%	312,551
Denmark	1.8%	3.3%	2.6%	1.6%	265,105
Finland	5.3%	8.9%	7.1%	2.8%	173,907
France	3.0%	5.3%	4.2%	2.1%	1,723,289
Germany	5.2%	8.6%	6.9%	2.7%	1,599,659
Ireland	2.6%	4.6%	3.6%	1.9%	124,002
Italy	3.4%	6.8%	5.1%	2.8%	502,150
The Netherlands	3.3%	5.6%	4.5%	2.1%	306,803
Norway	2.2%	5.2%	3.7%	2.6%	295,767
Spain	2.1%	4.1%	3.1%	1.9%	583,333
Sweden	2.9%	5.1%	4.0%	2.0%	644,287
Switzerland	2.0%	3.5%	2.8%	1.7%	1,328,124
United Kingdom	3.7%	5.0%	4.4%	1.6%	3,449,459
Europe	3.4%	4.8%	4.1%	1.5%	n/a
World	3.2%	4.4%	3.8%	1.4%	n/a
Average Eurozone	3.4%	6.0%	4.7%		
Value-Weighted Average Eurozone	3.6%	6.4%	5.0%		

Sources and Notes:

[1] - [4]: Credit Suisse Global Investment Returns Sourcebook 2013, Table 9.

[5]: Bloomberg LP as of 3/1/2013.

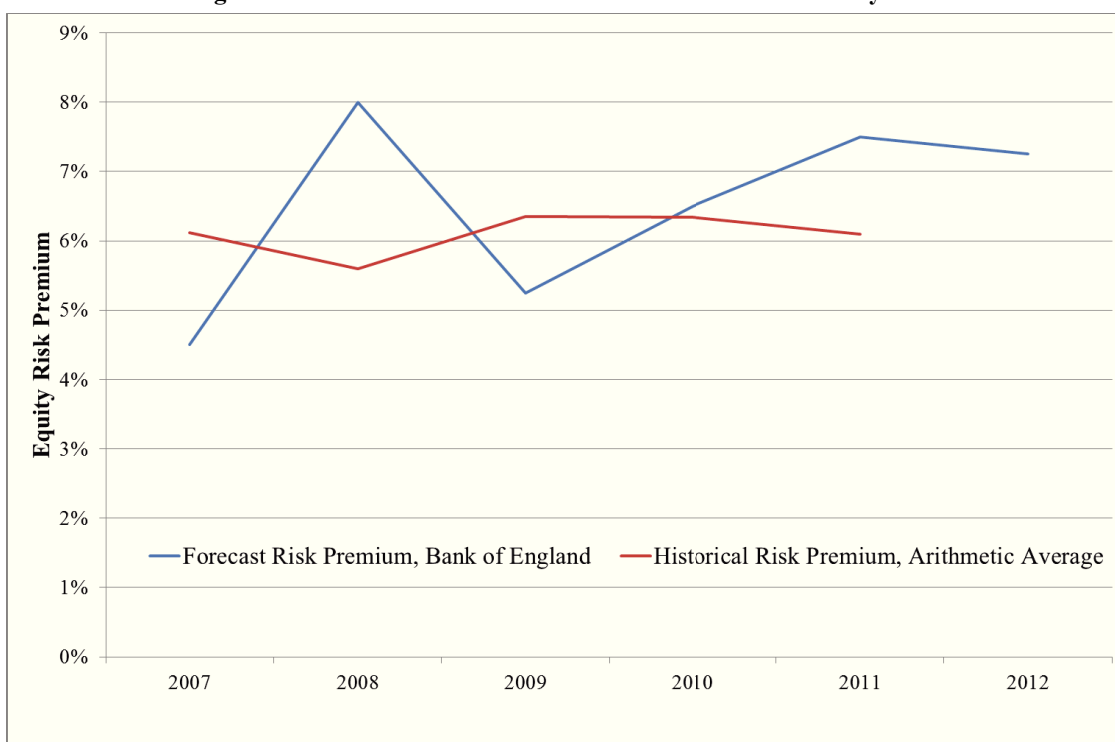
Looking at Table 9 the simple average of the arithmetic and geometric ERP for the period 1900 to 2012 was 4.1% if all of Europe is included, and 4.7% if only Eurozone countries are included. The very low ERP in Denmark and Switzerland in particular lower the simple average ERP for all of Europe. Using the market size to weight the averages for all of Europe, the ERP for the Eurozone is

¹⁵ E. Dimson, P. Marsh, and M. Staunton, *Credit Suisse Global Investment Returns Sourcebook 2013* (DMS), Table 10.

5.0%. These figures reflect the very long run and notably exclude countries in former Eastern Europe. As discussed in the previous section, we use the ERP for the Eurozone, since a Dutch investor is more likely to be diversified over the same currency zone, rather than to incur additional currency risks by diversifying within Europe but outside of the Euro zone.

ERPs forecasted on the basis of Dividend Growth Models are currently above the historically realised ERP. For example, the Bank of England produces ERP forecasts based on Dividend Growth Models, and forecasts the Euro Stoxx ERP at a little over 7%.¹⁶ As illustrated in Figure 4, 7% is above the historically realized simple average ERP for the Eurozone, which is 3.4% and 6.0% for the geometric and arithmetic average respectively.

Figure 4: Eurozone Historical and Forecast Risk Premiums by Year



Accordingly, forecast ERP estimates based on Dividend Growth Models are above the long-term average of the arithmetic and geometric ERP for Europe. Therefore, it seems reasonable not to make any of the downward adjustments that are sometimes applied to the historical average ERP, such as adjustments for the increase in price-dividend ratios over the last 50 years, and instead take the ‘raw’ historical ERP estimates. Accordingly, we apply a Eurozone average ERP of 5.0%.

¹⁶ Bank of England, “Financial Stability Report,” June 2012, Issue 31, Chart 1.11 p. 10. The next issue of the Bank of England’s Financial Stability Report is due in mid-December 2012.

2.6. SUMMARY OF CURRENT WHOLESALE BROADBAND WACC

Table 10 illustrates the overall calculation of the KPN's WACC obtained by combining the parameters in the previous sections.

Table 10: Current WACC for wholesale broadband

Risk free rate	[1]	2.52%	Section 2.3
Equity beta	[2]	0.81	Section 2.4
ERP	[3]	5.00%	Section 2.5
After-tax cost of equity	[4]	6.56%	[1]+[2]x[3]
Pre-tax cost of debt	[5]	5.20%	Section 2.1
Tax rate	[6]	25%	KPMG
After-tax cost of debt	[7]	3.90%	[5]x(1-[6])
Future gearing (D/A)	[8]	55%	Section 2.2
Gearing (D/E)	[9]	120%	[8]/(1-[8])
Nominal after-tax WACC	[10]	5.1%	(1-[8])x[4]+(1-[6])x[5]x[8]
Nominal pre-tax WACC	[12]	6.8%	[10]/(1-[6])
Inflation	[11]	2.00%	Brattle analysis
Real pre-tax WACC	[13]	4.72%	(1+[12])/(1+[11])-1

To convert the nominal WACC to a real WACC requires an adjustment for inflation. The methodology requires that inflation consider both historic and forecast rates of inflation in the Netherlands and Germany.

Historical inflation over the prior three years amounts to 2.07% for Germany and 2.48% for the Netherlands.¹⁷ This period matches the time horizon used for averaging the risk free rate, which may be useful as the bond yields will have inherent assumptions on the inflation expectations of the market.

Euro-area inflation predictions are provided by the ECB, which are based on a survey of professional forecasters. The short term prediction for the upcoming calendar year is 1.9%, and the five-year prediction is 2%.¹⁸

The Central Planning Bureau also provides a short term forecast of inflation rates for the Netherlands: the predicted inflation for 2013 is 2%. The Bundesbank provides a forecast for Germany of 1.6%.¹⁹

Based on the considerations above, we use an inflation rate of 2%. We apply the marginal corporate tax rate for the Netherlands, which in 2013 is 25%, to arrive at a real pre-tax WACC of 4.72%.

¹⁷ Data from Eurostat

¹⁸ Data from the ECB

¹⁹ Bundesbank, "Outlook for the German economy –macroeconomic projections for 2012 and 2013", June 2012.

3. 2011 WACC FOR WHOLESALE BROADBAND

3.1. COST OF DEBT

KPN's cost of debt as of the end of 2010 was calculated in a previous report for OPTA at 5.17%.²⁰ Adding 15 basis points to allow for issuing costs gives a final 2011 debt allowance of 5.32%.

3.2. GEARING

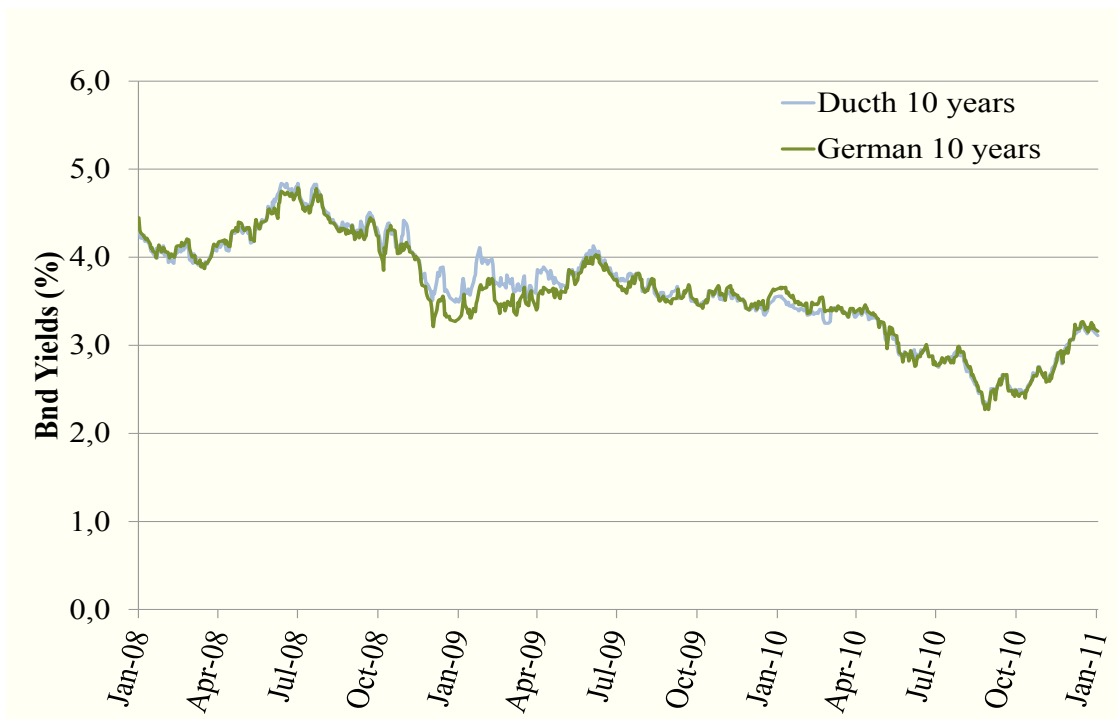
We calculate that at the end of 2010 KPN's gearing (net debt divided by net debt plus equity) was 44%. Appendix II illustrates the calculation. At the end of 2010 this would have been a good forward looking estimate of KPN's future gearing, and so we use this as our gearing assumption. Since we are not using KPN's beta in the analysis, we do not need to estimate KPN's gearing over the period 2008-2010.

3.3. THE RISK-FREE RATE

The method specifies a simple average of Dutch and German bonds 10-year government bonds for the risk-free rate. Figure 5 below shows the movement of the bond yields over the years 2008-2010. The three-year average yield is 3.63% for the 10-year Dutch government bond and 3.60% for the 10-year German government bond. This yields a simple average risk-free rate of 3.62%.

²⁰ NERA report, *Loc Cit.* footnote 10, Table 6.1 p.29.

Figure 5: Yield on Dutch and German Government 10 Year Bonds



3.4. BETA

We have calculated the average asset beta for the same peer group of fixed and mobile operators which we used to estimate the current WACC, for the years 2008-2010. We have used the same methodology explained in the section 2.4 and applied the Vasicek adjustments to the observed equity betas. For re-levering the equity betas we have re-calculated the levels of debt and equity for 2008-2010 for each firm.

Table 11 illustrates that the average asset beta for fixed-line firms is 0.35 and the average asset beta for mobile firms of 0.51. We have estimated a weighted average asset beta for KPN in 2011 based on the asset betas of fixed-line and telecoms firms, using as weights the average percentages of KPN's revenues from mobile and fixed activities in the years 2008-2010.²¹ Table 12 illustrates that this results in an estimated equity beta for KPN of 0.64.

Table 11: Asset Betas of Fixed and Mobile Firms in 2008-2010

Firm	Country	Gearing (D/E) [A] Bloomberg	Equity Beta [B] Brattle Estimation	Tax Rate [C] KPMG	Asset Beta [D] See Note
Fixed Line Operators Peer Group					
BT	UK	120.6%	0.88	28.0%	0.47
Iliad	France	13.4%	0.52	33.3%	0.48
TDC	Denmark	95.5%	0.17	25.0%	0.10
Average					0.35
Mobile Operators Peer Group					
Vodafone	UK	61.2%	0.79	28.0%	0.55
Mobistar	Belgium	14.5%	0.31	34.0%	0.28
Sonaecom	Portugal	59.2%	0.74	25.0%	0.51
Telenor	Norway	36.2%	0.90	28.0%	0.72
Average					0.51

Notes and Sources

$$[D]=[B]/(1+(1-[C])\times[A])$$

Table 12: Deriving KPN's beta for the years 2008-2010

Mobile Asset Beta	[1]	Table 11	0.51
Fixed Asset Beta	[2]	Table 11	0.35
Percentage of KPN Revenues from Mobile	[3]	See note	32%
Percentage of KPN Revenues from Fixed line or other	[4]	See note	68%
Estimated KPN Asset Beta	[5]	$[1]\times[3]+[2]\times[4]$	0.40
D/E	[6]	Appendix II	78%
Tax Rate	[7]	KPMG	25.5%
Future Equity Beta	[8]	$[5]\times(1+(1-[7])\times[6])$	0.64

Notes:

[3], [4]: Analysis on KPN's Annual reports (2008-2010)

3.5. THE EQUITY RISK PREMIUM

Table 13 illustrates the realised ERP derived from DMS data in individual European countries taken from the February 2010 DMS report. This report contains ERP estimates using data up to and

²¹ Percentage of revenues from mobile and fixed activities are derived from the Annual Reports of KPN for 2008; 2009 and 2010. Data used refers only to "domestic market".

including 2009. All the ERPs are calculated relative to long-term bonds and the weighting is based on market-capitalisation in 2010 of each country's stock market.

Table 13: Historic Equity Risk Premium Relative to Bonds: 1900 - 2009

	Geometric Mean [1]	Arithmetic Mean [2]	Average [3]	Standard Error [4]	Standard Deviation	Market Cap in 2010 (\$mm) [5]
Belgium	2,6%	4,9%	3,8%	2,1%	21,5%	269.287
Denmark	1,8%	3,3%	2,6%	1,6%	17,3%	244.196
Finland	5,4%	9,1%	7,3%	2,9%	30,4%	213.185
France	3,3%	5,7%	4,5%	2,2%	23,0%	1.758.718
Germany	5,4%	8,8%	7,1%	2,8%	28,6%	1.502.181
Ireland	2,6%	4,7%	3,7%	1,9%	19,8%	58.673
Italy	3,8%	7,3%	5,6%	2,8%	29,8%	598.426
The Netherlands	3,5%	5,9%	4,7%	2,1%	22,3%	327.188
Norway	2,4%	5,4%	3,9%	2,7%	28,1%	291.557
Spain	2,4%	4,4%	3,4%	2,0%	20,8%	631.737
Sweden	3,6%	6,0%	4,8%	2,1%	22,4%	596.551
Switzerland	2,1%	3,7%	2,9%	1,7%	17,7%	1.201.277
United Kingdom	3,9%	5,2%	4,6%	1,6%	17,1%	3.336.047
Europe	3,9%	5,2%	4,6%	1,6%	16,7%	n/a
World	3,7%	4,9%	4,3%	1,5%	15,8%	n/a
Average Eurozone	3,5%	8,1%	5,8%		39,0%	
Value-Weighted Average Eurozone	3,9%	7,0%	5,4%		27,9%	

Sources and Notes:

[1] - [4]: Credit Suisse Global Investment Returns Sourcebook, February 2010, Table 10.

[5]: Bloomberg LP as of 3/15/2013.

Consistently with our methodology in Section 2.5, we apply a Eurozone average ERP of 5.4% for WACC calculation of KPN in 2011.

3.6. SUMMARY OF 2011 WHOLESALE BROADBAND WACC

Table 14 illustrates the overall calculation of the KPN's WACC in 2011 obtained by combining the parameters in the previous sections.

Table 14: 2011 WACC for wholesale broadband

Risk free rate	[1]	3.62%	Section 3.3
Equity beta	[2]	0.64	Section 3.4
ERP	[3]	5.4%	Section 3.5
After-tax cost of equity	[4]	7.08%	$[1]+[2]\times[3]$
Pre-tax cost of debt	[5]	5.32%	Section 3.1
Tax rate	[6]	25.5%	KPMG
After-tax cost of debt	[7]	3.96%	$[5]\times(1-[6])$
Gearing (D/A)	[8]	44%	Section 3.2
Gearing (D/E)	[9]	78%	$[8]/(1-[8])$
Nominal after-tax WACC	[10]	5.72%	$(1-[8])\times[4]+(1-[6])\times[5]\times[8]$
Nominal pre-tax WACC	[12]	7.68%	$[10]/(1-[6])$
Inflation	[11]	1.7%	Brattle analysis
Real pre-tax WACC	[13]	5.88%	$(1+[12])/(1+[11])-1$

At the end of 2010, the ECB's inflation prediction for 2011 was 1.5%, and the forecast for 2015 was 1.9%. Based on this, it seems that inflation expectation were slightly lower than current inflation expectations. Accordingly we apply an inflation rate of 1.7% to convert nominal WACC in real WACC. We apply the marginal corporate tax rate for the Netherlands, which is 25.5% (average 2008-2010), to arrive at a real pre-tax WACC of 5.88%.

The real pre-tax WACC of 5.88% in 2011 is 116 basis points higher than current real pre-tax WACC of 4.72% calculated in Table 10. The reason for the higher 2011 WACC is that the 2011 risk-free rate was 112 basis points higher than the current risk-free rate. Hence, changes in underlying interest rates account for almost all of the change in the WACC.

4. WACC FOR FIBRE-TO-THE-OFFICE

FttO access allows operators to rent the KPN fibre network at a wholesale level to provide services to business customers. The main difference in terms of service is that FttO allows the retail service provider to sell an ultra-broadband service with download speeds of up to 100 MB/s.²²

The FttO activity may face different systematic risks than wholesale broadband services provided over a copper network. Accordingly, the FttO activity may have a different WACC than the wholesale broadband activity which we have discussed in the earlier sections. Because of this potential difference OPTA have asked us to estimate a separate WACC for the FttO activity. Moreover, OPTA apply the FttO WACC in a discounted cash flow model for the period 2005 to 2045. Accordingly, OPTA have requested that we develop an FttO WACC that is valid over this period. We first discuss how to estimate a WACC for the FttO activity, and then explain what adjustments should be made for applying the WACC in OPTA's DCF model.

²² OPTA differentiates between Fibre to the Home (FttH) and FttO activities. We note that the main difference between these two activities is the type of area where the network is deployed or rolled out. In a residential area the network is largely rolled-out on the basis of 'demand bundling' and it is referred to as FttH. In a business area the network is deployed on the basis of small-scale demand bundling and it is referred to as FttO. However, there is an overlap in the type of retail services provided over FttH and FttO networks.

4.1. THE SEARCH FOR AN FTTO PEER GROUP

To calculate a specific WACC for FttO services, we have first investigated if it is possible to find one or more listed firms that earn the majority of their revenue from FttO activities. If such firms existed, we could then estimate a beta for the FttO activity. Specifically, we have reviewed the annual reports and quarterly presentations of 24 listed telecommunications companies worldwide to find the percentage of revenues and EBITA from FttO activities. However, none of the firms surveyed reported earning a significant amount of revenue from fibre or FttO activities. Hence we are not able to identify a peer group for the FttO activity. Details of our survey with the breakdown of companies analysed, type of Fibre technology rolled-out (FttH, FTTC, P2P, GPON) and shares of revenues and EBITDA between different activities are reported in Appendix III.

The absence of significant revenues from fibre can likely be attributed to the early stage of deployment of fibre networks, especially in Europe where the 50% of take-up is envisaged in 2020 accordingly to the European Digital Agenda.²³ This means that even while some companies are investing in fibre networks, their fibre revenues and profits are very small compared to copper business. We also note that notwithstanding that the percentage of revenues from fibre remains small, most firms do not report revenues and profits divided into fibre and non-fibre revenues. More common ways of identifying revenues are as fixed-line and mobile, or by the type of service provided, such as broadband. It remains to be seen if firms will start reporting revenues according to the specific type of technology used (fibre or copper), and by customer type (FttO vs Fibre-to-the-Home for example).

As an alternative to finding a peer group from which we can estimate a beta, we have investigated reasonable ways to modify the Wholesale Broadband WACC to make it suitable for the FttO activity. We discuss possible adjustments below.

4.2. PRECEDENT FROM REGULATORY DECISIONS

According to the European Commission Recommendation on regulated access to Next Generation Access Networks,²⁴ when setting access prices to the unbundled fibre loop, National Regulatory Authorities (NRAs) should include a higher risk premium to reflect any additional and quantifiable investment risk incurred by the incumbent operator.

The European Commission also set out the principles that NRAs should follow in defining the adequate risk premium. Investment risk should be rewarded by means of a risk premium incorporated in the cost of capital.²⁵

“NRAs should estimate investment risk inter alia by taking into account the following factors of uncertainty: (i) uncertainty relating to retail and wholesale demand; (ii) uncertainty relating to the costs of deployment, civil engineering works and managerial execution; (iii) uncertainty relating to technological progress; (iv) uncertainty relating to market dynamics and the evolving competitive

²³ Source: Digital Agenda for Europe, Pillar n. IV, “Fast and ultra-fast internet access”, May 2010.

²⁴ Commission Recommendation of 20/09/2010, SEC 1037, par. 4.

²⁵ Commission Recommendation of 20/09/2010, SEC 1037, par. 6.

situation, such as the degree of infrastructure-based and/or cable competition; and (v) macro-economic uncertainty...

...Criteria such as the existence of economies of scale (especially if the investment is undertaken in urban areas only), high retail market shares, control of essential infrastructures, OPEX savings, proceeds from the sale of real estate as well as privileged access to equity and debt markets are likely to mitigate the risk of NGA investment for the SMP operator”.

Only Italy, Lithuania, and Spain have implemented the European Commission Recommendation on the definition of a WACC premium for fibre services and defined a premium for fibre services on top of the standard ‘copper WACC’. Values in Italy, Spain and Lithuania seem to have been defined as a pure incentive for fibre without detailed calculations on the magnitude of specific risk. In Italy the WACC for fibre investments is increased by four percentage points, while in Spain the WACC is increased by between 2.4% and 5.2%. Lithuania does not disclose the size of the fibre WACC premium it applies.

One important point to note about the Commission’s guidelines and the regulatory decisions in the table above is that the premium is generally provided for non-systematic risk. That is, it is for risks that an investor could diversify by investing in many different projects. For example, the risk that a fibre project could experience cost overruns could be diversified, by investing in a portfolio of projects. Some financial economists highlight that the WACC should only reflect systematic risk – that is, risks that cannot be diversified – and that other risks should be accounted for by giving an uplift to the allowed cash flows.²⁶ However, as we noted in our Phase I report for the NMa, from a practical point of view, it is very hard for the regulator to know what level of uplift to apply.²⁷

It is also important to highlight that in this report we are aiming to estimate a WACC for FttO that is directly comparable to the Wholesale Broadband WACC, and which covers only systematic risk. In this context, the fibre premia discussed above are of limited use, because they may reflect policy decisions rather than the actual systematic risk of fibre investments. In the next section we consider what effect investment in fibre will have on the systematic risk of a firm.

4.3. ESTIMATE OF THE CURRENT FTTO WACC

In our view there are two possible reasons to believe that the WACC for FttO will differ from the WACC for wholesale broadband. The first is to do with the ratio of fixed to variable costs in a newer fibre network relative to a mature copper network, and the second has to do with demand. It is also important to stress that both these factors will only affect the beta in the WACC calculation. Hence, our discussion of how to make an adjustment to the wholesale broadband WACC focuses on what adjustments we might need to make to the beta for wholesale broadband, so that it better reflects the risks of the FttO activity.

²⁶ See for example R.A. Brealey & S.C. Myers, *Principles of Corporate Finance*, Fifth International Edition, p. 972. Professor Myers is a Principal of *The Brattle Group*.

²⁷ See *The Brattle Group*, (Dan Harris, Bente Villadsen and Francesco Lo Passo) ‘Calculating the Equity Risk Premium and the Risk-free Rate, 26 November 2012, prepared for NMa, p.16.

With respect to the first issue, a hypothetical FttO-only company might have a relative high proportion of fixed costs relative to the networks which we used to estimate beta for the wholesale broadband activity. In our view, this higher proportion of fixed costs is not due to any inefficiency in financing or fundamental feature of the business fibre business relative to copper. Rather, it is because the fibre networks are newer and so may have a higher level of debt, relative to a mature copper network.

Recall that the equity beta of a firm increases with the level of debt, because the debt commitments must be paid before dividends are paid to shareholders. For example, suppose a firm has revenues of 100, and has debt costs (interest plus principal repayments) of 40. Ignoring any other costs, this leaves 60 for shareholders (equity holders). Debt costs remain fixed, so if revenue falls by 30%, to 70, then only 30 is left for equity holders after the 40 has been paid to service debt. Hence a 30% fall in revenue decreases cash flow to equity by 50%. Now suppose that the firm has more debt, so that total debt costs are 60. Repeating the exercise above, a 30% drop in revenues now causes cash to equity holders to fall from 40 to 10 – a fall of 75%. The firm's market value – as expressed through the share price – is the present value of the future cash flows to equity. Hence, as the level of debt increases, the sensitivity of equity cash flows to revenue, it also increases the sensitivity of the share price to revenue.

Recall also that beta measures the relationship between a firm's share price and the market index. We could reasonably assume that changes in a firm's revenue will be strongly correlated to changes in the market index – so that in an economic downturn both the market index and the firm's revenues will be lower. Hence a high level of debt will increase the correlation between the market index and the firm's share price, which means that the firm's beta will increase. Standard 're-levering' formulas have been developed to account for the effect of debt on a firm's observed beta, so that we can compare the beta of firms with different levels of debt. However, the re-levering formula's do not take into account the way that different absolute levels of debt change the ratio of fixed and variable costs for a given set of firms.

In Table 15 we illustrate this with an example of a new copper network with assets worth 100, and a mature, partly depreciated, copper network with assets of 80. We assume that both maintain a level of debt equal to 55% of the value of the assets. Because the fibre network is newer, it has a larger debt (row [3]). One can imagine that the mature copper network has paid down its debt in line with the depreciation of the assets, and also that the assets are depreciation in line with their decline in economic value. Both networks have the same variable costs, and charge an initial price that gives then a 10% margin. Because the fibre network has more debt costs, it has a higher share of fixed costs as a percentage of total costs (row [10]).

We then imagine that revenues fall by 20% for both the fibre and copper businesses. Because of its higher share of fixed costs, the profits of the fibre network fall by 101% while the profits of the copper network fall by 91%. Hence, the higher fixed costs make profits more sensitive to revenues, and hence macroeconomic conditions more generally. Hence we would expect to see a higher beta for the new fibre network than for the mature copper network.

In Table 15 we also show that we can replicate the fibre network's sensitivity of profits to revenues by assuming a higher level of debt for the copper network. With a gearing of 70%, the copper network has a similar operating leverage as the fibre network. Hence we could replicate the effect of higher operating leverage by re-levering the beta to a gearing of 70%, instead of the forecast 55% level of gearing.

Table 15: Example of operating leverage with higher fixed costs

			New Fibre	Mature Copper	Mature Copper with high debt
Assets	[1]	TBG Input	100	80	80
Gearing	[2]	TBG Input	55%	55%	70%
Debt	[3]	[1]x[2]	55	44	56
Demand	[4]	TBG Input	10	10	10
Variable cost/unit of demand	[5]	TBG Input	0.4	0.4	0.4
Variable costs	[6]	[4]x[5]	4	4	4
Interest Rate	[7]	TBG Input	5%	5%	5%
Fixed (Financing) costs	[8]	[3]x[7]	2.75	2.2	2.8
Total costs	[9]	[6]+[8]	6.75	6.2	6.8
% Fixed costs	[10]	[8]/[9]	41%	35%	41%
% Variable costs	[11]	[6]/[9]	59%	65%	59%
Margin	[12]	TBG Input	10%	10%	10%
Initial revenues	[13]	[9]x(1+[12])	7.4	6.8	7.5
Price per unit	[14]	[13]/[4]	0.7	0.7	0.7
Profit	[15]	[13]-[9]	0.7	0.6	0.7
<i>Reduced demand scenario</i>					
Reduced demand	[16]	TBG Input	8.0	8.0	8.0
Variable costs	[17]	[16]x[5]	3.2	3.2	3.2
Fixed (Financing) costs	[18]	[8]	2.8	2.2	2.8
Total costs	[19]	[17]+[18]	6.0	5.4	6.0
Revenues	[20]	[14]x[16]	5.9	5.5	6.0
Profits	[21]	[20]-[19]	-0.01	0.06	-0.02
% Change in revenues	[22]	([13]-[20])/[13]	20%	20%	20%
% Change in profits	[23]	([15]-[21])/[15]	101%	91%	102%
Degree of Operating Leverage	[24]	[23]/[22]	5.1	4.5	5.1

KPN's forecast leverage is 55%, which gives an equity beta of 0.81. A firm like KPN with a gearing of 70% (or equivalently a firm with a gearing of 55% and higher fixed costs) would have an equity beta of 1.17. This represents an increase in the equity beta of 0.36, relative to a gearing of 55% and lower fixed costs.

Table 16: Estimated effect of operating leverage on the equity beta

Tax Rate	[1] KPMG	25%
Asset Beta	[2] Section 2.4	0.42
Assumed Gearing (D/A)	[3] Assumed	70%
Leverage D/E	[4] [3]/(1-[3])	233%
Equity beta	[5] [2]x(1+(1-[2])x[4])	1.17

The current ERP estimate is 5.0%. Hence, increasing the beta by 0.36 would result in an increase in the cost of equity of $0.37 \times 5.0\%$ or 1.85 percentage points. The overall effect on the after-tax nominal WACC would be to increase it from 5.11% to 6.93%, an increase of 0.82 percentage points. The real pre-tax WACC would increase from 4.72% to 5.79%, an increase of 1.07 percentage point. The nominal pre-tax WACC would increase by 1.09 percentage point. Table 17 illustrates the calculations.

Table 17: Effect of a higher equity beta on the FttO WACC

			Wholesale Broadband WACC	FttO WACC	Difference
Risk free rate	[1] Section 2.3		2.52%	2.52%	
Equity beta	[2] Section 2.4 and this section		0.81	1.17	
ERP	[3] Section 2.5		5.00%	5.00%	
After-tax cost of equity	[4] [1]+[2]x[3]		6.56%	8.37%	1.80%
Pre-tax cost of debt	[5] Section 2.1		5.20%	5.20%	
Tax rate	[6] KPMG		25%	25%	
After-tax cost of debt	[7] [5]x(1-[6])		3.90%	3.90%	
Future gearing (D/A)	[8] Section 2.2		55%	55%	
Gearing (D/E)	[9] [8]/(1-[8])		120%	120%	
Nominal after-tax WACC	[10] (1-[8])x[4]+(1-[6])x[5]x[8]		5.11%	5.93%	0.82%
Nominal pre-tax WACC	[12] [10]/(1-[6])		6.81%	7.90%	1.09%
Inflation	[11] Brattle analysis		2.00%	2.00%	
Real pre-tax WACC	[13] (1+[12])/(1+[11])-1		4.72%	5.79%	1.07%

Accordingly, based on this analysis, we think that, to account for the higher operating leverage of a new FttO business, it could be reasonable to add about one percentage point to the real-pre-tax WACC for wholesale broadband.

The other potential factor that we could adjust the wholesale broadband WACC for is demand. Specifically, if demand for FttO proved to be more or less sensitive to changes in macroeconomic conditions than demand for copper networks, then we would expect the beta for FttO to differ from the beta for copper networks.

In the Netherlands, wholesale rates for Fibre-to-the-Home (FttH) are around double the rates for copper. However, the service is also of a higher quality, offering much higher bandwidth. In other words, it seems likely that FttH occupies a separate product market than copper-based broadband. Hence it is not clear whether the demand for fibre would be more or less sensitive to economic

conditions than demand for copper. With regards to FttO specifically, we note that the retail market for business customers is usually a market with high willingness to pay for ultra-broadband services. As noted above, in many cases FttO networks are built upon a specific request received directly from the business customer willing to receive the ultra-broadband services. On the contrary, roll-out of FttH networks anticipates the demand for services from residential customers, which could make FttH a more speculative investment.

We conclude that there is no evidence that OPTA should make an additional adjustment to the wholesale broadband WACC to account for the different sensitivity of FttO demand to the economy relative to demand for copper-based telecoms services. As more investments in fibre networks are made it may be possible to gather evidence on the relative sensitivity of demand for fibre and copper. But no such exercise is possible at present.

4.4. FTTO WACC FOR 2005 TO 2045

In the previous section we discussed adjustments to the current wholesale broadband WACC to make it more suitable for the FttO activity. We need to make a second adjustment, because the FttO WACC will be applied in a discounted cash flow model for the period 2005 to 2045.

In general, we note that there are no predictions available for most of the WACC inputs. For example there are no forward predictions of how the ERP might change between 2013 and 2045 – our current estimate of the future ERP is simply a forecast of the returns equity investors might expect or require ‘in the future’ based on the past. But the ERP estimate is not for a specific period. Similarly, it is unknown how the beta for the FttO activity might change over time. The beta for mobile telecoms services has decreased quite significantly since these services were introduced, as mobile moved from being an expensive luxury product to something closer to a basic utility.

Given this uncertainty in forecasting the parameters of the WACC, as well as the uncertainty in the current FttO WACC, we have only adjusted for changes in underlying interest rates – so the risk-free rate. We have calculated the risk-free rate, using the same methodology as in section 2.3, for each year between 2005 and 2012 inclusive. For each year, we calculate the risk-free rate on the last day of the preceding year. For example, for 2005, we calculate the risk-free rate using data for the period 2002 to 2004 inclusive. For the ‘future FttO WACC’, the method specifies to use the risk-free rate adopted for the current WACC calculations. Table 18 summarizes the results.

Table 18: Risk-free rates for the period 2005 to 2045

Year	Risk-free rate
2005	4,43%
2006	3,93%
2007	3,80%
2008	3,84%
2009	4,11%
2010	4,05%
2011	3,62%
2012	3,18%
2013-2045	2,52%

We then use these risk-free rates in estimating the WACC for FttO, using the higher beta that we estimated in the previous section. Table 19 summarizes the resulting WACCs.

Table 19: FttO WACC for the period 2005 to 2045

			FttO WACC	FttO WACC	FttO WACC	FttO WACC
			2005	2006	2007	2008
Risk free rate	[1]	Section 2.3	4.43%	3.93%	3.80%	3.84%
Equity beta	[2]	Section 2.4	1.17	1.17	1.17	1.17
ERP	[3]	Section 2.5	5.00%	5.00%	5.00%	5.00%
After-tax cost of equity	[4]	[1]+[2]x[3]	10.27%	9.77%	9.64%	9.68%
Pre-tax cost of debt	[5]	Section 2.1	5.20%	5.20%	5.20%	5.20%
Tax rate	[6]	KPMG	25%	25%	25%	25%
After-tax cost of debt	[7]	[5]x(1-[6])	3.90%	3.90%	3.90%	3.90%
Future gearing (D/A)	[8]	Section 2.2	55%	55%	55%	55%
Gearing (D/E)	[9]	[8]/(1-[8])	120%	120%	120%	120%
Nominal after-tax WACC	[10]	(1-[8])x[4]+(1-[6])x[5]x[8]	6.8%	6.6%	6.5%	6.5%
Nominal pre-tax WACC	[12]	[10]/(1-[6])	9.1%	8.8%	8.7%	8.7%
Inflation	[11]	Section 7	2.00%	2.00%	2.00%	2.00%
Real pre-tax WACC	[13]	(1+[12])/(1+[11])-1	6.92%	6.62%	6.55%	6.57%

			FttO WACC	FttO WACC	FttO WACC	FttO WACC	FttO WACC
			2009	2010	2011	2012	2013-2045
Risk free rate	[1]	Section 2.3	4.11%	4.05%	3.62%	3.18%	2.52%
Equity beta	[2]	Section 2.4	1.17	1.17	1.17	1.17	1.17
ERP	[3]	Section 2.5	5.00%	5.00%	5.00%	5.00%	5.00%
After-tax cost of equity	[4]	[1]+[2]x[3]	9.95%	9.90%	9.46%	9.03%	8.37%
Pre-tax cost of debt	[5]	Section 2.1	5.20%	5.20%	5.20%	5.20%	5.20%
Tax rate	[6]	KPMG	25%	25%	25%	25%	25%
After-tax cost of debt	[7]	[5]x(1-[6])	3.90%	3.90%	3.90%	3.90%	3.90%
Future gearing (D/A)	[8]	Section 2.2	55%	55%	55%	55%	55%
Gearing (D/E)	[9]	[8]/(1-[8])	120%	120%	120%	120%	120%
Nominal after-tax WACC	[10]	(1-[8])x[4]+(1-[6])x[5]x[8]	6.6%	6.6%	6.4%	6.2%	5.9%
Nominal pre-tax WACC	[12]	[10]/(1-[6])	8.9%	8.8%	8.6%	8.3%	7.9%
Inflation	[11]	Section 7	2.00%	2.00%	2.00%	2.00%	2.00%
Real pre-tax WACC	[13]	(1+[12])/(1+[11])-1	6.73%	6.70%	6.44%	6.18%	5.79%

Appendix I – Statistical Adjustments to the Peer Group

We used a series of standard diagnostic tests to assess if the beta estimates satisfy the standard conditions underlying ordinary least squares regression. These standard conditions are: that the error terms in the regression follow a normal distribution and that they do not suffer from heteroskedasticity²⁸ or auto-correlation.²⁹ Failure to meet these conditions would not invalidate the beta estimates, but would have the following consequences:

1. Although OLS is still an unbiased procedure in the presence of heteroskedasticity and/or autocorrelation, it is no longer the best or least variance estimator.
2. In the presence of heteroskedasticity and/or autocorrelation, the standard error calculated in the normal way may understate the true uncertainty of the beta estimate.
3. Heteroskedasticity and/or auto-correlation may indicate that the underlying regression is misspecified (i.e. we have left out some explanatory variable).

Heteroskedasticity

We apply White's test for heteroskedasticity. Table 20 illustrates the results.

Table 20: White's test for Heteroskedasticity

	3 yr		Heteroskedasticity
	White Stat	p-value	
<i>Fixed Line Operators Peer Group</i>			
BT	1.93	0.50	No
Iliad	32.50	1.50	No
TDC	11.81	2.50	No
<i>Mobile Operators Peer Group</i>			
Vodafone	12.08	3.50	No
Mobistar	5.83	4.50	No
Sonaecom	5.53	5.50	No
Telenor	50.39	6.50	No

The results indicate the absence of heteroskedasticity in the sample.

Autocorrelation

We also apply the Durbin-Watson test for auto-correlation. Unsurprisingly, this test indicates a degree of autocorrelation in all of the regressions, also likely reflecting the development of the credit crisis and the changing extent of market volatility. The effect of this auto-correlation is that standard errors will over-estimate the precision of the regression. The results are presented in **Table 21**:

²⁸ Heteroskedasticity means that there exists sub-populations in the sample which have different variance from others.

²⁹ Auto-correlation means that the error terms between periods are correlated.

Table 21: Durbin–Watson Test for Auto-correlation

	3 yr	
	DW Stat	Serial Correlation
<i>Fixed Line Operators Peer Group</i>		
BT	1.635	Yes
Iliad	1.680	Yes
TDC	1.504	Yes
<i>Mobile Operators Peer Group</i>		
Vodafone	1.533	Yes
Mobistar	1.657	Yes
Sonaecom	1.409	Yes
Telenor	1.904	No

Prais-Winsten Regressions

To account for the inclusion of auto-correlation and heteroskedasticity in the sample a standard statistical technique is to apply a regression using the Prais–Winsten estimation tests. The results are presented in Table 22:

Table 22: Prais-Winsten Regressions Results

	Beta	Standard Error
<i>Fixed Line Operators Peer Group</i>		
BT	0.878	0.056
Iliad	0.515	0.050
TDC	0.157	0.053
<i>Mobile Operators Peer Group</i>		
Vodafone	0.783	0.048
Mobistar	0.303	0.033
Sonaecom	0.733	0.048
Telenor	0.894	0.118

The corrections for auto-correlation and heteroskedasticity do not have a significant impact on the results.

Appendix II – Details on KPN's Leverage

Table 23: KPN's Debt and Gearing End 2009 to 2012 Inclusive

	Notes	3 Yr Average	31-Dec-12	30-Sep-12	30-Jun-12	31-Mar-12	31-Dec-11	30-Sep-11	30-Jun-11	31-Mar-11	31-Dec-10	30-Sep-10	30-Jun-10	31-Mar-10	31-Dec-09
Debt [1]	Bloomberg		14.511	14.511	13.839	13.489	13.099	13.540	13.389	12.595	12.537	13.517	13.960	13.515	13.371
Cash Items [2]	Bloomberg		1.495	1.495	878	1.267	990	645	1.124	944	823	1.335	1.624	2.367	2.692
Net Debt [3]	[1]-[2]		13.016	13.016	12.961	12.222	12.109	12.895	12.265	11.651	11.714	12.182	12.336	11.148	10.679
Present Value of Operating Leases [4]	See note		2.183	2.085	1.988	1.890	1.793	1.744	1.695	1.645	1.596	1.639	1.682	1.725	1.768
Net Debt including Operating Leases [5]	[3]+[4]		15.199	15.101	14.949	14.112	13.902	14.639	13.960	13.296	13.310	13.821	14.018	12.873	12.447
Shares [6]	Bloomberg		1.432	1.432	1.432	1.432	1.432	n/a	1.528	1.528	n/a	n/a	n/a	n/a	n/a
Share Price [7]	Bloomberg		3,72												
Market Cap [8]	Bloomberg		5.320	8.512	10.817	11.807	13.234	14.629	15.328	18.370	17.173	17.841	16.950	18.981	19.286
Leverage [9]	[5]/[8]	112%	286%	177%	138%	120%	105%	100%	91%	72%	78%	77%	83%	68%	65%
Gearing [10]	[5]/([5]+[8])	50,3%	74%	64%	58%	54%	51%	50%	48%	42%	44%	44%	45%	40%	39%

Notes and sources:

[1],[2],[6]: 31 Dec 2012 value assumed to be equal to the 30 Sep 2012.

[4]: End of year values from Table 20, all other values interpolated.

[8]: Value for 31 Dec 2012 equal to [7]x[6]

Table 24: Calculation of Operating Lease Leverage (2012)

Timing		<1	1-5				>5				
Payment Date (years) [A]		1	2	3	4	5	6	7	8	9	10
2012											
Operation Leases, € mln [1]	See note	527	257	257	257	257	928				
Projected 2012 Payments [2]	See note	527	257	257	257	257	186	186	186	186	186
Date of Projection [3]		31-dic-12									
<i>Cost of Debt Calculation</i>											
Spread of 10-year BBB rated Industrials [4]	Bloomberg	1,69%									
Dutch Government Debt [5]		0,02%	0,18%	0,38%	0,68%	0,96%	1,23%	1,45%	1,63%	1,79%	1,94%
Estimated Cost of Debt [6]	[4]+[5]	1,72%	1,87%	2,07%	2,37%	2,65%	2,92%	3,14%	3,32%	3,48%	3,64%
Discount Factor [7]	$1/(1+[6])^A$	0,983	0,964	0,940	0,911	0,877	0,841	0,806	0,770	0,735	0,700
Discounted Cash Flows [8]	[2]x[7]	518	248	242	234	226	156	150	143	136	130
Present Value of Commitment, € mln [9]	Sum of row [8]	2.183									

Notes and Sources:

[1]: 2012 KPN Annual Report, p.142. Total amount of commitments for 1 to 5 years of 1,029 is equally divided across the 4 years.

[2]: [1] until year 6; [1]/5 afterwards.

Appendix III – FttO Peer Group Analysis

Table 25: Revenues breakdown by activities for selected peers

Firm	Listed/NGA	Technology	Total Revenue	Openreach	BT Global Services	Broadband/Fiber	Video	Fixed Telephone	Telephone Network	TV	Internet and Phone business	Telecom	Mobility service	Other service	Fixed Telephone and TV	Pay TV	Audiovisual	Pay TV Broadband and Voice	Satellite and TV distribution	Cable TV	Wholesale	Retail	Total		
BT, £ million	[1]	√	19,307	8%	40%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15%	36%	100%	
KPN, € million	[2]	√	8,796	-	-	-	-	16%	-	-	11%	-	32%	11%	-	-	-	-	-	-	-	29%	-	100%	
Belacom, € million	[3]	√	6,417	-	-	-	-	43%	-	-	-	-	28%	29%	-	-	-	-	-	-	-	-	-	100%	
Veon Telecom, \$ million	[4]	√	110,875	-	-	-	-	37%	-	-	-	-	63%	10%	-	-	-	-	-	-	-	-	-	100%	
Deutsche Telekom, € mill	[5]	√	58,653	-	-	-	-	-	-	-	-	88%	-	12%	-	-	-	-	-	-	-	-	-	100%	
Telefonica, € million	[6]	√	18,378	-	-	-	-	58%	-	-	-	-	42%	-	-	-	-	-	-	-	-	-	-	100%	
Free - Iliad, € million	[7]	√	2,122	-	-	99.6%	-	1.6%	-	-	-	-	-	17%	-	-	-	-	-	-	-	-	-	100%	
Liberty Global, \$ million	[8]	√	9,511	-	-	23%	-	46%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100%	
Telenor, € million	[9]	√	1,376	-	-	32%	-	-	20%	-	-	-	-	11%	-	-	-	-	-	-	37%	-	-	100%	
TDC, DKK million	[10]	√	26,116	-	-	20%	-	14%	-	15%	-	-	25%	11%	-	-	-	-	-	-	15%	-	-	100%	
Teliax, SEK mill	[11]	√	104,354	-	-	35%	-	-	-	-	-	-	49%	16%	-	-	-	-	-	-	-	-	-	100%	
Elisa, € million	[12]	√	1,530	-	-	-	-	-	39%	-	-	-	61%	-	-	-	-	-	-	-	-	-	-	100%	
Kabel Deutschland, € mill	[13]	√	1,599	-	-	-	-	-	-	71%	29%	-	-	-	-	-	-	-	-	-	-	-	-	100%	
Eircom, € million	[14]	√	1,828	-	-	-	-	-	78%	-	-	-	25%	-3%	-	-	-	-	-	-	-	-	-	100%	
Telecom Italia, € million	[15]	√	19,538	-	-	-	-	64%	-	-	-	-	36%	-	-	-	-	-	-	-	-	-	-	100%	
Telenor, NOK million	[16]	√	98,516	-	-	-	-	-	-	-	-	-	69%	9%	-	-	-	-	-	-	-	-	-	100%	
Sonacom/Optimus Vodafone, € million	[17]	√	863	-	-	-	-	26%	-	-	-	-	66%	8%	-	-	-	-	-	-	-	-	-	100%	
Ziggo, € million	[19]	√	1,478	-	-	-	-	43%	-	8%	-	-	92%	-	-	-	-	-	-	-	-	-	-	100%	
Zon	[20]	√	855	-	-	-	-	-	47%	-	-	-	-	10%	-	-	-	-	-	-	-	-	-	100%	
ONO	[21]	√	1,485	-	-	3%	76%	-	-	-	-	-	-	21%	-	-	-	-	-	-	-	-	-	100%	
Tele 2, SEK million	[22]	√	43,726	-	-	13%	-	7%	-	-	-	-	78%	3%	-	-	-	-	-	-	-	-	-	100%	
Comhem, SEK million	[23]	√	4,520	-	-	-	27%	12%	-	-	-	-	-	23%	-	37%	-	-	-	-	-	-	-	100%	
Virgin media, £ million	[24]	√	670	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28%	72%	100%

Notes and Sources:

- [1]: BT, Annual Relation 2012, pp. 51, 113.
- [2]: KPN, Annual Relation 2012, pp. 25, 27, 29, 80.
- [3]: The total revenues are the revenues generated in Holland which are the 67% of the total consolidated revenues of the group. Same approach for the EBITDA, which is the 68% of the total consolidated EBITDA of the group.
- [4]: Verizon, Annual Relation 2011, pp. 29-31.
- [5]: Veon Telecom, Annual Relation 2012, pp. 20-22.
- [6]: Deutsche Telekom, Annual Relation 2012, pp. 56. The total revenues are the revenues generated in Spain which are the 29% of the total consolidated revenues of the group.
- [7]: Free Iliad, H1 2012, pp. 2, 40.
- [8]: Liberty Global, Annual Relation 2011, p. 96 and 132.
- [9]: Telenor, Annual Relation 2011, p. 172 and 200.
- [10]: TDC, Annual Relation 2011, p. 18, 2 and 32.
- [11]: Teliax, Annual Relation 2011, p. 37, 55.
- [12]: Elisa, Annual Relation 2011, pp. 20, 31.
- [13]: Kabel Deutschland, Annual Report 2011, p. 19 and 77.
- [14]: Eircom, Financial Statement 2010, p. 9 and 36.
- [15]: Sonacom/Optimus Vodafone, Annual Relation 2011, p. 17. The total revenues are the revenues generated in Italy which are the 64% of the total consolidated revenues of the group. Same approach for the EBITDA, which is the 75% of the Total
- [16]: Zon, Annual Report 2011, p. 20 and 39.
- [17]: Sonacom, Annual Report 2011, p. 10.
- [18]: Vodafone, Annual Report 2011, Excel spreadsheet.
- [19]: Ziggo, Annual Report 2011, p. 24 and 44.
- [20]: Zon, Annual Report 2011, p. 17 and 21.
- [21]: ONO, Annual Report 2011, p. 176 and 212.
- [22]: Tele 2, FY 2012, p. 16 and 18.
- [23]: Comhem, FY 2012, p. 31, 33 and 35.
- [24]: Virgin Media, Annual Report 2012, p. 47.

Table 26: EBITDA breakdown by activities for selected peers

Firm	Listed	NGA	Technology	Total EBITDA	Broadband	Fixed Telephony	Wireline	Pay TV, Broadband and	Audiovisuals	Mobility service	Openreach	Wholesale Retail	Telephony	Other	Total
BT, £ million	[1]	✓	FTTH GPON	6.064	-	-	-	-	-	-	38%	20%	30%	-	100%
KPN, € million	[2]	✓	FTTC+VDSL2	5.138	-	-	-	-	-	-	-	-	-	-	-
Belgacom, € million	[3]	✓	FTTC+VDSL2	1.897	-	-	-	-	-	-	-	-	-	-	-
Verizon, \$ million	[4]	✓	FTTC+VDSL2	12.880	-	-	-	-	-	-	-	-	-	-	-
Deutsche Telecom, € million	[5]	✓	FTTC+VDSL2	20	-	-	-	-	-	-	-	-	-	-	-
Telefonica, € million	[6]	✓	FTTH GPON	-	-	-	-	-	-	-	-	-	-	-	-
Free - Iliad, € million	[7]	✓	FTTC+VDSL2	833.399	101%	-	-	-	-	-	-	-	-	-	100%
Liberty Global, \$ million	[8]	✓	HFC(FTTN+Coax)	-	-	-	-	-	-	-	-	-	-	-	-
Telenet, € million	[9]	✓	DOCSIS 3.0	-	-	-	-	-	-	-	-	-	-	-	-
TDC, DKK million	[10]	✓	FTTC+VDSL2	10.441	-	-	-	-	-	-	-	-	-	-	-
H3G			FTTH/B(P2P)												
Telenia Sonera, SEK million	[11]	✓	DOCSIS 3.0	-	-	-	-	-	-	-	-	-	-	-	-
Elisa, € million	[12]	✓	FTTH/B (P2P)	506	-	-	-	-	-	-	-	-	-	-	-
Kabel Deutschland, € million	[13]	✓	HFC(FTTN+Coax)	-16.568	-	-	-	-	-	-	-	-	-	-	-
Eircom, € million	[14]		DOCSIS 3.0	648	-	-	-	-	-	-	-	-	-	-	-
Telecom Italia, € million	[15]	✓	GPON+VDSL2	9.243	-	-	-	-	-	-	-	-	-	-	-
Telenor, NOK million	[16]	✓	FTTH GPON	25.702	-	-	-	-	-	-	-	-	-	-	-
Sonacom/Optimus	[17]	✓	FTTC+VDSL2	213	-	-	4%	-	-	94%	-	-	-	-	100%
Vodafone, £ million	[18]	✓	FTTH GPON	14.475	-	-	-	-	-	-	-	-	-	-	-
Ziggo, € million	[19]	✓	HFC	835	-	-	-	-	-	-	-	-	-	-	-
Zon	[20]	✓	HFC(FTTN+Coax)	93	-	-	-	84%	-	-	-	-	-	-	100%
ONO	[21]		HFC	367	-	-	-	-	-	-	-	-	-	-	-
Tele 2, SEK million	[22]	✓	FTTH P2P	10.960	12%	-	9%	-	-	77%	-	-	-	-	100%
Comhem, SEK million	[23]		HFC	1.770	-	-	-	-	-	-	-	-	-	-	-
Virgin media, £ million	[24]	✓	DOCSIS 3.0	-	-	-	-	-	-	-	-	-	-	-	-
			HFC												
			DOCSIS 3.1												

Notes and Sources:

- [1]: BT, Annual Relation 2012, pp. 51, 113.
- [2]: KPN, Annual Relation 2012, pp. 25, 27, 29, 80.
- [3]: Belgacom, Annual Relation 2012, pp. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.
- [4]: Verizon, Annual Relation 2011, pp. 29-31.
- [5]: Deutch Telekom, Annual Relation 2011, pp. 2, 221.
- [6]: Telefonica, Annual Relation 2012, p. 56. The total revenues are the revenues generated in Spain which are the 29% of the total consolidated revenues of the group.
- [7]: Free Iliad, Annual Relation 2012, pp. 240-241.
- [8]: Liberty Global, Annual Relation 2011, p. 96 and 132.
- [9]: Telenet, Annual Relation 2011, p. 17 and 20.
- [10]: TDC, Annual Relation 2012, p. 18, 23, 26, 29, 32.
- [11]: Teliasonera, Annual Relation 2011, p. 20, 31.
- [12]: Elisa, Annual Relation 2011, p. 37, 55.
- [13]: Kabel Deutschland, Annual Report 2011, p. 19 and 77.
- [14]: Eircom, Financial Statement 2010, p. 9 and 36.
- [15]: Telecom Italia, Annual Relation 2011, p. 10.
- [16]: Telenor, Annual Relation 2011, p. 10.
- [17]: Sonacom, Annual Report 2011, p. 10.
- [18]: Vodafone, Annual Report 2011, Excel spreadsheet.
- [19]: Ziggo, Annual Report 2011, p. 34 and 54.
- [20]: Zon, Annual Report 2011, p. 172 and 215.
- [21]: ONO, Annual Report 2011, p. 176 and 212.
- [22]: Tele 2, FY 2012, p. 16 and 18.
- [23]: Comhem, FY 2012, p. 31, 33 and 35.
- [24]: Virgin Media, Annual Report 2012, p. 47.

Appendix IV – Investments by Telecoms Firms

We have investigated whether telecoms firms which we know are making major investments in fibre appear to have a higher beta. Specifically, we calculated the asset beta and the ratio between capital expenditure (capex) and revenues over the past three years for Telia Sonera and Liberty Global, two firms which have been investing in FttH. We compared this data with two other telecom firms – BT and TDC – that have instead been investing in fibre-to-the-cabinet (FttC), which is less capital intensive. In more detail:

- Telia Sonera (Sweden) is a fixed-line operator that launched a plan to build FTTH (point-to-point) in October 2011 able to reach 50% of the population by the end of 2014.³⁰ As of September 2012 homes passed (HP) in FTTH were about 520k, compared to 400k in December 2010.³¹ In March 2012 Telia Sonera has confirmed its effort in deploying FTTH by acquiring *Svenska Stadsnät AB*, a company providing fiber capacity to municipalities, companies and households.³²
- Liberty Global is investing in new DOCSIS 3.0 technologies on cable network in Europe. As of December 2012, Liberty Global has reached the following targets of HP:³³
 - 1,297 million of HP in Austria;
 - 12,2 million of HP in Germany;
 - 737k of HP in Ireland;
 - 2,8 million of HP in Netherland.³⁴
- BT is investing not in FTTH but instead in Fibre to the cabinet (FTTC). As of today, current percentage of HP in FTTH (GPON) over entire population reached by BT in UK is less than 1%.³⁵
- TDC is investing little in FTTH but at the same time is now investing in in Fibre FTTC, mobile LTE solutions and cable networks. The latest data available on Ftt solutions (both FTTH and FTTC) are from December 2011 and reveals a number of 1,4 million of HP. Public data do no distinguish between FTTH and FTTC solutions.³⁶

Table 27 illustrates that Telia Sonera and Liberty Global have an average asset beta of 0.745, compared to an asset beta of 0.52 for BT and 0.24 for TDC.³⁷ However, we also see that the average capex/revenues ratio for Telia Sonera is similar to the ratio for BT and TDC. This suggests that it is not high operating leverage that is driving the higher beta for Telia Sonera. Only Liberty Global has a significantly higher level of investment as a percentage of revenue.

Table 27: Capex/Revenues ratio and equity beta for selected firms

	Capex/Revenues 2010	Capex/Revenues 2011	Capex/Revenues 2012	Average Capex/Revenues 2010-2012	Asset Beta
	A	B	C	D	E
Telia Sonera	12,36%	14,35%	15,24%	13,98%	0,76
Liberty Global	20,22%	20,26%	18,25%	19,58%	0,73
BT	12,11%	12,90%	13,44%	12,82%	0,52
TDC	13,50%	13,00%	13%	13,30%	0,24

Sources:

[A];[B];[C]: Annual Reports 2010, 2011, 2012.

[D]: Bloomberg for Telia Sonera and Liberty Global (data of 3/13)

Brattle Analysis for BT and TDC

³⁰ Source: Cullen International, “Cross-country-analysis”, *NGA Deployment by operators*, February 2013.

³¹ Source: Telia Sonera Investor: <http://www.teliasonera.com/Documents/Reports/2012/Q2/TeliaSonera-PresentationQ2-2012.pdf>

³² Source: Telia Sonera Press Release of 1 March 2012 (<http://www.teliasonera.com/en/newsroom/press-releases/2012/3/teliasonera-acquires-svenska-stadsnat-ab/>)

³³ Source: Cullen International, “Cross-country-analysis”, *NGA Deployment by operators*, February 2013.

³⁴ Data refer to September 2012 for UPC.

³⁵ Source: Cullen International, “Cross-country-analysis”, *NGA Deployment by operators*, February 2013.

³⁶ Source: Cullen International, “Cross-country-analysis”, *NGA Deployment by operators*, February 2013.

³⁷ Note that the betas for Telia Sonera and Liberty Global are two-year daily betas as opposed to three-year daily betas for BT and TDC, and so are not strictly comparable. Nevertheless our experience is two and three year betas over this period give very similar results, and so we do not expect the difference in time period to make a material difference.