Project Manager
Energy market investigation
Competition and Markets Authority
Victoria House
Southampton Row
London
WC1B 4AD

The Weighted Average Cost of Capital for Electricity and Gas Networks

Submission by Paul Hunt[1], 14 October 2014

Email: paulthunt@btinternet.com

Introduction

On 27 June 2014 Ofgem made a reference to the Chair of the Competition and Markets Authority (CMA) for an investigation into the supply and acquisition of energy in Great Britain. When conducting an investigation of this nature the CMA acts through a group of independent members (the Group Members) selected from its panel. The Group Members selected have been charged with determining whether or not any feature or combination of features of each relevant market prevents, restricts or distorts competition in connection with the supply or acquisition of any goods or services in the UK or a part of the UK. If the CMA decides that there is such a prevention, restriction or distortion of competition, it will have found an 'adverse effect on competition' (AEC).

[1] Paul Hunt is an independent energy economics consultant working primarily in the areas of gas industry structure and regulation with a specific interest in the development, financing and pricing of services on gas transmission and distribution networks. He has also applied the common principles and procedures of the financial and economic analysis of investment in specific, long-lived assets to assignments in the oil and electricity industries, since these industries are also characterized by this type of asset.

Beginning with significant involvement in gas market liberalisation in Great Britain – including advising the gas regulator and the then Monopolies and Mergers Commission (subsequently re-configured, via the Competition Commission, as the Competition & Markets Authority) - the geographical scope of his work has expanded and he has considerable international experience throughout Europe, Africa, the Middle East, Russia and East Asia. He has provided advice to the European Commission on its gas market liberalization programme and evaluated gas interconnection and storage projects under the European Energy Programme for Recovery. He has worked for gas market participants throughout the EU in the context of gas market liberalization and is involved in the development of the EU's Gas Target Model being facilitated by the Directorate-General for Energy of the European Commission (DG ENER), the grouping of national energy regulators for the Member States (ERGEG) and the Agency for Co-operation of Energy Regulators (ACER). He has written a paper which sets out a basis for developing the mandated Entry-Exit pricing of gas transmission in the context of the EU Gas Target Model:

http://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG23-Entry-ExitTransmissionPricingwithNotionalHubsCanItDeliverAPanEuropeanWholesaleMarketInGas-PaulHunt-2008.pdf

Because Ofgem has made this reference there appears to be an understanding that the performance of its functions and how these may or may not have contributed to the possible existence of AECs that the Members are investigating will not be part of the investigation. There are strong grounds for asserting that Ofgem's performance of its functions should be part of the Members' investigation.

First, it should not require the recent award of the Nobel Prize in Economics to Jean Tirole to demonstrate that there is a large body of theory and evidence highlighting how firms subject to direct regulation or to regulatory oversight and monitoring respond to regulatory interventions and how these responses may be in their interests but detrimental to the public interest. The history of economic regulation is replete with examples of how interventions by regulatory bodies, that are almost invariably well-intentioned but with the regulatory bodies either lacking sufficient powers of enforcement or being subject to conflicting policy directions, can lead to unintended effects that are detrimental to the public interest. Investigating the performance of Ofgem in the context of this investigation does not imply a prior suspicion that Ofgem has failed to perform its functions appropriately. But a failure to do so would rule out, unwisely, investigation of the possibility that Ofgem, either through no fault of its own or because it is subject to conflicting policy directions, has contributed to the emergence of any EACs that might be identified.

Secondly, on those occasions when regulatory bodies make references to it because a regulated firm has refused to accept a regulatory determination the CMA takes account in its investigation of how the regulatory body has performed its functions and frequently makes determinations that differ from those initially made by the regulatory body – and which provoked the reference. There appears to be no reason why the Members should not adopt a similar, though perhaps somewhat broader, approach in this investigation and assess how Ofgem has performed its functions.

Thirdly, and perhaps most importantly, it appears that when it is establishing the cost of capital for the regulated energy networks Ofgem is generating a cost higher than an appropriate application of the theories and the data it employs would suggest. This higher cost of capital feeds in to the revenues and tariffs for the energy networks and leads, both directly and indirectly, to prices to final consumers being higher than they should or need be. If this is the case, it is a clear detriment to the public interest. In addition, higher network costs which are borne initially by suppliers and then passed through to final consumers could create a barrier to the entry of new suppliers and this would be a clear EAC.

This submission is structured as follows. The next section provides some context and background on the emergence and development of the British model of competition and regulation in those industries providing utility services. This model has been adopted and adapted throughout the EU. The following section presents a focus on the regulation of energy networks and leads to an assessment of the derivation of the cost of capital by both Ofgem and the Competition Commission (the CMA's precursor) which highlights the apparent discrepancy between these estimates of the cost of capital and those which emerge from an appropriate application of the theories and practice both Ofgem and the Competition Commission assert they employ. The final section assesses possible reasons for this discrepancy and concludes.

Background and Context

This section sets out the background and context in which economic regulation of the cost of capital is applied.

Privatisation and Regulation

In Great Britain (GB), the privatisation of a number of industries was accompanied by the formal establishment of economic regulation as a statutorily empowered activity. Regulation was applied to a subset of the physical assets of the industry and to the services these provided to final service-users and consumers - and, in effect, to the integrated firms that owned and operated these assets. This subset of physical assets typically consists of physical networks and facilities that allow the provision of what are generally considered to be essential utility services, such as electricity and gas supplies, water and waste water services, fixed-line telephony services, rail freight and passenger services and the air freight and passenger services provided by airports both to carriers and their passengers. And so, in Great Britain, economic regulatory bodies were established on a statutory basis for these industries, for example, Ofgem (Gas and Electricity Markets Authority, Ofwat (Water Services Regulation Authority), Ofcom (Office of Communications, ORR (Office of the Rail Regulator) and CAA (Civil Aviation Authority).

Rationale for Economic Regulation

The rationale for economic regulation is based on two separate, but not mutually exclusive, grounds. The first ground is that the owners and operators of these facilities may have been granted specific exclusive or monopoly rights; the second is that the efficient establishment and use of these networks or facilities frequently exhibit natural monopoly characteristics.[2] As a result, the owners and operators of these networks and facilities have an incentive to exercise and abuse their market power (in the absence of effective competition) to charge prices higher than those that would be discovered in a competitive market or to reduce the volume or diminish the quality of service at a given price below what would be provided in a competitive market. Therefore, it is considered to be in the public interest to establish economic regulation of these industries to exercise control over prices and over the volume and quality of service so as to replicate, in so far as it might be possible, the outcomes of a competitive market.

De-integration and Introduction of Competition

In the period since privatisation and the establishment of economic regulation of these industries there has been a progressive effort to separate the regulation and provision of the services provided by the owners and operators of the physical networks and facilities from the regulation and provision of services from production of generation through to delivery final service-users and consumers. This has been facilitated by the de-integration of the previously integrated providers of network and facilities services and of services to final service-users and consumers into providers of network and facilities services and providers of services to final service-users and consumers. And it has been accompanied, in some industries, by the entry of new providers of services to final service-users and consumers with both they and the de-integrated business units or firms contracting with the network and facilities service providers for these services and competing to provide services to final service-users and consumers.[3]

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[2] There is a 'chicken or egg' question here. Were the owners of these networks and facilities granted monopoly rights because the provision of services using these assets exhibited monopoly characteristics? Or did the owners and operators of these assets demand and secure these monopoly rights by asserting the existence of monopoly characteristics irrespective of the evidence or the actual reality? In any event, the use of the term 'natural monopoly' has become prevalent. It is true that natural monopolies do arise in specific circumstances and in defined geographical areas, but there can be little doubt that those enjoying a dominant position and eyeing an opportunity to consolidate it have every incentive to secure a statutory definition and authorisation of a monopoly position.

[3] Politicians, policy-makers, regulators (and their acolytes) advancing this process of de-integration and the enforced roll-out of retail access invariably make use of a 'positive spin' to

The implementation of this separation has not been uniform. Technical and economic characteristics of the various industries have either facilitated or impeded its implementation. For example, the separation has been implemented fully in the electricity and gas industries with wholesale and retail supply and trading activities being performed by firms entirely separate from the firms providing network and facilities services. But, in the water industry, the potential for the provision of, and competition in, bulk water supplies separate from the management, distribution and delivery of water supplies appears to be limited.

The Evolving Role of Economic Regulation

The separation of activities in the industries where it has occurred has re-defined the economic space previously occupied by the integrated firms into an economic space defined by the provision of network and facilities services and one defined by the competitive provision of commodities and services. This, in turn, has prompted the emergence of two dimensions of economic regulation. The first may be considered as 'classic' economic regulation of the providers of network and facilities services whose activities exhibit monopoly characteristics; the second is the fostering and monitoring of competitive activities. The focus here is on classic economic regulation and, in the context of the Energy Investigation being conducted by the Competition and Markets Authority, on the economic regulation of electricity and gas transmission and distribution networks.

The Economic Regulation of Electricity and Gas Transmission and Distribution

These networks and facilities are characterised by long-lived, specific assets. The primary requirement of owners of these assets (and of other providers of finance) is to secure a cast-iron assurance of full investment recovery at an appropriate risk-related rate of return.

Energy Network Regulation in the US

In the US, long-term contracts for capacity, evergreen distribution franchises and, where they exist and where transmission capacity may be defined and quantified contractually, forward markets in capacity provide much of this assurance of investment recovery. This assurance is supported and excess recovery constrained by regulation of rates (or transportation tariffs) both at the federal and state level. Energy regulators in the US seek to strike a balance between the interests of investors and the public interest – and generally achieve this.

Energy Network Regulation in GB (and the EU)

In GB (and generally throughout the EU) almost all transmission and distribution capacity in place prior to the initiation of the process to de-integrate the electricity and gas industries and to introduce both wholesale and retail competition was provided by state-owned, state-sponsored or state-supported entities which were awarded monopoly rights to construct and operate capacity and exclusive rights to generate, procure and supply electricity and gas. Long-term contracts for capacity were not contemplated or considered necessary and, in any event, would have proved difficult to draft, agree and enforce. The integrated transportation and supply firms could rely on the revenue extracted from captive consumers to ensure investment recovery. And they enjoyed statutory backing to extract this revenue.

make the process more palatable and enticing to voters and consumers. The process is described in terms of 'completing the internal energy market', 'market opening', 'market liberalisation', 'providing third party access (TPA) to networks' and 'introducing competition and choice to consumers'. As a result, it is very easy to portray those who advance reasoned critiques of what is being down and of how it is being done as reactionaries and defenders of vested interests.

Now, however, following the de-integration of the electricity and gas industries and the introduction of wholesale and retail competition, producers, suppliers and retailers who rely on transmission and distribution services are unwilling, and have no incentive, to enter in to long-term contracts for these services. Regulations imposed by the EU's institutions, often to secure ends unrelated to the stated objectives of the regulations, proscribe and impede the contractual definition of transmission capacity that would allow trading of this capacity and the emergence of a competitive market in capacity.[4]

This is regrettable, but it has to be accepted as a given. The owners and operators of the networks adamantly oppose any changes that might diminish their enjoyment of the monopoly rights or of the *de facto* monopoly positions they have secured. Producers, suppliers and traders strongly resist any changes to the trading flexibility they currently enjoy which is based on a total abstraction from the physical reality of the underlying networks and resist even more any possibility of increased contractual commitments. And all of these market participants have the resources and ability to influence governing politicians, policy-makers and regulators to prevent any changes along these lines.

As a result, in addition to their responsibilities to foster and monitor wholesale and retail competition, energy regulators in GB and throughout the EU are required to regulate networks in a manner that will retain and attract the necessary investment financing. It is they who provide the assurance of investment recovery. This places regulators at a considerable disadvantage when seeking to regulate network firms. Investors and other providers of finance have the power to demand (and secure) excessive rates of return to provide finance and to threaten a shortfall in investment-financing if their demands are not satisfied. Invariably, regulators, mindful of the implications of delays in the provision of, or of failures to provide, necessary capacity will err on the side of generosity at the expense of final consumers. Suppliers who pay the resulting higher tariffs in the first instance cheerfully pass these through to final consumers. They have no incentive to champion the collective interests of their customers who are being encouraged to switch suppliers continuously in pursuit of lower prices – and who are frequently berated by politicians, policy-makers and regulators if they are not actively engaged in the retail market.

The Cost of Capital for Energy Networks

This enforced regulatory generosity at the expense of final consumers may be revealed by examining the most recent determinations by Ofgem of the Weighted Average Cost of Capital (WACC). These are presented, in summary form, in public on the cost of capital and financeability by Joint Regulators Group (JRG) – now the UK Regulatory Network (UKRN)[5].

It is necessary to briefly consider the theoretical basis of these determinations.

The Capital Asset Pricing Model (CAPM)

Most economic regulators in GB (and also those throughout the EU, and further afield, who have adopted and adapted the British model of economic regulation) employ the Capital Asset Pricing Model (CAPM). The CAPM has been subjected to much criticism over the

[4] The most egregious example is the EU's Gas Regulation 715/2009 which mandates the use of Entry-Exit gas transmission pricing and proscribes the definition or use of 'point-to-point' (P2P) capacity. A leading NERA consultant has succinctly highlighted the flaws (and attractions to key EU stakeholders) of an Entry-Exit approach: "Adoption of an "entry-exit" definition of capacity would be particularly destructive to competition, since it breaks the link between capacity contracts (property rights) and actual pipeline assets. An entry-exit regime blocks competitive entry, entrenches the position of incumbent pipeline operators, and creates a need for more regulation and more complex regulatory rules." http://www.nera.com/nera-files/NL_ERI_EN454_Issue_36_Final.pdf
Needless to say, these views reflect those of the author and not necessarily those of NERA.

[5] Joint Regulators Group, "The Cost of Capital and Financeability", London, March 2013.

years primarily due to its failure to pass empirical tests. It has been modified and, in a number of instances, supplanted by alternative approaches and models, such as Arbitrage Price Theory and the Fama-French three-factor model, to ensure applicability to a broad range of asset classes. However, despite its restrictive assumptions, its simplicity has contributed to an enduring and expanding application, particularly in the arena of economic regulation. In addition, for the subset of physical assets subject to economic regulation – which are generally characterised as long-lived and specific – its purported deficiencies are less serious.

There is a further factor which partly explains and justifies the endurance and prevalence of the CAPM in the regulatory arena. As noted above, prior to the initiation of the process of de-integration the integrated firms had an assurance of investment recovery from the revenue extracted from captive consumers. De-integration and the introduction of competition in supply ostensibly released these final consumers from their captivity. But, while there will always be final consumers who can't pay or won't pay, the extent of default and delinquency is negligible when related to the revenues generated by the vast majority of final consumers who will always pay for what they view as essential services. The processes of privatisation and de-integration may have moved this asset class from the state's balance sheet, but they have not, and should not have, changed, to any meaningful extent, the intrinsic riskiness of investing in these assets. The potential for capital appreciation is, and should be, limited. Electricity and gas transmission and distribution are essentially 'boring' businesses with a focus on investment recovery at an appropriate risk-related rate of return. The deficiencies of CAPM stand revealed when it is applied to more complex and risky asset classes. But these deficiencies are much less prevalent for this asset class.

The CAPM is based on a simple proposition:

$$E[r_A] - r_{rf} = \beta_A.\{E[r_M] - r_{rf}\} \qquad (1)$$

This states that the expected rate of return on an asset, $E[r_A]$, in excess of the risk-free rate of return, r_{rf}, (in other words, the asset's risk premium) is equal to the expected rate of return generated by the market, $E[r_M]$, in excess of the risk free rate (in other words, the equity risk premium (ERP)) times the correlation between the returns generated by the asset and the market. This last is termed the asset beta, β_A, and is a measure of the asset's non-diversifiable risk for which those financing the asset (either as owners or other providers of finance) require an appropriate reward. The relevance and application of this proposition is supported by a seminal insight of financial economics which is applied with the CAPM to estimate what is usually termed the 'plain vanilla' WACC which abstracts from the impact of taxation of profits.

The Modigliani-Miller (M-M) Theorem

Under what has now become standard financial theory, initially developed by Modigliani and Miller, the cost of capital of an asset is determined by the fundamental, or systematic, risk of the asset, and not just its capital structure. In other words, the riskiness of cash flows is affected by systematic risk and not by the capital structure – the mix of debt and equity.[6] This fundamental insight, generally known as the Modigliani-Miller (M-M) Theorem, holds only under certain very restrictive assumptions that include the absence of corporate taxes, transaction and bankruptcy costs and informational asymmetries. Relaxing these assumptions and applying these insights to a wide range of firms and assets has generated a huge literature and many applications in practice using the Capital Asset Pricing Model (CAPM). Systematic risk is typically captured within the CAPM framework, under which

[6] Modigliani, F. and Miller, M. H. (1958). The Cost of Capital, Corporate Finance and the Theory of Investment. *American Economic Review*, 48, 261-97.

asset risk is quantified by the asset's beta coefficient, i.e. the degree to which asset-based cash-flows are correlated with the market.

The riskiness of cash-flows, as quantified by the asset beta, could affect the capital structure of a company. For example, lower asset betas may allow investors to take on higher leverage, on the back of more stable expected streams of cash-flows. However, the simple argument that debt issuance is cheaper than equity, so higher gearing must mean cheaper financing, overlooks the impact on equity costs of an increase in leverage. However, as per the M-M Theorem, equity costs increase with higher leverage, because a higher debt percentage increases the riskiness of shareholders' capital. But it also increases the cost of debt, though from a lower base. Therefore, the weighted average cost of capital (or WACC) is constant over the capital structure of the company.

In practice, when taxation is applied, the tax-deductability of debt interest payments provides an incentive to firms to increase the debt percentage as this reduces the pre-tax WACC while generating and increase in the cost of equity – and in the potential post-tax return to equity. This is often described as exploiting the 'tax shield' through the reduction of the firm's tax liability that comes from increasing debt. Indeed, as Miller-Modigliani showed in a subsequent 1963 paper, the cost of capital declines linearly with increases in the debt percentage. But there is a limit to which this decline in the cost of capital - and the increase in the potential rate of return on equity - may be exploited. Providers of debt finance, fearful of the risks of default by, or of bankruptcy of, the borrower, either impose constraints on the extent of leverage they will accept or signal significant increases in the cost of debt if leverage were to exceed a certain extent. The effect would be to increase the cost of capital if the firm were to seek to increase the debt percentage beyond a specific extent. The specific leverage at which these higher costs would kick in varies from firm to firm, but the effect is to impose a case-by-case limit on leverage.

However, despite these complicating factors, most economic regulators and financial practitioners tend to consider that the essence of the M-M Theorem holds: that increased leverage leads to higher equity risks (and correspondingly higher equity costs) and to higher risks to providers of debt finance (and higher debt costs) and that, in the absence of taxation, the cost of capital remains unchanged across a wide variety of mixes of debt and equity.

Applying the CAPM with the M-M Theorem

When applying the CAPM with the M-M Theorem, most practitioners make the convenient assumption that the debt beta (the correlation between the risk premium for debt-financing of this asset and ERP) is zero so as to derive directly the equity beta (the correlation between the risk premium for equity investment in this asset and the ERP determined by the market). This flies in the face of the M-M Theorem. A positive debt beta that increases with leverage (or the debt percentage) is required in combination with a positive equity beta that also increases with leverage to generate a constant asset beta across all percentages of debt. This is a fundamental element of the M-M Theorem – as follows:

$$\beta_A = \lambda\beta_D + (1-\lambda)\beta_E \qquad (2)$$

and this leads to:

$$\beta_A = \lambda\frac{\gamma\beta_A}{(1-(1-\gamma)\lambda)} + (1-\lambda)\frac{\beta_A}{(1-(1-\gamma)\lambda)} \qquad (3)$$

where

$$\beta_A = asset\ beta$$

$$\beta_D = debt\ beta$$

$$\beta_E = equity\ beta$$

$$\lambda = debt\ percentage$$

$$\gamma = ratio\ of\ firm\ specific\ debt\ and\ equity\ risk\ premia$$

This is the basis for generating the after-tax (or 'plain vanilla') WACC as follows:

$$WACC\ (after-tax) = \lambda\left(r_{rf} + \frac{\gamma ERP\beta_A}{(1-(1-\gamma)\lambda)}\right) + (1-\lambda)(r_{rf} + \frac{ERP\beta_A}{(1-(1-\gamma)\lambda)}) \qquad (4)$$

An estimate of γ may be derived from observations on the existing debt premium for the firm, from the cost of debt quoted by debt providers for new debt issue by the firm, from assessments by ratings agencies or by providers of financial data and statistics or from assessments of the debt premia for comparable firms with similar debt percentages. In tbis instance it is derived from the debt premium assumed by Ofgem. Equation 4 may be viewed as a disaggregation of Equation 1 above in to its debt and equity cost components. It is now possible to examine how this has been applied by Ofgem, the energy network regulator in Great Britain.

Ofgem's Derivation of the 'Plain Vanilla' WACC

Ofgem's derivation is presented in the following table for five price control reviews: Electricity Distribution Price Control Review 5 (DPCR5) – for all electricity distributions networks (EDNs) and the Gas Distribution 1 (GD1) – for all gas distribution networks (GDNs), National Grid Gas Transmission (NGGT), National Grid Electricity Transmission (NGET), Scottish Highlands Electricity Transmission Ltd. (SHETL) and Scottish Power Transmission Ltd. (SPTL) price control reviews under the 'Regulation=Incentives+Innovation+Outputs' (RIIO) framework. The shaded rows present Ofgem's calculations.

It is important to note that economic regulators in GB do not make a decision on the appropriate leverage or debt percentage. It is asserted that the regulated firms are best placed to decide on capital structure. This is consistent with the M-M Theorem in the absence of taxation of profits. The WACC should remain constant across a wide range of debt percentages. Therefore regulators employ a notional debt percentage and generate a point estimate of the WACC for that notional debt percentage. The implication is that the WACC will remain unchanged for a wide range of debt percentages around this notional value.

Table 1 Ofgem's WACC Calculations in Five Price Control Reviews

	Price Control Review		DPCR5	RIIO-GD1	RIIO-T1		
	Regulated Firm		EDNs	GDNs	NGGT	NGET	SHETL/SPTL
	Period		2010-15	2013-21	2013-21	2013-21	2013-21
1	***Cost of Equity***						
2	Risk-free Rate (RFR)		2.00%	2.00%	2.00%	2.00%	2.00%
3	Equity Beta	(4)/[1-(11)]	0.90	0.90	0.91	0.95	0.95
4	Implied Asset Beta		0.32	0.32	0.34	0.38	0.43
5	Assumed Debt Beta		0.00	0.00	0.00	0.00	0.00
6	Equity Risk Premium (ERP)		5.25%	5.25%	5.25%	5.25%	5.25%
7	Cost of Equity (post-tax)	(2)+(6)x(3)	6.7%	6.7%	6.8%	7.0%	7.0%
8	***Cost of Debt***						
9	Cost of Debt (gross of tax shield)		3.60%	2.92%	2.92%	2.92%	2.92%
10	Implied Debt Premium (DP)	(9)-(2)	1.60%	0.92%	0.92%	0.92%	0.92%
11	Notional Gearing		65.00%	65.00%	62.50%	60.00%	55.00%
12	Marginal Tax Rate		28.00%	23.00%	23.00%	23.00%	23.00%
15	**'Plain Vanilla' WACC**	(11)x[(2)+(10)]+[1-(11)]x(7)	4.69%	4.25%	4.37%	4.55%	4.75%
16	Asset beta consistent with Ofgem WACC	[(15)-(2)]/(6)	0.513	0.429	0.451	0.485	0.524
17	Gamma#1 (from Ofgem DP and asset beta)	[[1-(11)]x(10)]/[(4)x(6)-(11)x(10)]	0.912	0.305	0.284	0.255	0.238
18	Gamma#2 (from DP and implied asset beta)	[[1-(11)]x(10)]/[(16)x(6)-(11)x(10)]	0.339	0.195	0.193	0.184	0.184
19	Ofgem Cost of Debt	(2)+(17)x(6)x(16)/[1-[1-(17)]x(11)]	3.60%	2.92%	2.92%	2.92%	2.92%
20	Ofgem Cost of Equity	(2)+(6)x(16)/[1-[1-(17)]x(11)]	6.73%	6.73%	6.78%	6.99%	6.99%
21	Ofgem WACC	(11)x(19)+[1-(11)]x(20)	4.69%	4.25%	4.37%	4.55%	4.75%
22	Revised Cost of Debt	(2)+(18)x(6)x(4)/[1-[1-(18)]x(11)]	3.60%	2.92%	2.92%	2.92%	2.92%
23	Revised Cost of Equity	(2)+(6)x(4)/[1-[1-(18)]x(11)]	3.75%	5.02%	5.24%	5.61%	5.86%
24	Revised WACC	(11)x(22)+[1-(11)]x(23)	3.65%	3.65%	3.79%	4.00%	4.24%

Source: Ofgem via Joint Regulators Group and own calculations

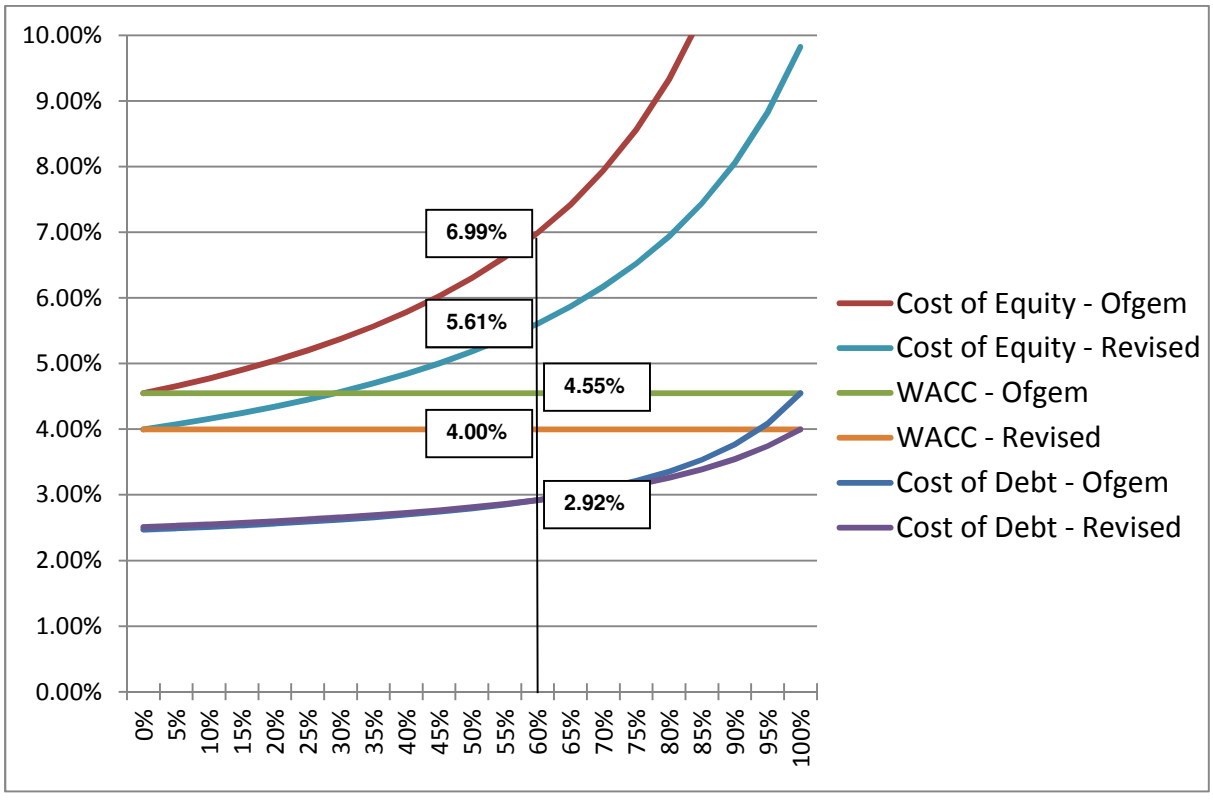
Ofgem calculates the cost of equity and the cost of debt separately. It derives an estimate of the asset beta (which is implied in the calculations it presents) and, by assuming a debt beta of zero, uses the M-M Theorem (Equation 2 above) to estimate the equity beta in Row 3. This allows the cost of equity to be estimated for the specific notional gearing used in each price review (Row 7). When this is combined with an estimate of the debt premium (DP in Row 9) it is possible to calculate the 'plain vanilla' WACC (Row 15).

However, a direct application of the CAPM and the M-M Theorem allows the WACC to be derived directly from the risk-free rate and the asset beta. Applying this approach in Row 16 to Ofgem's estimate of the WACC indicates that this estimate is consistent only with an asset beta that is much higher than the asset beta applied by Ofgem (in Row 4).

In turn, it is possible to generate two estimates of the gamma parameter (in Equation 4 above) in Rows 17 and 18. The first estimate is derived using the DP and asset beta used by Ofgem. The second is derived using the DP and the estimate of the asset beta implied by Ofgem's WACC estimate. Using these parameter estimates in turn it is possible to replicate Ofgem's estimates and revised estimates of the cost of debt, the cost of equity and of the WACC from first principles using a consistent application of the CAPM and the M-M Theorem. Ofgem's assumption of a debt beta of zero is entirely inconsistent with the estimate of the debt premium it uses. The result is an implied asset beta that is much higher than the asset beta it assumes and a WACC that is higher than what a consistent application the CAPM and the M-M Theorem would generate.

The risk-free rate, the asset beta, the equity risk premium and the debt premium are the key variables and parameters derived from market data and statistics that are required for the calculation of the WACC. One would expect them to be applied consistently with the CAPM and the M-M Theorem. Such an application is presented in the following figure for the National Grid Electricity Transmission (NGET) values in Table 1.

Figure 1 Ofgem and Revised Estimates of the WACC and its Components



Relevant values from the NGET calculation in Table 1 for Ofgem's chosen notional debt percentage of 60% are presented in the figure.

In addition, Ofgem assumes a real risk-free rate that is far higher than current AAA long-term bond yields and ignores the thrust of monetary policy aimed at suppressing long-term yields. The result is that Ofgem is awarding these regulated networks a rate of return that is considerably higher than its own estimate of the asset beta would suggest or justify. Ofgem, similarly to other economic regulators, seeks to justify these higher rates of return by highlighting its duty to ensure the financeability of these regulated firms. It goes on to employ financial metrics and hurdles developed by the credit ratings agencies to make a case that these higher rates are required to comply with these financial criteria. The argumentation based on the use of these metrics is tenuous at best and tends to confirm, rather than refute, the evidence that Ofgem is being overly generous to the owners of these network firms.

A more recent assessment of the determination of the WACC for another electricity network provides further evidence of Ofgem's generosity.

The Competition Commission's Decision on the WACC for NIE

Towards the end of 2012, the Northern Ireland Authority for Utility Regulation (NIAUR) issued its final decision on the price control for the electricity transmission distribution networks owned and operated by Northern Ireland Electricity (NIE). NIE rejected this decision and the NIAUR referred NIE to the Competition Commission (CC). The CC issued its final determination in March 2014.[7] The determination includes its decision on the 'plain vanilla' WACC. The calculations underpinning this decision are presented in the following table. The shaded rows present the CC's calculations.

[7] Competition Commission, 'Northern Ireland Electricity Limited price determination: reference under Article 15 of the Electricity (Northern Ireland) Order 1992 – final determination', London, 26 March 2014.

Table 2 The Competition Commission's WACC calculation for NIE

	Parameter/Variable	Calculation	Low	High
1	Gearing		45.0%	45.0%
2	Cost of debt (pre-tax)	(6)+(8)	3.10%	3.10%
3	Cost of equity (post-tax)	(6)+(7)x(9)	3.38%	4.93%
4	WACC (a la CC)	(1)x(2)+[1-(1])x(3)	3.26%	4.11%
5	**Cost of equity calculation**			
6	RFR		1.00%	1.50%
7	ERP		4.00%	5.00%
8	Implied Debt Premium (DP)	(2)-(6)	2.10%	1.60%
9	Derived equity beta	[(12)-(1)x(11)]/[1-(1)]	0.60	0.69
10	**Asset beta calculations**			
11	Debt beta assumption		0.05	0.05
12	Asset beta		0.35	0.40
13	Asset beta consistent with Ofgem WACC	[(4)-(6)]/(7)	0.564	0.522
14	Gamma#1 (from CC DP and asset beta)	[[1-(1)]x(8)]/[(7)x(12)-(1)x(8)]	2.538	0.688
15	Gamma#2 (from DP and implied asset beta)	[[1-(1)]x(8)]/[(7)x(13)-(1)x(8)]	0.882	0.466
16	CC Cost of Debt	(6)+(14)x(7)x(13)/[1-[1-(14)]x(1)]	3.10%	3.10%
17	CC Cost of Equity	(6)+(7)x(13)/[1-[1-(14)]x(1)]	3.38%	4.93%
18	CC WACC	(1)x(16)+[1-(1)]x(17)	3.26%	4.11%
19	Revised Cost of Debt	(6)+(15)x(7)x(12)/[1-[1-(15)]x(1)]	3.10%	3.10%
20	Revised Cost of Equity	(6)+(7)x(12)/[1-[1-(15)]x(1)]	1.83%	3.83%
21	Revised WACC	(1)x(19)+[1-(1)]x(20)	2.40%	3.50%

Source: CC and own calculations.

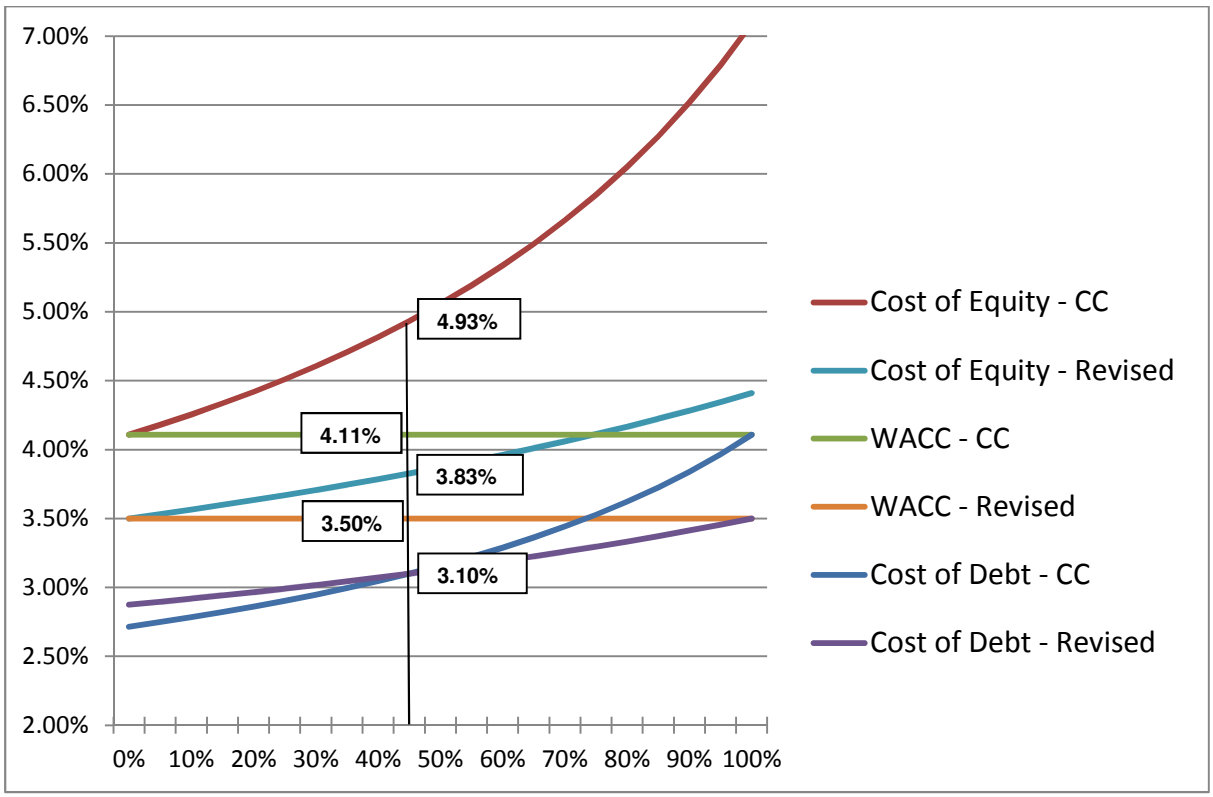
This table has a similar layout to the previous table. The CC presented a range for key parameters and variables that generates low and high estimates. It ultimately decided to choose the higher estimate. Since this relates to a regulated network that is within the UK but not regulated by Ofgem one would not expect to see identical values for parameters. But there are some noteworthy differences between the CC's calculations and those of Ofgem. The CC, taking a forward-looking view, opts for a lower risk-free rate and assumes a low, but non-zero, debt beta of 0.05. The outcome is an estimate of the WACC lower than Ofgem's estimations – not much lower than those for gas transmission and distribution, but 50 to 70 bps lower than those for the other regulated networks.

However, similarly to the assessment of Ofgem's calculations, a consistent application of the CAPM with the M-M Theorem generates a WACC (Row 21) that is lower than the CC's estimate (Row 4). And again, similarly to the assessment of Ofgem's calculations, the asset beta that is consistent with the WACC it estimates (Row 13) is considerably higher than its initially estimated asset beta (Row 12).

It appears that Ofgem is estimating higher costs of capital (and awarding higher rates of return) than a consistent application of the CAPM and the M-M Theorem to its estimates of key parameters and variables would generate. The Competition Commission is forcing a downward revision of the WACC estimates, but the resulting reduction is largely due to a reduction in the risk-free rate. Given the major programmes of 'quantitative easing' being pursued by the US Federal Reserve, and by the Banks of England and Japan, whose intent

is to suppress long-term bond yields, it is surprising that Ofgem set a real risk-free rate at 2%. The CC's reduction in this rate appears to be justified, but a reasonable case could be advanced for reducing it further. There is considerable uncertainty about when and then how quickly the monetary authorities will unwind their current policies and begin to raise interest rates, but, given the usual duration of price control periods it should be possible to take a view from the regulatory perspective. It is a little surprising to find regulatory bodies – and a regulatory appeals body – effectively 'institutionalising' risk-free rates that are higher than than those desired by the monetary policy authorities. However, even if the CC's lower estimate of the riks-free rate is accepted, as shown in Table 2, a consistent application of the CAPM and the M-M Theorem would generate even lower estimates of the WACC and this is illustrated in the following figure.

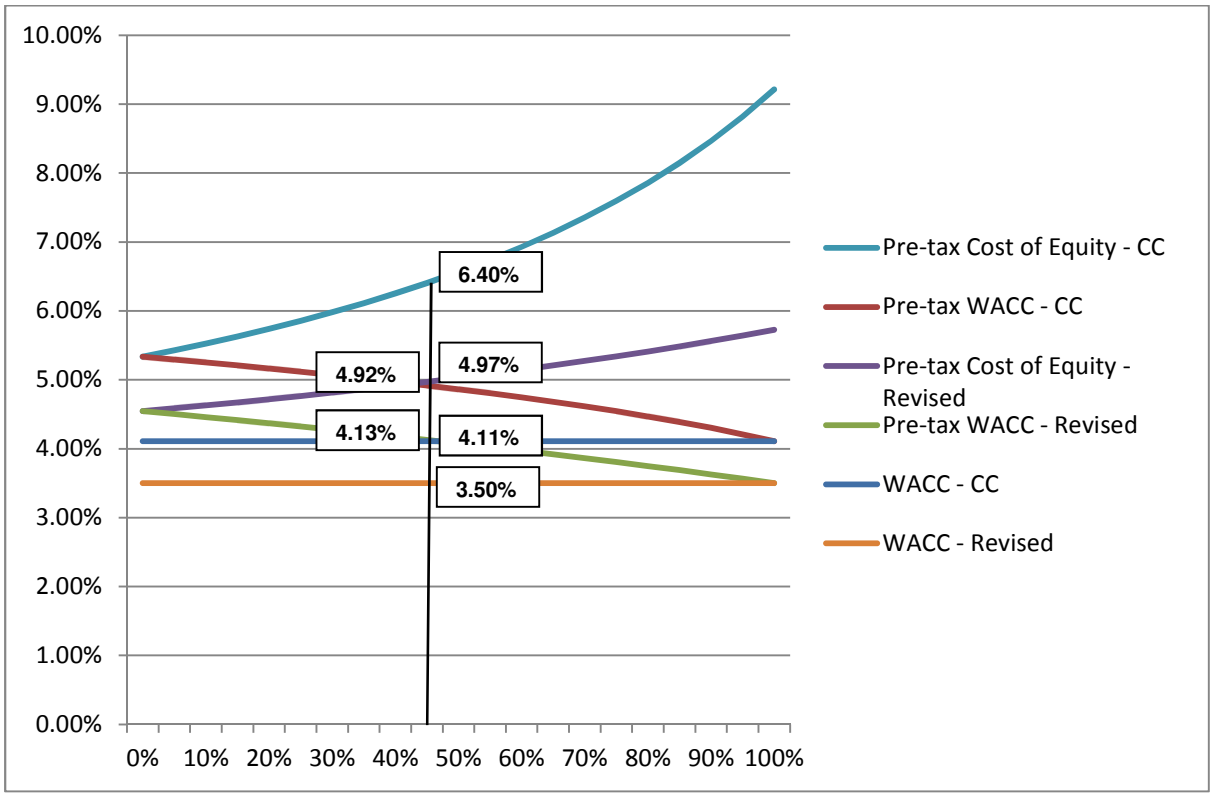
Figure 2 CC and Revised Estimates of the WACC and its Components



The Impact of Taxation on the WACC

As noted above, regulated firms have an incentive to exploit the 'tax shield' by increasing the debt percentage. This is presented in the following figure.

Figure 3 CC and Revised Estimates of the Pre-tax WACC



For reference purposes the CC and Revised estimates of the (post-tax or 'plain vanilla') WACC, 4.11% and 3.50%, respectively, are presented and these remain constant over the debt percentage range. Previously, most regulators simply grossed up the post-tax cost of equity by the marginal tax rate to derive the pre-tax WACC. A number still do both in Britain and in other jurisdictions. But, increasingly, efforts are made to model the impact of taxation to derive the pre-tax WACC. The CC, in its NIE determination, adopted this approach and directed its use appropriately. However, for the purposes of illustration, it is assumed that a simple grossing up of the post-tax cost of equity by a marginal tax rate of 23% is applied.

As would be expected, in both the CC and Revised cases, the pre-tax WACC declines steadily from the value of the pre-tax cost of equity, at a zero debt percentage, to the value of the post-tax WACC at 100% debt. At the CC's chosen debt percentage of 45% the pre-tax WACCs are, resp., 81 and 63 bps higher than the post-tax WACCs for the CC and Revised cases. This gap closes by 17 and 15 bps when the debt percentage is increased from 45% to 60%, but the pre-tax cost of equity increases by 53 and 17 bps, respectively. This illustrates the incentive that regulated firms have to increase the debt percentage up to the limits that providers of debt finance signal or impose.

When regulators seek to model the impact of taxation on the WACC during price control periods they generate an implicit 'effective' rate of tax that, generally, is lower than the marginal rate and reduces the gap between the pre-tax and post-tax estimates of the WACC. However, though diminished, regulated firms still have an incentive to increase the debt percentages above the notional levels set by regulators. And this generates a higher cost of equity and, potentially, a higher rate of return on equity.

All of this leads to a brief assessment of the issues raised and to some conclusions.

Assessment and Conclusions

In general, energy network regulation in Great Britain and throughout the EU is deeply flawed. Far too many duties have been imposed on energy regulatory bodies with regard to the design and monitoring of potentially competitive market mechanisms, but without the powers necessary to fulfil these duties. This policy failure is serious, but the flaws are revealed far more starkly in what might be considered the application of 'classic' economic regulation: the regulation of energy networks. Unfortunately, in the absence of long-term contracts for electricity or gas transmission capacity or forward markets for this capacity and in the context of considerable political and policy uncertainty, regulators are obliged to provide the owners of energy networks with the assurance of investment recovery they require. And the owners of energy networks have both the power and incentive to exploit this regulatory obligation by demanding and securing the rate of return on investment they desire. Unless they are awarded the rate of return on investment they desire the volume of investment required will not be forthcoming. Regulators invariably succumb and we have seen above the violence they are prepared to do to the application of the CAPM and the M-M Theorem to achieve this outcome. It is difficult to fault the regulatory bodies. They have been placed in an impossible position.

It is, of course, possible to assert that the asset beta derived from market data and statistics is under-stated and does not take proper account of the political and regulatory risks to which owners of energy networks are exposed on a forward-looking basis. The network owners could claim that while they have some assurance of investment recovery during a price control period they have little assurance of the continuation of this investment recovery in the subsequent periods for assets whose useful lives extend over a number of price control periods.[8] However, network owners tend to overstate the capriciousness of regulators. The reality is more likely that a regulatory body that is insufficiently independent of political or policy driven decisions may be forced to respond to excessive or ill-thought through government interventions in the market in a manner that might inadvertently damage the interests of network owners. This, however, is a deficiency in the policy and regulatory framework that requires a direct remedy. In the absence of such a remedy, it does not justify an elevated reward to network owners.

In its 'Hope Decision'[9] of 1944, the US Supreme Court established some abiding principles of economic regulation.

It established, firstly, that the setting of regulated tariffs or prices "involves a balancing of the investor and the consumer interests"; secondly, that "the investor interest has a legitimate concern with the financial integrity of the company whose rates [i.e. tariffs or prices] are being regulated. From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on the debt and dividends on the stock"; and, thirdly, that "the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital".

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8 It is probably also important to note that there is a variety of network owners and investors whose interests and incentives may vary. In addition, some of the network firms may be privately owned, some may be publicly quoted and, in other cases, the network business unit may be a subsidiary of a publicly quoted firm carrying on other activities. The 'ring-fencing' applied by regulators to regulated activities is intended to address this variation, but its effectiveness can be questioned – and is worthy of further investigation.

9 Federal Power Commission et al v. Hope Natural Gas Company, 320 U.S. 591 (64 S.Ct. 281, 88 L.Ed. 333)

In the light of this, Ofgem fails on the first principle. No regulator can simultaneously provide an assurance of investment recovery, properly advocate and protect the collective interests of final consumers and strike a balance between the interests of investors and consumers. It is a profound failing of the British model of regulation that there is no effective representation and advocacy of the collective interests of final consumers in regulatory or competition authority proceedings.

Ofgem also fails on the third principle. It claims to award returns to the equity owners that are commensurate with returns on investments in other enterprises having corresponding risks, but actually awards higher returns.

It is difficult to avoid the conclusion that Ofgem is being excessively generous with final consumers' money in the returns it awards to energy network owners. And it is equally difficult to avoid the conclusion that it is a matter that should be investigated by the CMA as part of its energy market investigation.