Supplementary Papers

Draft Statement of Principles for the Regulation of Transmission Revenues

Date: 27 May 1999

Contents

Executive summary

Part A discusses a number of issues relating to the cost of capital that were initially highlighted in Appendix E of the Commission's assessment of the Victorian Gas Access Arrangements.

This paper sets out the rational for the Commission's preferred approach to the calculation of the cost of capital, the regulatory framework, and the treatment of depreciation.

Part B describes the different cost of capital methodologies applied by overseas utility regulators, in particular the UK, USA and South America. It highlights that problems arising from the treatment of tax are not unique to Australia and that different approach have been developed by overseas utility regulators.

These supplementary papers are to be read in conjunction with the *Regulatory Principles* and a summary of each paper is provided below.

PART A: Commission working paper

Features of the Commission's regulatory framework

The regulatory framework will be based on a revenue cap determined using the building block approach. Incentive regulation will be in the form of CPI-X adjustments on an annual basis. The return on assets will be determined on a nominal post-tax basis, with estimated tax relevant to the regulatory period treated explicitly as part of the forecast cost of service. Depreciation profiles will be constructed to equate in a meaningful way with economic depreciation.

Areas of contention

Pre-tax versus post-tax

Both pre-tax and post-tax approaches require tax liabilities to be properly assessed and, on this basis, there is little to choose between a pre-tax and a post-tax formulation of WACC. Given that there is little to choose between post-tax and pre-tax formulations, the issue is fundamentally how best to assess tax liabilities- short term or long term.

Long term versus short term estimation of tax liabilities

There are a number of flaws associated with the use of a long term pre-tax WACC including:

- front end loaded investor returns (the S-bend issue);
- uncertainty over long term tax provisions; and
- and difficulties in estimating long term effective tax rates and applying them within a formula based approach.

For these reasons the conclusion of the Victorian Gas Access Arrangements debate was to adopt a post-tax rate of return and assess tax liabilities on a period by period basis from projected cash flows for each regulatory period. Moreover, it was acknowledged that a post-

tax approach was more analytically rigorous as well as offering a more transparent procedure than the formula based pre-tax approach.

Assessment of tax liabilities on a period by period basis does potentially create some volatility in revenues because of an uneven pattern of tax liabilities over time. However, this is not a new issue and there is a well established method for dealing with it in the USA (called 'normalisation').

Conversion

The CAPM model produces a nominal post-tax return on equity, which when coupled with the return on debt gives the weighted average cost of capital. In order to go from the nominal post-tax WACC to a pre-tax WACC, there is an issue of conversion.

In the UK and in the Victorian Gas Access Arrangements debate a number of conversion formulas were put forward. However each of these formulae for converting from a nominal WACC to a pre-tax WACC is subject to limitations as none is able to account for the complexities and interactions of key variables (tax and inflation).

For the Victorian Gas Access Arrangements Decision the unanimous view of the experts was that the most effective way to address the treatment of tax and conversion was to adopt a relatively simple WACC formulation and deal with tax as an item in the cash flows. This approach has been developed for the *Regulatory Principles*.

An economic approach to depreciation

Conventional treatments of regulatory depreciation have conceded to accounting convenience and have no economic basis. For the *Regulatory Principles* the Commission proposes a competition based approach to depreciation. It is believed that this approach to depreciation provides an economic basis to depreciation, better reflects the behaviour of a competitive market, and takes account of technological change and potential for by-pass.

Revenue smoothing via this approach minimises inter-temporal price distortions (inter-generation price shocks). The competition depreciation approach also minimises potential geographical price distortions linked to the vintage of assets serving neighbouring systems. Further, it preserves the consistency requirements of any framework; that is, there will be no double counting of depreciation. Under a nominal approach this means that the accumulated depreciation will not exceed the initial cost of the assets.

The advantages of specifying the regulatory rate of return in nominal terms

The integrated use of the CPI-X adjustment mechanism and an economically meaningful interpretation of depreciation arrangements offer the normal advantages claimed of a real framework within the context of a nominal framework.

A nominal framework provides somewhat greater transparency as:

- the calculation of target revenues and tax liabilities is more directly linked with available data;
- some aspects of depreciation in the real framework are not easily understood (e.g. accumulated depreciation allowances will exceed the initial cost of the assets); and
- markets and financial commentators more readily understand nominal rates of return.

For these reasons a framework which uses nominal financial parameters is the preferred mechanism for deriving target revenues.

Equivalence of the models (CPI-X/nominal versus CPI-X/real)

It can be shown that CPI-X/nominal and CPI-X/real models are equivalent for establishing the forecast cost of service. Further, once target revenues are established, the procedure in calculating the X-factor and subsequent CPI-X adjustments are identical.

PART B: Final report for the Commission prepared by NERA

Taxation and the cost of capital: A review of overseas experience

The debate surrounding the use of pre- or post-tax formulations of the rate of return, the appropriate conversion formula and the application of statutory or effective tax rates, stems from:

- a fundamental tension between regulation on the basis of CPI-linked real revenues and a taxation system which operates in nominal terms; and
- differences in timing between the depreciation allowed for taxation and that allowed for regulatory purposes.

Section 2 of the NERA report notes that regulatory regimes based on historic cost asset values (such as the US) avoid the first of these complications. However, the second factor is common to both historic cost regimes and those based on CPI-X linked asset values.

Regulators have tended to adopt one of two approaches in addressing the issue of taxation in determining the rate of return. The first is to incorporate the impact of taxation via an algebraic formula to convert the required post-tax return to a pre-tax return. There is a trade-off between the complexity of such a formula and its accuracy in fully capturing the impact of taxation on the return earned by the regulated business.

The second approach has been to apply a post-tax rate of return directly, and to then allow separately for taxation as one of the regulated business' operating costs. In order to do this, however, the business' expected cashflows need to be modelled, and again there is a trade-off between the complexity and the expected accuracy of this modelling.

Table 1 summarises the approach taken by regulators overseas towards the treatment of taxation in estimating the cost of capital.

In the UK, the MMC, Offer and Ofgas have all adopted a real, pre-tax rate of return, based on the same simplified conversion formula. Ofwat and the Office of the Rail Regulator (Orr) estimate the cost of capital on a real, post-tax basis, and have allowed separately for the cost of tax, either as an addition to the allowed rate of return, or as an element of the cashflows used to determine the revenue requirement. Oftel is the only UK regulator to have changed its approach. In its 1992 decision Oftel determined the WACC on a nominal, pre-tax basis. In Oftel's 1997 decision it moved to a nominal, post-tax approach, following concerns about the accuracy of the conversion formula when applied to BT.

In the US regulators estimate the allowed return on a nominal, post-tax basis, and include a long-term ('normalised') estimate of the effective tax rate as part of the business' operating

costs. The long history of regulation in the US has allowed a consensus to emerge on the appropriate treatment of taxation, and the issue is now seen as largely non-contentious.

The issue of what is the most 'appropriate' approach to take in setting the WACC therefore seems to be largely dependent on the underlying regulatory framework (current or historic cost asset base) and the extent to which assumptions underlying alternative conversion formulae between post-tax and pre-tax WACCs are thought to be appropriate in practice.

Table 1: Summary of approaches taken to WACC

	WACC Formulation				**Tax Rate Used**	
	Real	**Nominal**	**Pre-tax**	**Post-tax**	**Statutory**	**Effective**
US		All		All		Long-run
UK	Majority	Oftel	MMC Offer Ofgas Oftel (pre-1997)	Ofwat Oftel (post 1997) Orr	MMC Offer Ofgas	Ofwat, Orr: short run
Argentina	Gas Electricity		Gas Electricity		Gas Electricity	
Mexico	Gas		Gas		Gas	
Philippines	MWSS			MWSS	MWSS	

PART A

Commission Working Paper

1. Background

In its final decision on the Victorian Gas Access Arrangements (Appendix E) the Commission made a commitment to address concerns raised in the context of that decision within the *Statement of Principles for the Regulation of Transmission Revenues* (*Regulatory Principles*). The Commission therefore views the *Regulatory Principles* as an opportunity to propose a regulatory framework which, while building on the experience of existing regimes, avoids some of the major regulatory problems associated with those regimes.

The purpose of this paper is to review some the features of the framework being proposed in the *Draft Regulatory Principles* and how such changes address the issues of concern raised in connection with alternative frameworks.

Chapter 6 of the NEC provides guidelines and identifies a number of requirements for the design of the *Regulatory Principles*. However, these are of a nature consistent with the preferred framework being contemplated and therefore do not impose a material constraint on the proposed design.

Briefly, the framework contemplated has the following features:

- a revenue cap based on forecasts of the cost of service;
- CPI-X adjustments of the revenue cap on an annual basis to take account of changes in actual inflation relative to forecasts used to establish the revenue cap;
- return on assets determined on a post-tax basis with estimated tax relevant to the regulatory period treated explicitly as part of the cost of service;
- an approach to depreciation (return of capital) which equates in a meaningful way with economic depreciation; and
- the regulatory rate of return expressed in nominal terms.

This particular combination of features differs from existing frameworks both in Australia and overseas. Therefore, in proposing this as an alternative it is important to be able to demonstrate that each feature generates net benefits. In some cases this will require a demonstration of equivalence with some aspects of existing frameworks with the benefits arising through greater simplicity and/or transparency.

Given the innovative features of the proposal, it may be asked whether the revisions are worthwhile and in some cases achieve the claimed equivalence with desirable features of more traditional frameworks. The purpose of this working paper is to address these concerns head on and provide reassurance that the Commission's proposed framework represents an advance over currently used frameworks.

2. The issues

The key questions addressed in this paper are:

- Should tax assessment of returns be considered on a period by period basis or over the lifetime of the assets involved?
- Does the CPI-X adjustment mechanism yield identical outcomes regardless of whether a nominal or real rate of return on equity or assets is used to establish target revenues?

- Is economic depreciation in place of the simpler approaches of the past worth the trouble?
- Should a regulatory decision on rates of return be expressed in real or nominal terms?

In answering these questions the separability of the issues needs to be acknowledged.

For example, the long-term tax vs short-term tax assessment has nothing to do with whether a pre-tax or post-tax weighted average cost of capital (WACC) formulation is used. This is despite the fact that the issue has often been characterised as the *pre-tax* vs *post-tax* debate. Presumably the association is a result of the fact that the long-term tax assessments have been applied exclusively in conjunction with a pre-tax WACC and the short-term in conjunction with a post-tax WACC. Once the tax assessment is made it is a trivial matter to convert a rate of return from pre-tax to post-tax and vice versa. To help clarify matters and for somewhat greater precision the terms **LT-pre-tax** and **ST-post-tax** are used in this paper.

Similarly, a rate of return expressed in either real or nominal terms may be used to estimate the revenue cap but the choice does not determine whether the framework is a real or nominal one.[1] It is in fact the application of the CPI-X adjustment mechanism, which creates a real framework and protects the transmission network service provider (TNSP) from inflation risk. To help clarify matters and for somewhat greater precision the terms **CPI-X/nominal** and **CPI-X/real** are used in this paper and distinguished from **non-CPI-X** frameworks.

Finally, the non-CPI-X frameworks in the USA have traditionally been associated with a historic cost asset base that is depreciated, in nominal terms, linearly over time. By contrast, the depreciation of assets associated with the CPI-X regimes in Australia and the UK have been on the basis of linear depreciation of the historical cost base expressed in real terms. Each approach yields a very different revenue profile over time. What is important to note however, is the fact that the link between the depreciation profiles and the nature of the regime is historic and somewhat coincidental – it is not necessarily an inherent part of the framework. The point of these remarks is that the issue of a more flexible approach to depreciation to achieve desired revenue paths is independent of other aspects of the framework adopted.

These distinctions and their importance will hopefully become clearer in later sections of the paper.

To assist in the analysis simple scenarios have been developed to illustrate the effect of adopting alternative framework assumptions. The scenarios have been designed to provide a clear illustration of most of the issues addressed but abstract from the detail required in an actual determination. Details of these scenarios are shown in Appendix A.

Also to assist in the exposition and to clarify the relevance of particular framework features, reference will be made to the approaches used overseas and recent reviews of those frameworks. Further exposition on the practises used in other countries can be found in Paper B of this document**.**

Prior to assessing the outstanding questions mentioned above it will be useful to review some fundamental aspects of the proposed framework which are not contentious:

- the cost-of-service framework basis for the revenue cap; and

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[1] The nominal and real rates of return formulations are equivalent provided consistency is maintained with inflation adjustments and depreciation allowances.

- the CPI-X adjustment mechanism.

An understanding of these aspects of the framework is important since together they determine the relevance of the questions being asked and also help to highlight differences in the regulatory frameworks adopted in the USA with those currently applied in the UK and Australia.

3. Cost-of-service framework

Natural monopoly businesses are normally regulated to avoid the economic inefficiencies associated with monopoly pricing of services. As a basis for determining what revenue cap or target revenues should be allowed, most regulatory frameworks involve estimating the overall cost of service. A building block approach is used to aggregate expected costs, which include:

- administrative and operations and maintenance expenditures;
- an allowance for depreciation (or return of capital); and
- a reasonable rate of return on assets taking account of taxes that will have to be paid and the risks involved.

The assessment of administrative, operations and maintenance expenditures is fairly straightforward, the other elements are not. For example there is not universal agreement on how existing assets entering a new regulatory regime should be initially valued for regulatory purposes. There is greater consensus on the rolling forward of the regulatory asset base over time, although a number of outstanding issues remain to be resolved. However, these issues are common to all regulatory frameworks and are not considered in the context of this paper.

Another matter of importance is internal consistency within the framework itself. For example there is a link between the way the depreciation allowance is calculated and the formulation for the rate of return used. Consistency, for example, requires no double counting of depreciation. For the purpose of this paper only frameworks that maintain such consistency are considered.

Within internally consistent frameworks there remain a number of ways in which the rate of return can be formulated. Whatever approach is used, it is important that the prospective revenues offer the service provider a prospective risk adjusted commercial return for efficient supply of the regulated service. This feature is fundamental to all regulatory frameworks currently in place in the USA, the UK, Mexico and Australia.[2] The extent to which different frameworks actually achieve this objective is a matter of some contention.

All the regulatory frameworks known to the Commission and discussed in this paper determine a regulatory rate of return by applying the well-known and well-accepted Capital

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[2] Setting a rate of return below the cost of funds in the market could make continued investment in developing the network difficult or unattractive for the owner. This would create pressure for the regulated business to reduce maintenance and capital expenditure below optimum levels and undermine the quality of service. Conversely if the rate of return were set at too high a level by the regulator, the regulated businesses would earn a return in excess of their cost of capital. This would distort price signals to consumers and investors, resulting in a mis-allocation of resources and sub-optimal economic outcomes.

Asset Pricing Model (CAPM).[3] This model uses stock market data to suggest what commercial rate of return is appropriate for the investments made by the service provider given the business risks involved (which take account of the regulatory framework). The model expresses the rate of return as the prospective **post-tax nominal return on equity** and can be adjusted to allow for debt to derive the corresponding post-tax return on assets otherwise known as the WACC, post-tax nominal.

Within the framework to drive the component of costs corresponding to the return on capital there is a choice between the use of a:

- nominal rate of return; and
- real rate of return.[4]

There is also a choice between whether the rate of return concept used should be expressed in post-tax terms (as is CAPM) or converted to a pre-tax form. Further, given that an assessment of tax is required, there is the key question of whether it should be based on an estimate of tax liabilities over the lifetime of the assets involved or whether it is more appropriate to consider tax liabilities only within the context of a more limited regulatory period.

These choices with respect to the rate of return are considered further in the following sections.

4. Regulatory reviews and the CPI-X adjustment mechanism

Once a revenue cap has been determined it is unlikely to remain appropriate over time as circumstances change. This raises the requirement for regulatory review.

In the USA there is no specific time period between reviews, either the TNSP or its customers may request a review at any time on the basis that an earlier determination is now inappropriate. While there is no claw-back of excessive profits or compensation for shortfalls, the pressures for regular re-assessment of revenues, and their link with costs, has led to the USA approach being labelled as rate-of-return-regulation.

Existing regulatory regimes in the UK, Mexico and Australia adopt a fixed regulatory period, usually of five years. Revenue caps are assessed for the whole five years and not normally reviewed until just before the commencement of the next regulatory period when all regulatory and financial parameters are reassessed. By fixing the revenue caps over the medium term the TNSP has a significant incentive to reduce its costs and achieve a higher

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[3] In the UK, regulators also estimate a rate of return based on the Dividend Growth Model. However, they generally acknowledge the paucity of information to support such an approach and the estimate is generally used as a 'ballpark' check on the CAPM calculation.

[4] The use of a real rate of return requires compensation for inflation to be reflected in depreciation allowances while in a nominal framework it is already captured within the rate of return.

return for its shareholders. This incentive for efficiency gains is viewed as an important improvement on the USA framework where such efforts would only attract an early review.[5]

Flowchart 1: Establishment of revenue caps and CPI-X adjustment

Regulatory Decision (nominal approach)			**Real Approach Variation**
Step 1.			
Decision Parameters – RAB (A) at start of period , - post-tax WACC (r)	Associated forecasts O&M (OM), Capex (K), ΔCPI for each year of regulatory period	Estimate OM(i), K(i), ΔCPI(i), A(i) for i= 1,2,..5	Ditto but all $ values expressed in real terms
Step 2.			
Compute Target Revenues (TR) on basis of forecasts	Sum forecast elements of cost for each year (O&M + Deprec + Return)	TR(i) = OM(i) + A(i)+K(i)-A(i+1) + r x A(i) + Tax	
Step 3.		.	
Choose Revenue Cap for Year 1 - Usually select R(1) = TR (1)	Will be used as basis for revenue cap in following years via CPI-X	R(i) = R(i-1) x (1+ΔCPI(i))x (1- X)	
Step 4.			
Calculate X	Revenue Caps to give same NPV as Target Revenues (net of O&M) – using WACC as discount rate	NPV(TR(1),..TR(5)) = NPV(R(1),…R(2))	Need to inflate up to $ of the day to get actual revenue caps
At End Year i			
Establish Actual Revenue Cap for Year i+1 ie AR(i+1) NB AR(1)=R(1)	Re-apply CPI-X adjustment using CPI outcome for year just past ΔACPI (i)	AR(i+1) = AR(i) x (1+ΔACPI(i)) x (1- X)	Exactly the same
Regulatory Asset Base For Next Regulatory Period			
Adjust regulatory asset base for changes in actual inflation and actual capex	Apply depreciation allowances for period as assessed to asset base based on actual capex		Ditto. May not need to change real base for existing assets

Notes

(1) In steps 1 and 2, the effective tax rates required to estimate r are based on cash flow estimates. The cash flows and the taxes are derived to give revenues consistent with the 'vanilla' WACC.

(2) In both real and nominal frameworks some residual inflation risk remains due to lagged adjustment of CPI. However, there is no systematic bias and the net effect should be minimal over the longer term.

In addition to this incentive mechanism the frameworks in the UK and Australia share another significant feature. This is the **CPI-X adjustment mechanism** which allows the revenue cap to be reset to the extent that actual inflation outcomes differ from forecasts used

[5] There is however a school of thought that suggests there may not be a great difference between the USA framework and the incentive motivated schemes over the longer term. This is because users will eventually recognise that unless the business has time to benefit from efficiency improvements it is unlikely to make them at all. However, even if this is true, the USA framework makes no automatic provision for inflation adjustments.

in the establishment of revenue caps for the regulatory period.[6] In addition, at the end of the regulatory period, the residual value of the regulatory asset base is also adjusted for errors in the inflation forecasts. This maintains consistency with depreciation allowances in the CPI-X adjusted cap occurring within the period. The steps involved in setting the revenue cap in this way with annual adjustments is illustrated diagrammatically in Flowchart 1.

The CPI-X adjustment procedure has two important consequences. First, it automatically adjusts revenues for actual inflation outcomes, a variable beyond the control of the TNSP and users alike, and removes one of the more important factors that might otherwise require a review of the regulatory settings. Second, and perhaps more importantly, such CPI-X adjustments have the effect of passing any inflation risk from the asset owner to users - as would occur automatically in a competitive framework. Apart from the fact that such a feature better reflects the workings of a competitive market, the reduced risks facing the TNSP means that its risk adjusted rate of return applied within the framework can be correspondingly lower.

This removal of inflation risk for the TNSP means that it is more or less assured of a **real** rate of return consistent with that implicit or explicit in the rate of return used to establish the revenue cap at the outset of the regulatory period. In this sense the CPI-X mechanism establishes a **real rate-of-return framework** regardless of whether a real or nominal measure of return is used to establish revenue targets. As already mentioned this distinction is important since one option being proposed by the Commission is to express rates of return in nominal terms but also apply the CPI-X adjustment mechanism. This approach needs to be clearly distinguished from the application of nominal rates of return in the USA which are used in conjunction with a **non-CPI-X** framework.

5. Long-term versus short-term assessment of tax

Under the pre-tax approach the calculated return on assets includes an amount to cover tax liabilities of the business while under the post-tax approach the amount corresponding to tax liabilities must be added as a separate item within the cost of service calculation. The use of a pre-tax rate of return is frequently advocated on the grounds that it avoids the need to explicitly add into the 'cost of service' calculation an amount to compensate for tax obligations of the service provider. Such arguments are misguided in that the tax calculation still needs to be carried out in order to convert from the post-tax rate of return indicated by CAPM benchmarks to the corresponding pre-tax real rate required for the regulatory framework. Therefore, both approaches require tax liabilities to be properly assessed and, on this basis, there is little to choose between a pre-tax and a post-tax formulation of WACC.

Since both approaches require tax liabilities to be properly assessed the issue is not so much whether to use a pre-tax or a post-tax approach but how best to estimate the effective tax rate.

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[6] - In some frameworks the revenue cap is used as an intermediate step in the development of an average revenue cap or a tariff cap. In such instances, there may be additional adjustments to individual tariffs on an annual basis to take account of differences in demand from those forecast and/or unexpected changes in the composition of services demanded.
- Such revenue caps take account of reasonably expected productivity improvements and new capital expenditures and are generally smoothed with the use of an X-factor. The X-factor is the annual increase in revenues, in the absence of inflation, that makes the smoothed revenue caps have the same NPV of revenues as that based on the forecasts of costs.

The first question is whether tax liabilities should be based on actual tax payments or estimated tax liabilities based on assumptions (e.g. gearing) consistent with the regulatory accounts. The latter is the more generally accepted approach since such calculations are independent of the financial character of the owner, its non-regulated operations and is not subject to manipulation (e.g. tax liabilities are easily transferred within a larger corporate entity by the restructuring of debt).

The key question then becomes whether tax liabilities should be assessed on a year by year basis, or estimated on the basis of an average effective tax liability over the lifetime of the assets.

Regulatory frameworks using the 'pass though' approach as applied in the USA, calculate taxes relevant in the short-term and allow these to be passed on to users as part of the cost of service. This is in keeping with the simplicity of their approach where the post-tax nominal rate of return indicated by the CAPM model can be used directly in the calculation of target revenues.

In the UK and Australia rates of return have been formulated as a real WACC. Mexico and Ofwat, Oftel (post'97), and Orr of the UK estimate tax liabilities in the short term and incorporate these explicitly into the cost of service calculation (i.e. a real ST-post-tax formulation). MMC, Offer, Oftel (pre'97) and Ofgas in the UK, on the other hand, in common with recent Australian access arrangements, have utilised a pre-tax formulation with the conversion from the post-tax rate of return (indicated by CAPM) being based on a long term view of tax liabilities (i.e. a real LT-post-tax formulation).

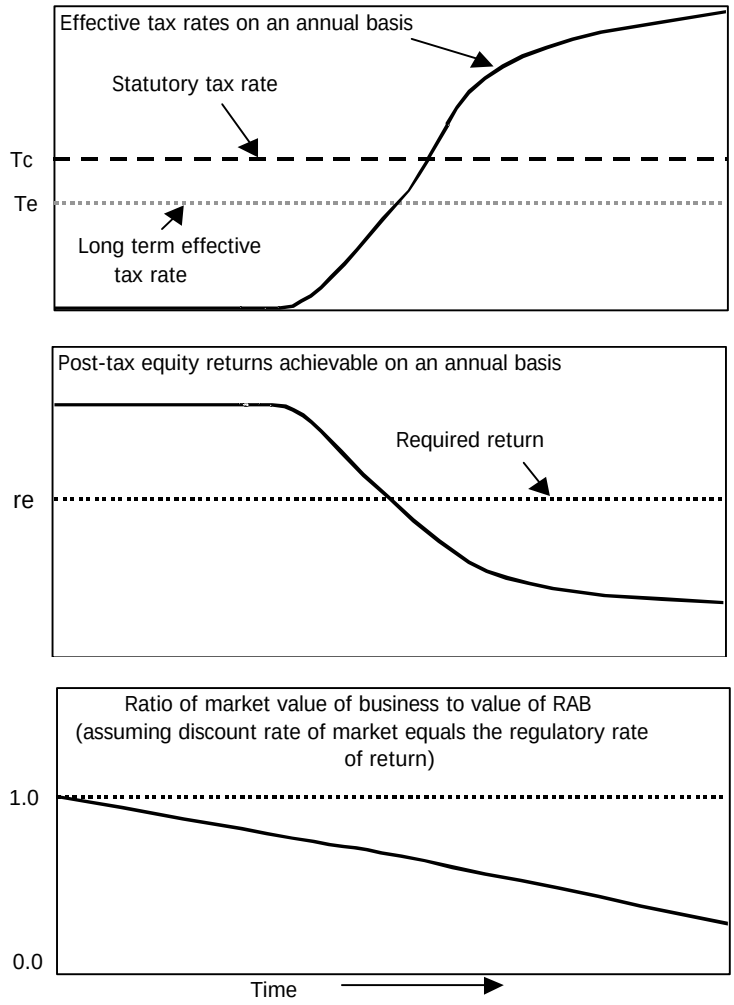
5.1 Long-term tax assessment and the S-bend problem

For the moment it is assumed that the tax wedge calculation (to derive a pre-tax WACC) is done correctly given other assumptions about the tax regime applying over the life of the assets and inflation over that period.

A feature associated with the use of a lifetime based estimate of effective tax liabilities to assess cost of service provision, is the fact that actual tax payments tend to be concentrated towards the end of the life of the assets. This arises because tax depreciation provisions normally allow capital expenditures to be written-off faster than the economic rate of depreciation. As a result the business achieves returns well in excess of those intended under the regulatory framework in the early years but these are offset by lower than commercial returns later on. As a consequence the commercial value of the business would tend to fall below the value assigned to the regulatory asset base over time. These features are illustrated graphically in Figure 1 for the situation of a single long-lived asset with lumpy ongoing capital expenditure requirements.[7]

[7] For a TNSP with a range of assets of varying vintages the effects will be somewhat muted. However, the picture is substantially a reasonable reflection of what would happen with a newly established set of infrastructure and, importantly, for most of the newly privatised service providers. The latter fall into this category because of Commonwealth legislation which effectively treats the assets of such businesses as new assets for tax purposes when they enter the taxation net.

Figure 1: Illustration of the S-bend problem arising from the use of a long term based effective tax rate



This expected profile of tax payments and its implications for the profile of post-tax returns seems likely to give rise to a number of regulatory problems:

- Despite the fact that average post-tax returns may be sufficient over the long-term, a regulator may face 'moral hazard' problems in enforcing an arrangement which rewards investors with less than the market (post-tax) cost of capital at some time in the future on the basis that they had received above market returns at some stage in the past – today's investors will inevitably be different from those of a decade ago.
- Setting a post-tax WACC on the firm's regulatory asset value which is initially above and is subsequently below the required return of existing and prospective investors appears contrary to basic principles of utility regulation (where prices should reflect the efficient cost of service as far as possible).

These concerns were collectively described as the 'S-bend' problem in the context of the Victorian Gas Access Arrangements Decision and identified as creating potential future regulatory difficulties.[8]

It should be noted that these problems are due to the profile of actual tax payments by the businesses and will arise regardless of which estimate of the average rate of taxation is used. That is, the issue is independent of whether a simplistic assumption about taxation is adopted, or a more complex estimate of the long-term effective rate is attempted.

The value of tax system concessions to a business (relating to debt financing and depreciation) depend on the rate of inflation. This renders the forecasting of effective tax liabilities over the lifetime of an asset an uncertain exercise, even ignoring the likelihood that tax laws (including the statutory rate) will change over the period. The extent of such change is illustrated in Table 1, which identifies the corporate tax rate, depreciation provisions and inflation at various points over the past 20 years. It now seems likely that there will be further changes as a result of the Commonwealth's most recent review of business taxation (the 'Ralph Report'). Continuing tax depreciation concessions associated with particular plant depend only on the date of installation, while the corporate tax rate may vary from year to year. This means that re-calculation of effective tax rates over the longer term can be quite tricky and would clearly vary from one natural monopoly business to another. Add to this the fact a burst of inflation can dramatically diminish the future value of tax depreciation allowances for all time, highlights another aspect of uncertainty.

Table 1: Key parameters determining long term effective tax rates

Year	Corporate tax rate %	Tax depreciation of asset with >30 yr economic life (% pa)		Average inflation rate % pa
		Prime cost	Dimin. value	
1977-82	46	2	3	9.4
1982-88	46	20	na	7.7
1996-98	36	7	10	<1.0
2000-	30?	2?	3?	2.0?

Source: CCH Master Tax Guide – various. Figures for 2000 were obtained from the Review of Business Taxation.

If it were considered appropriate to re-adjust long term rates of return for existing assets depending on their vintage, this may require a multiplicity of effective tax rates. At the very least it will be important to distinguish the prospective long term effective tax rate and assessed rate of return applicable to new investment from the rates that may be considered appropriate for existing plant. Unless this is done it may be difficult to provide the right incentive for new investment.

The consequence of misjudging the effective rate of tax is that investors are over or under-rewarded for the risks they bear. It is unlikely that re-adjustment of the wedge at successive reviews will fully compensate for initial errors in tax assessments. Hence, there is additional risk faced by the TNSP with respect to post-tax returns over the longer term. This may be a significant contributing factor to the observation that observed beta values for businesses

[8] It has also been suggested that marginal investment decisions may be distorted, encouraging 'gold-plating' in early years (when post-tax returns are higher than necessary) and potentially causing under-investment when post-tax returns fall below the market requirement. However, this would only be true if the longer term WACC was excessive, and in this case there would be an incentive for 'goldplating' irrespective of the form of the WACC.

subject to this type of regulation are typically higher than in the USA where taxes are determined on a near term basis. Therefore, one consequence of utilising long-term assessments of tax is higher rates of return to compensate for higher business risk.

The strong link between the value of taxation concessions and inflation outcomes means the TNSP bears a substantial element of long-term inflation risk which is not offset by the CPI-X adjustment mechanism. Given the attention assigned the CPI-X adjustment mechanism as a means of shifting short-term inflation risk to consumers, it is somewhat surprising that the LT-pre-tax WACC formulation, which re-creates the problem within a longer term perspective, has been so widely adopted.

5.2 The tax wedge and conversion to a LT-pre-tax rate of return

As noted earlier, the basic input to the rate of return determination is the nominal post-tax return on equity coming from CAPM estimation (or from the DGM). This means that a value is assigned to the tax wedge, and the consequential LT-pre-tax rate of return, should give cash-flows which provide a prospective post-tax return on equity as indicated by the CAPM. Given the time value associated with the early tax write-off of assets, the only way of confirming whether this is true is by modelling the cash flows and tax payments likely to emerge from the use of a particular LT-pre-tax rate of return.[9] The LT-post-tax internal rate of return investors would achieve, if the other regulatory assumptions were met, can then be calculated.

The Commission adopted this approach when it assessed the Victorian Gas Access Arrangements. However, the applicants in that instance did not envisage any such check. Also, it appears that all the UK regulators, that utilise a LT-pre-tax rate of return (WACC), abstract from any such assessment and instead rely on what appear to be 'rule-of-thumb' conversions. These generally appeal to the theoretical link between pre-tax and post-tax rates of return in the context of a simple single period model but do not appear to take account of accelerated tax provisions that are likely to apply to the actual assets involved.

5.3 Conversion technicalities

The conversion from the nominal post-tax return on equity to the equivalent real LT-pre-tax WACC received considerable attention during the course of the Victorian Gas Access Arrangements Decision. It is enlightening to explore some of the issues surrounding conversion further as difficulties still arise, even if there are no uncertainties over future tax rates or inflation. In the Victorian Gas Access Arrangements the applicant proposed a long term effective tax rate set equal to the corporate tax rate and used a variation of the Officer WACC formula to calculate the LT-pre-tax WACC.[10] This formula makes no provision for special features of the tax system such as accelerated depreciation.

An interpretation of this approach is that WACC was intended to reflect the rate of return appropriate to the economic model, expressed in **real** terms, underlying the proposed regulatory framework. In this interpretation, a real pre-tax WACC is applied to the real

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[9] An analytical derivation is possible but only proves tractable with one or two assets.

[10] The proposed formulation sought to take account of imputation credits and therefore used as a starting point the expression for the nominal WACC established by Officer to reflect the impact of imputation credits. The inclusion of imputation credits is a complication not critical to the conversion issue and is not considered in detail as part of this paper.

written down value of the asset base, depreciation for tax purposes coincides precisely with regulatory depreciation and all borrowings are also in real terms (i.e. financed by indexed bonds). There are some justifications for such an approach in that one view on accelerated depreciation tax allowances is that they compensate businesses for the eroding effects of inflation. If this was actually achieved the simplification may be worthwhile. However, the variations in tax rules over time and the volatility of inflation as illustrated in Table 1 must raise some doubts about the validity of the approximation and its robustness as a generalised approach. The extent and causes of the biases are illustrated below through the use of stylised models. If the regulatory economic model interpretation is used it is important that the approach be supported by a reality check to see whether the cash flows using a more realistic tax scenario give similar target revenue outcomes.

On the basis of the Commission's cash flow analysis, the regulatory model interpretation failed the reality check by a fairly substantial margin in the case of the Victorian Gas Access Arrangements. The source of the discrepancy was twofold.

The first cause of the discrepancy was the inappropriateness of the formula proposed for deriving the real pre-tax WACC. If it were reasonable to accept the regulatory model interpretation there is no question of what formulation is appropriate. However, it is clear that considerable confusion still exists over what the correct formulation should be.

To help clarify these issues the alternative real pre-tax WACC formulations and their features are outlined below. This analysis does not utilise the Officer formulation as imputation credits and how they may be represented is not germane to the conversion issue. The starting point for all the formulations is the nominal or real post-tax return on equity and the formula for the real pre-tax WACC is meant to generate the real post-tax return on equity as an expected rate of return from the regulatory framework assuming that the regulatory model holds true.

Notation:

r_e, rr_e	-	nominal and real post-tax return on equity
r_d, rr_d	-	nominal and real cost of debt
D, E	-	shares of debt and equity
T_c	-	the corporate tax rate
T_e	-	effective tax rate on equity
w	-	nominal post-tax WACC
rw	-	real post-tax WACC
W	-	nominal pre-tax WACC
RW	-	real pre-tax WACC
f	-	inflation rate

The post-tax nominal WACC it is given by

$$w = r_e . E + r_d . D . (1 - T_c) \quad (1)$$

CSFB:

The real pre-tax WACC proposed by CSFB in relation to the Victorian Gas Access Arrangements achieved conversion, first by grossing up equation (1) to obtain the nominal pre-tax WACC

$$W = w / (1 - T_c) \quad (2)$$

then converted to a real figure using the Fisher relationship

$$RW_{CSFB} = (1 + W) / (1 + f) - 1 \quad (3)$$

Unfortunately, this does not give r_e as the post-tax return on equity. What it does achieve is the pre-tax return on equity that is obtained by grossing up r_e by the corporate tax rate – not a valid assumption in the regulatory model.

UK:

The more valid formulation is the one seemingly used by UK regulators. This first converts the nominal post-tax return on equity and the pre-tax cost of debt to their real counterparts using the Fisher relationship and calculates the real pre-tax WACC as

$$RW_{UK} = rr_e . E / (1 - T_c) + rr_d . D \quad (4)$$

While the UK formulation gives the right outcome for the regulatory model, there is a fairly subtle point relating to the tax deductibility of debt that needs to be considered. The regulatory model assumes that the tax deduction of interest payments coincides with the real interest amount. However, the tax office calculates the tax deductibility of interest as if the corresponding nominal interest rate was used, that is, the real interest amount plus the capital appreciation in the value of borrowings. Even if other aspects of the regulatory framework were thought to give a reasonable approximation of the real world, this feature is significant and must be redressed. This may be done by adjusting the nominal post-tax cost of debt to real debt by the Fisher equation and then grossing up to give a pre-tax cost of debt. This gives the conversion formula

$$RW_{UK2} = rr_e .E / (1 - T_c) + D.\{[1 + r_d.(1 - T_c)]/[1 + f] - 1\}/(1 - T_c.) \quad (5)$$

MACQUARIE:

During the Victorian Gas Access Arrangements considerations, Macquarie Risk Advisory Service, appealing to a simple annuity example suggested that the transformation order proposed by CSFB be reversed – adjust the nominal post-tax WACC for inflation using the Fisher relationship, then gross up for tax, so that the real pre-tax WACC is given by

$$RW_{MACQ} = [(1 + w) / (1 + f) - 1] / [1 - T_c] \quad (6)$$

It turns out that (5) and (6) are analytically identical and either formulation can be used to represent the real pre-tax WACC assuming that the regulatory model provides a reasonable approximation for accelerated tax depreciation.

The relationship between the alternative formulations depends on the gearing assumption, the corporate tax rate and the inflation rate as follows

$$RW_{MACQ} = RW_{UK2} \quad (7)$$

$$= RW_{UK} - [f / (1 + f)]. [T_c / (1 + T_c)] . D \quad (8)$$

$$= RW_{CSFB} - [f / (1 + f)]. [T_c / (1 + T_c)] \quad (9)$$

The order of magnitude of these differences is indicated in Table 2 below. It can be seen that the differences are significant and especially sensitive to the inflationary environment. Further, the preferred formulation is sensitive to the inflation assumption. Given that the **real WACC** regulatory formulation is intended to generate real revenues which are independent of the inflationary environment this outcome is somewhat disturbing.

Table 2: Real pre–tax WACC estimates from different WACC formulations (using parameter assumptions of the base scenario in Appendix A but with a range of alternative inflation assumptions (per cent))

Formulation	Inflation assumption (per cent per annum)				
	0.0	**2.0**	**4.0**	**6.0**	**8.0**
RW_{CSFB}	9.15	9.51	9.85	10.18	10.50
RW_{UK}	9.15	9.07	8.98	8.91	8.83
RW_{UK2}	9.15	8.40	7.69	7.00	6.33
RW_{MACQ}	9.15	8.40	7.69	7.00	6.33

The second reason for the real pre-tax WACC formulations failing the reality check is that, in the inflationary environment forming the basis for deriving target revenues, the real model mis-calculates the value to the investor of the tax depreciation allowances. In the case of the CSFB formulation their value was substantially over-estimated, and in the case of the Macquarie formulation, under-estimated. This suggests, in this instance, an effective tax rate below the corporate tax rate should be used in the appropriate formula. The question over how the effective tax rate should be assessed remains.

Surprisingly, if an effective tax rate different from the corporate tax rate is utilised, the appropriate formula is no longer the Macquarie/UK2 conversion, as these formulations are designed to already reflect the value of tax concessions associated with the tax shield of debt.

In fact, if the correct effective tax rate on equity is utilised the correct formula is in fact that proposed by CSFB. This full circle turnaround is less surprising when it is recognised that what the CSFB formulation delivered was the nominal pre-tax return on equity assuming the effective tax rate equalled the statutory rate. So if the correct effective tax rate is used in place of the corporate tax rate, the correct relation between the pre-tax and post-tax return on equity is preserved. However, the formula in this case also requires the effective tax rate on equity T_e to be distinguished and calculated separately from the effective tax shield on debt T_d.

Figure 2 illustrates how the required real pre-tax WACC within a real regulatory framework varies with alternative tax depreciation allowances and the inflationary environment. The calculations are based on a model simulating the scenarios discussed in Appendix A. (It

should be noted that the model confirms the analytical assessment of the alternative real pre-tax WACC formulations.)

As expected, the more accelerated are depreciation allowance for tax purposes, relative to regulatory depreciation, the more likely the formula based WACC will be over-generous. However, for modest depreciation allowances and with higher levels of inflation the TNSP would be under-compensated by the formula based WACC. The levelling-off of the required WACC with extremely generous allowances simply reflects the fact that with faster write-offs the benefits are unable to be fully utilised.[11]

Figure 2: Required real pre-tax WACC variation with the rate of depreciation write-off for tax purposes

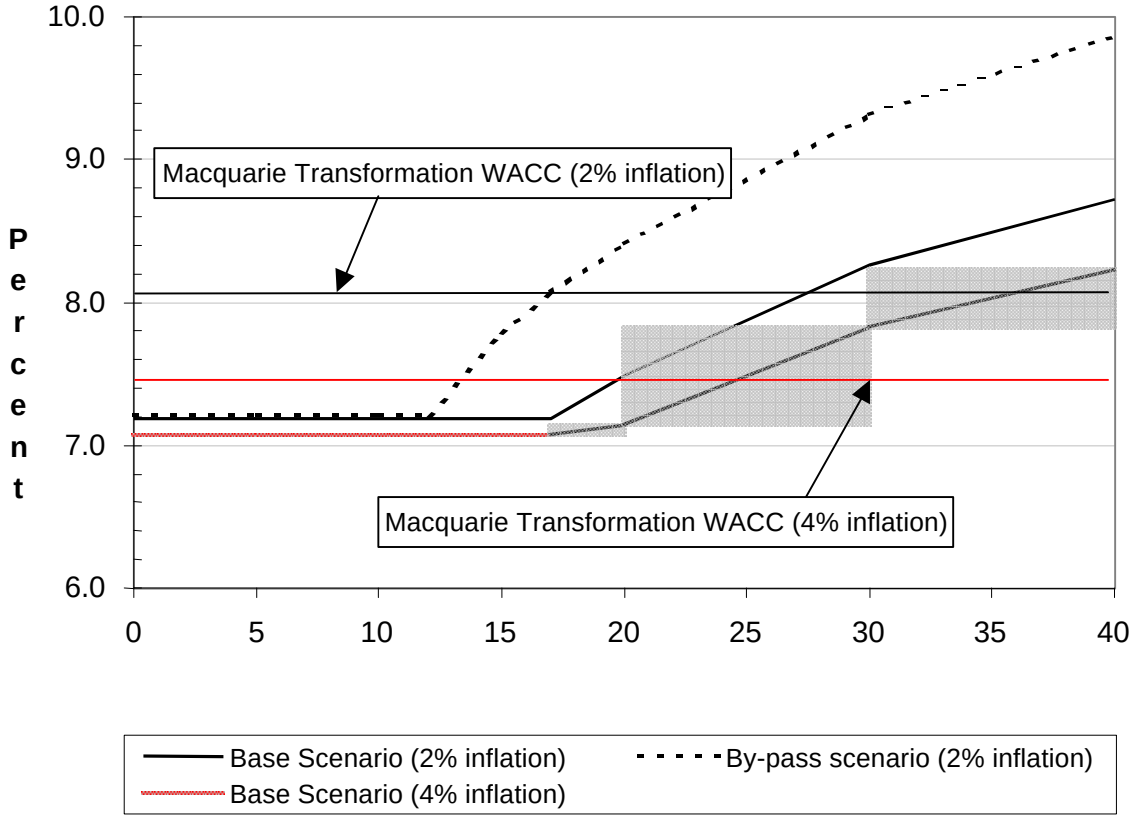

Figure 2 considered scenarios with a small range of inflation (2% and 4%), yet the range of potentially required WACCs is substantial. The formula based WACCs provide the right answer for just one tax depreciation scenario.

Therefore, the major point to appreciate is that any approach using a simple formula as the basis to calculate the LT-pre-tax WACC will be of questionable validity. It must be checked against likely cash flows consistent with the regulatory assumptions applied elsewhere in the framework - to confirm that it is actually consistent with the post-tax return on equity, ostensibly used as the basis for its derivation. Where there is a discrepancy the cash flow model can indicate the effective tax rates that will provide a correct LT-pre-tax WACC formula. The value for the LT-pre-tax WACC can be derived (iteratively) directly from the

[11] This would not happen if the operation was part of a broader business operation with tax liabilities arising elsewhere that would enable the depreciation concession to be utilised immediately.

cash flow model without resorting to the additional steps of estimating the effective tax rate and substituting this into the formula. However, if such modelling is carried out, a formula for the LT-pre-tax WACC becomes redundant since the necessary target revenues are derived in the process.

5.4 Avoiding the pitfalls of a framework based on a LT-pre-tax WACC

In summary the problems associated with the use of a LT-pre-tax WACC include:

- regulatory difficulties linked to the front-end-loaded investor returns;
- uncertainty over the long term tax provisions;
- the link between the value of tax concessions and inflation which creates a degree of long-term inflation risk for the service provider; and
- difficulties in estimating long term effective tax rates and applying them within a formula approach.

Not all these problems were aired at the forum to discuss WACC issues arising in the context of Victorian Gas Access Arrangements Decision, however it appears they may have a common remedy.

At that forum, there was a perception of choice between two broad alternatives. Regulatory decision-making can deploy relatively simple assessments of cash flows (that is, before tax and financing) but these must be coupled with much more complex formulations of WACC.

The alternative is to use the less complex and more transparent post-tax formulation of WACC, which in turn must be applied to derive cash-flows, inclusive of internally consistent tax assessments, that support the indicated post-tax rate of return. This is the approach favoured by the Commission.

Similar issues were also recognised by informed commentators in Australia prior to the forum. For example, in an early submission prior to the Commission's *Draft Decision*, the Commonwealth Bank commented that:

> ... a conceptual problem [with the approach adopted by the Applicant] is that it grosses up the WACC for the maximum possible tax payable. The corporate tax rate is currently 36%… [but] often the utilities bought on sale are geared enough to have the effective tax rate well below 36%. It would be more fair to end users if a post-tax WACC was used and the actual tax paid by the utility on a year by year basis was simply refunded as part of the total revenue equation. This would equate federal taxes as a cost much the same as best practice operating costs are currently treated (ie refunded).

Most experts and practitioners at the WACC forum also expressed the view that the most rigorous way to address taxation is to start with the post-tax return on equity, or a post-tax WACC derived from it, and allow taxes to be assessed directly from the cash-flows required to support that post-tax return.

The consensus was that annual cash flows should be considered for the regulatory period in question and based on the regulatory accounts and tax law (and foreshadowed changes) known to be relevant at the time of the decision. This ST-post-tax approach relies only on the immediate inflationary outlook and short term changes in tax rules and is not subject to the

same degree of uncertainty implicit in the LT-pre-tax alternative.[12] A consequence of this framework is that the investor potentially receives the post-tax return indicated by the CAPM benchmark **in every period**. With this outcome the discounted value of future cash flows associated with the assets in question will tend to mirror the value assigned to the regulatory asset base at any point in time. This is considered far more appropriate than the outcome with the use of the LT-pre-tax WACC where the regulatory asset value will generally exceed the market value of those cash flows.

Short-term assessment of tax is, in fact, the approach adopted by USA regulators in the context of a nominal non-CPI-X framework. Ofwat, Oftel and Orr in the UK use the approach in the context of a **rea**l ST-post-tax WACC/CPI-X based framework. The Commission's framework proposes to use a short-term assessment of tax in the context of a **nominal** ST-post-tax WACC/CPI-X based framework.

While not all UK regulators currently apply a short-term assessment of tax within a CPI-X based framework there seems to be some reassessment by others regarding their use of a pre-tax WACC, for example Orr, Ofwat, Oftel, while Offer had indicated a preference for the post-tax approach.

5.5 Is there a downside to the use of a ST-post-tax approach?

Given the strength of the case against the LT-pre-tax approach, it is puzzling to understand why a ST-post-tax approach has not been adopted by all regulators. Without wanting to defend the selection of the LT-pre-tax approach there are some potentially less elegant aspects of the ST-post-tax approach that need to be recognised and addressed.

First, any ST-post-tax rate decision cannot be made in total abstraction of the current status of the regulatory accounts for the particular firm under consideration and the prevailing taxation and economic environment. This may not seem unreasonable, however, it appears to be one of the justifications for using the LT-pre-tax WACC approach. However, the additional factor to consider is that a different rate decision may emerge for two, otherwise similar, businesses simply as a result of a different vintage profile of assets. Similarly, in moving from one regulatory period to the next, the rate decision may vary simply because of the changed tax status of certain assets (e.g. they may have become written-off for tax purposes). Of course, the consistency between regulatory decisions comes from the benchmark post-tax return on equity, used as the basic input, and its direct link with the revenue caps assessed. This fundamental relationship is not assured with the use of the LT-pre-tax approach.

Second, the explicit inclusion of tax liabilities as part of the cost of service calculation and its variability over time may generate target revenues which undergo a sustained rise when the bulk of tax depreciation concessions expire. Even though such a rise merely compensates for lower revenues earlier on, there may be a price hike for users that would not occur in a competitive market. Such a jump would not occur in a LT-pre-tax framework and that may have been another reason for choosing that approach.

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[12] A LT-post-tax approach where cash-flows could be considered over the life of the asset - but given that the analysis would be reviewed for the next regulatory period such an exercise is only of academic interest. Similarly, a ST-pre-tax approach could be considered but the most reasonable interpretation is one which requires the same cash flow analysis as the ST-post-tax approach.

Of course a change in revenue levels and/or prices may occur for many other reasons and the tax related effects may be relatively minor depending on the profile of assets involved. In the USA, where the ST-post-tax approach is used as a matter of course, the problem is well understood. Where such effects feature as part of a framework, it is referred to as the 'flow through' approach.

However, 'flow through' is not an essential feature of a ST-post-tax framework and it is easily remedied. In a number of US jurisdictions, regulators use a 'normalisation' approach to smooth the allowance made for taxation in the benchmark revenue requirement over time, while at the same time providing investors with the correct post-tax returns (and so avoiding the problems of a long term effective tax rate).

Under this approach, the benchmark tax cost is determined on the basis of the regulatory depreciation rather than taxation depreciation. Thus, in the early years, this will overstate the taxation liability (and the utility will be over-rewarded) whereas in the later years this will understate the taxation liability (and the utility will be under-rewarded). However, the overpayment (or underpayment) of taxation is treated as a temporary 'return of capital' (or an injection of capital when there is an underpayment), which is deducted from (or added to) the regulatory asset base for the purposes of determining the benchmark revenue requirement.

The implications of this approach are that:

- the end-users pay as if taxation and economic depreciation are identical, implying a constant effective tax rate in their eyes; however
- the benefit that the regulated entity otherwise would receive from receiving overpayment of taxation in the early years is recognised and returned to end-users through the temporary reduction in the regulatory asset base; and
- the post-tax return on assets (or equity) is constant over time as the adjustment to the regulatory asset base exactly offsets the benefit or detriment arising from a difference between the notional and actual (benchmark) taxation.

The Commission tends to the view that 'flow through' represents a shortcoming in the design of the framework and should be remedied. The normalisation approach fits perfectly with the Commission's concept of flexible depreciation schedules developed on the basis of providing a more economically efficient profile for tariffs over time. While the Commission's framework may use a slight variation of the 'normalisation' approach, the underlying principle is the same.

5.6 Conclusions regarding LT vs ST assessment of tax

There are a number of serious problems associated with the use of a LT-pre-tax WACC. Approximately in order of perceived importance they are:

- uncertainty over the validity of the long term parameters required in its calculation and the transparency of those calculations;
- the uncertain quality of the relationship of the resultant cash-flows with the return on equity benchmark assumption ostensibly used as the basic input;
- the creation of significant long-term inflation risk for the service provider; and
- regulatory problems posed by the S-bend phenomenon.

The ST-post-tax approach on the other hand has none of these problems, makes more direct and transparent use of basic input assumptions and requires only short-term (five year) considerations of tax and financial forecasts. There are some slight inconveniences (e.g. tax pass-through volatility) in using a framework which seeks to explicitly capture commercially significant aspects of the financial and taxation system. However, these are readily accommodated in a easily understood fashion as an integral part of the broader framework.

The case against the LT-pre-tax approach appears to be overwhelming given the shortcomings of that approach and the availability of an alternative with desirable characteristics.

6. Equivalence of CPI-X/nominal and CPI-X/real rate of return formulations

Having resolved that the ST-post-tax framework provides a more logical and transparent mechanism than the LT-pre-tax approach, there remains a choice between expressing the rate of return in real or nominal terms. Either can be accommodated as part of a framework. However, given that the fundamental objective is to design a framework that delivers the expected return on equity indicated by CAPM benchmarks it is important to confirm this equivalence. Concern has also been expressed over whether the nominal framework provides the same protection from inflation risk linked with the real approach.

The CPI-X based frameworks adopted in the UK and Australia to date have utilised a rate of return expressed in real terms (a CPI-X/real framework). For reasons to be discussed in section 8 the Commission has proposed that a nominal formulation of the rate of return be utilised in conjunction with the CPI-X adjustment mechanism (CPI-X/nominal framework).

The Commission proposes to demonstrate formally in this section that in respect of doing the revenue calculations and any subsequent CPI-X adjustments the results are identical provided the rate-of-return in each case is properly derived.

The steps in the procedure to establish target revenues are essentially the same regardless of whether the rate of return is expressed in real or nominal terms. Once target revenues are established procedures to calculate the X-factor, establish the revenue cap and subsequent CPI-X adjustments are identical. Therefore, for equivalence it is sufficient to prove that the target revenues emerging from the nominal and real calculations are identical. The full procedure was previously detailed in Flowchart 1.

6.1 Analytical proof of equivalence

To ensure that unambiguously correct values for the nominal and real rates of return are applied in the derivation, the fundamental driver in each case is the nominal post-tax return on equity that comes from the CAPM framework rather than a WACC derivation. Further, the analysis is maintained in very general terms with no special form for the depreciation schedule or constancy of rates (inflation, interest, return on equity etc) from one year to the next. The only concession to simplification is an assumption of no new capital expenditure.

Notation:

r_{et}, rr_{et}	-	nominal and real post-tax return on equity pertaining to period t
r_{dt}, rr_{dt}	-	nominal and real cost of debt pertaining to period t
D_t, E_t	-	shares of debt and equity applying in period t
I_t, AI_t	-	forecast and actual inflation index at the end of period t
T_t, t_t	-	nominal and real tax liabilities assessed at the end of year t
OM_t, om_t	-	nominal and real operations and maintenance expenditures in year t
A_t, a_t	-	nominal and real value of the regulatory asset base at the beginning of year t

Note that in comparing the target revenue calculations for each approach the revenues and constituent cost of service elements are expressed in prices pertinent to the end of the relevant period. The following identities relating nominal and real values are used in demonstrating equivalence:

$$a_t = A_t / I_{t-1}$$
$$rr_{et} = (1 + r_{et}) \cdot I_{t-1} / I_t - 1$$
$$rr_{dt} = (1 + r_{dt}) \cdot I_{t-1} / I_t - 1$$
$$om_t = OM_t / I_t$$

The following table shows the expressions for cost of service elements emerging from each approach. The real estimates of cost of service need to be inflated to allow tax liabilities, which must be assessed in nominal terms, to be calculated and the target revenues must eventually be expressed in nominal terms. The fourth column shows the inflated real calculation after making the substitutions of the nominal parameters from the real/nominal relationships indicated above.

Table 3: Cost of service elements in real and nominal terms

Item	**Nominal**	**Real**	**Real (after substitution) x I_t**
Post-tax return on equity	$E_t \cdot A_t \cdot r_{et}$	$E_t \cdot a_t \cdot rr_{et}$	$\{E_t.A_t/I_{t-1}.[(1 + r_{et}).I_{t-1}/ I_t . - 1]\} \cdot I_t$
Pre-tax cost of debt	$D_t \cdot A_t \cdot r_{dt}$	$D_t \cdot a_t \cdot rr_{dt}$	$\{D_t.A_t/I_{t-1}.[(1 + r_{dt}). I_{t-1}/ I_t. - 1]\} \cdot I_t$
Depreciation allowance	$A_t - A_{t+1}$	$a_t - a_{t+1}$	$[A_t/I_{t-1} - A_{t+1}/I_t] \cdot I_t$
O&M	OM_t	om_t	$[OM_t/I_t] \cdot I_t$
Taxes	T_t	t_t	$T_t \cdot I_t$
Target revenue	TR_t	tr_t	$tr_t \cdot I_t$

For equivalence the nominal target revenue calculations must be identical. In this derivation it is not necessary to calculate the expressions for the taxes in each case since these will be equal provided that the sum of the remaining elements are equal.[13] So it remains to show that

[13] Note that real taxes t_t cannot be calculated directly but must be deduced from tax liabilities assessed after converting the real numbers into nominal terms.

the sums of the returns on equity, the cost of debt, depreciation allowances and O&M are the same.

For the nominal approach these sum to

$$A_t \,.\, [(r_{et} \,.\, E_t) + (r_{dt} \,.\, D_t)] + A_t - A_{t+1} + OM_t \qquad (A)$$

For the real approach the comparable summation is obtained by simplifying the top 4 cells in the fourth column to obtain

$$A_t \,.\, E_t \,.\, r_{et} + E_t \,.\, A_t - E_t \,.\, A_t \,.\, I_t / I_{t-1} +$$
$$A_t \,.\, D_t \,.\, r_{dt} + D_t \,.\, A_t - D_t \,.\, A_t \,.\, I_t / I_{t-1} +$$
$$A_t \,.\, I_t / I_{t-1} - A_{t+1} + OM_t \qquad (B)$$

Noting that $E_t + D_t = 1$ and collecting terms this simplifies to

$$A_t \,.\, [(r_{et} \,.\, E_t) + (r_{dt} \,.\, D_t)] + A_t - A_{t+1} + OM_t$$

Which is identical to (A), the expression obtained using the nominal formulation.

Once the target revenue calculations are shown to be the same it follows that subsequent adjustments involving the calculation of X and the CPI adjustments must also give identical outcomes. It can also be shown that CPI-X adjustments, with retrospective adjustments, give the same outcomes that would have been obtained if the actual inflation outcomes were known in advance. Of course in reality actual inflation outcomes can only be known with a lag and there is potential for a discrepancy. However, over time such errors can be expected to become inconsequential.

The validity of the CPI adjustment mechanism is readily proved using equation A. The CPI adjusted target revenue is obtained by multiplying the target revenue by the actual inflation index and dividing by the forecast index used (i.e. x AI_t/I_t) then noting that all the terms can be expressed as values they would have been assigned if the actual, rather than forecast, inflation number had been used in their derivation. The real rate of return interpretation of this feature can be more readily appreciated when it is noted that the adjustment, based on the real rate of return analysis, means AI_t replaces I_t in the expression for the calculation of the target revenue.

7. The advantages of an economic definition of depreciation

None of the analyses presented in this paper have required any assumptions about the depreciation schedule that may be associated with a particular framework. Indeed the scheme chosen for regulatory depreciation and the resultant features of the revenue profile over time, are not dependent on the regulatory framework used. This is despite the fact that one regulatory framework has frequently been favoured over another simply because it is associated with a particular regulatory depreciation profile. For example, a real regulatory framework is often claimed superior on the basis that it gives a more efficient time profile of tariffs than a nominal framework. In fact this superiority comes from a depreciation scheme based on straight line depreciation of the asset base expressed in real terms compared with one applying linear depreciation of the asset base expressed in nominal terms. The depreciation scenarios (the base scenario and scenario 3) in the context of stylised models described in Appendix A include both these depreciation schemes as examples. The resulting

asset profiles over time are illustrated in real and nominal terms in Charts A1 and A2 respectively. The nominal figures illustrate the general shape of the revenue path outcomes.

However, linear depreciation of a real asset base does not always provide a better revenue profile. Indeed, scenario 2 in Appendix A, incorporating a potential by-pass situation, required non-linear depreciation of the real asset base. This ad hoc adjustment to this particular regulatory problem gave a depreciation outcome that was, in fact, very close to that posed by the nominal scheme rejected in the previous comparison. This can be readily appreciated by noting the features of the profiles in Charts A1 and A2 included in Appendix A.

Given that the regulator faces a range of challenges, it is indeed fortunate that there is flexibility available in terms of depreciation and that this is not tied to a particular regulatory framework. This point does not seem to have been adequately appreciated in the past. For the *Regulatory Principles* the Commission has taken full advantage of this flexibility as a means of encouraging more efficient tariff profiles over time.

Having taken this step, the obvious question is whether the traditional depreciation profiles are the best practice option. The answer is clearly no. Scenario 2 was just one example and that was merely an ad hoc solution to a particular situation. There are other recognisable shortcomings associated with linear depreciation which seems to be based on accounting convenience rather than being economically motivated.

Key identifiable problems are the fact that in regulatory frameworks using linear depreciation, whether nominal or real, there is typically a jump in tariffs/revenues as one major item of capital reaches the end of its useful life and is replaced by another (see Figure 3 below). A related feature is the fact that two otherwise similar service providers under the same regulatory framework and using similar equipment may have different prices due purely to the age of the equipment (see Figure 4).[14] Such discontinuities represent inter-temporal and possible geographic economic distortions that would not be observed in competitive business activities.

To avoid problems such as these, the Commission favours an approach that assigns depreciation in an economically meaningful way. In a competitive environment this would correspond to assets values being depreciated in line with changes in replacement costs, and pricing of services being independent of the vintage of the assets which provide those services. In other words the revenues will assume a time profile which is closely related to the replacement cost of assets or alternative technologies where these exist. Under this approach scenario 2 presented in Appendix A is readily accommodated as part of this broader framework. In effect the approach is one where the asset base is based on a continuously updated DORC valuation, at least conceptually.[15] The mechanics of the smoothing approach are closely related to the mathematics of an annuity or a housing loan, with the revenues corresponding to the instalments on the loan, and depreciation, the principal reductions. There is an additional adjustment required to account for changes in replacement cost (possibly associated with technological change and/or by-pass). Such modifications are similar to those involved in a low start loan where instalments increase over time in line with incomes. This approach to depreciation is termed *competition depreciation*. The calculations

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[14] Whether they are competing indirectly or not is irrelevant.

[15] In this context a particular version of DORC is considered where the depreciation is non-linear but based on annuitising the revenue stream linked to the asset. The formula is identical to that for principal repayments associated with a housing loan.

may not be as simple as the linear frameworks but they are readily derived and can be flexibly adjusted to accommodate changing expectations on technology and potential by-pass.

Figure 3: Stylised revenue stream over three generations of assets

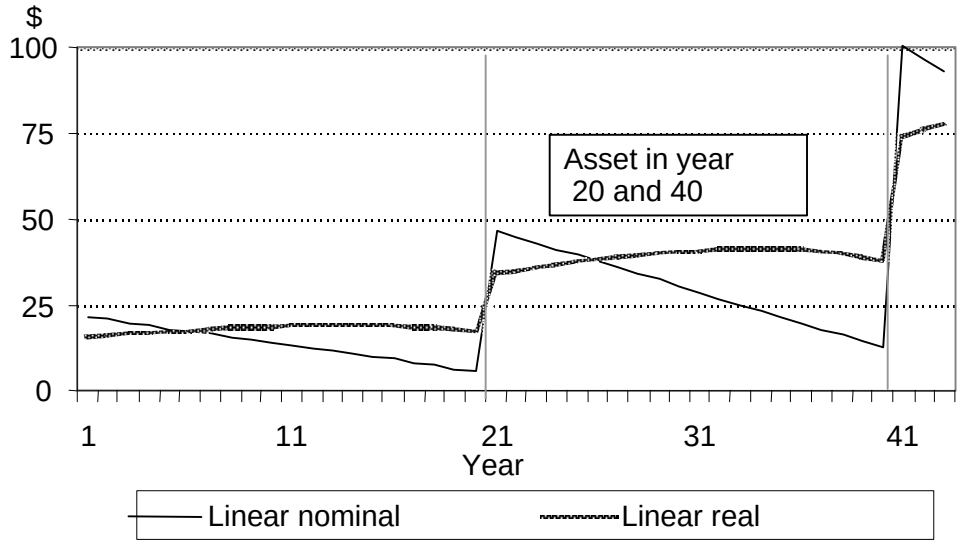
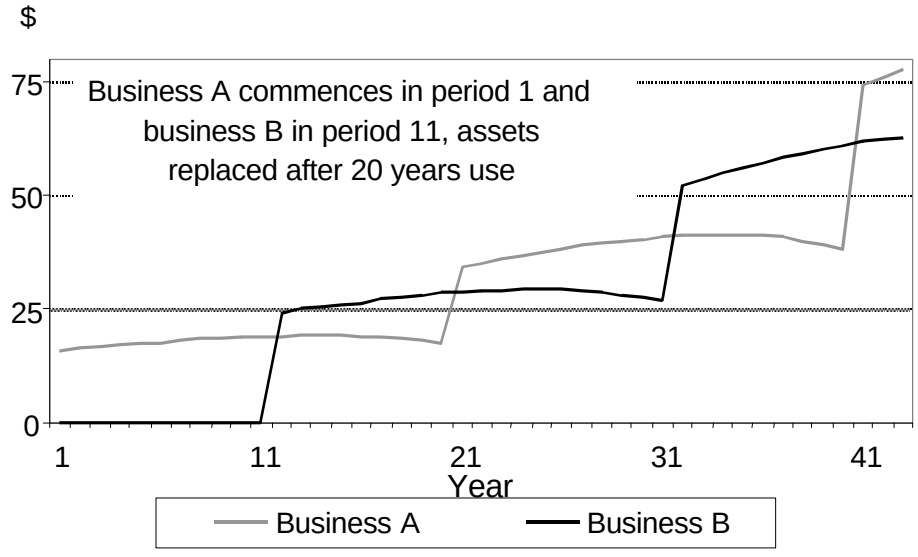


Figure 4: Stylised revenue stream for two identical businesses with different vintages of assets (both based on linear depreciation of the real RAB)



With the recognition of a flexible approach to depreciation it is also relatively easy to accommodate actual DORC re-assessments that may be periodically performed. When this occurs the RAB is not simply reset as this may involve a price shock and a windfall gain or loss to the TNSP. Instead there would be a gradual transition to what is perceived to be the

more appropriate RAB time path. The time for transition would be sufficient to avoid major price shocks associated with the changed level of depreciation required as a result of transition.[16]

It may be suggested that the annuity approach represents a solution to a problem that is not material, as the issues it resolves are diminished because most service providers have a portfolio of assets with different vintages and replacement schedules. This is true, but this view means noting that there are compensating errors which make the issue less obvious. This is not necessarily an argument for discarding the approach in favour of, what are effectively, ad hoc alternatives. There are cases that will arise where such effects are important and these still have to be dealt with. They include single purpose assets and the range of businesses currently being privatised, which will be treated for regulatory purposes as new operations. Perhaps more importantly, the approach is critical to industries where technological change may be much greater but with considerable uncertainty on timing of its introduction.

The robustness of the competition depreciation over a range of industries provides an additional argument for its adoption within the *Regulatory Principles*.

8. Should the regulatory rate of return be expressed in nominal of real terms

From the earlier discussion in this paper it is clear that any regulatory framework can be expressed in nominal or real terms yet achieve the same regulatory outcomes. Therefore, it may be argued that it does not matter which approach is chosen. In the *Regulatory Principles* the Commission has proposed that a specification in nominal terms is the logical way to go.

However, before outlining the reasons for this it should be noted that a number of arguments exist for supporting the real formulation.

8.1 Arguments for expressing the rate of return in real terms

The traditional justification for the use of the real framework is that it generates a more desirable revenue profile over time. However, in the previous section it was shown that this was due to the depreciation profile selected rather than the application of a real framework per se. The other traditional justification is that the real framework frees the business from inflation risk. However, it was demonstrated earlier that this does not come about by virtue of the real framework, but rather the CPI-X adjustment mechanism that is often packaged with it.

With these justifications vaporising, support for a real approach seems to rest on a perception that for economists it is easier to think in real terms and abstract from inflation possibilities. There may be some truth in this but it is a luxury that is not available to regulators. Even if the real LT-pre-tax WACC approach is persisted with, an earlier section proved that the correct WACC could not be derived in the absence of inflation and was likely to impact on the value of tax concessions. Of course, if a real ST-post-tax WACC approach (the preferred option) is used, all the revenue calculations need to be inflated into nominal terms to allow the tax liabilities to be calculated (since taxes are assessed in nominal terms). Therefore,

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[16] This is to avoid double counting or under provision for depreciation.

although some aspects of the framework can be initially considered in real terms a conversion to nominal is always required.

A final argument in favour of expressing the rate of return in real terms has been that it allows consistency from one regulatory decision to the next because the number is unaffected by inflation levels that may be prevailing at the time. This assertion is of somewhat dubious value given the influence of inflation on the appropriate real pre-tax WACC. If the post-tax WACC approach is used, it is the real return on equity that drives the revenue calculations and any WACC calculation comes from a subsequent calculation. In any event if the rate of return number was intended to be locked-in from one regulatory period to another, or between different businesses, there would seem to be little point in ever re-considering the rate of return as part of a review.

8.2 Arguments for expressing the rate of return in nominal terms

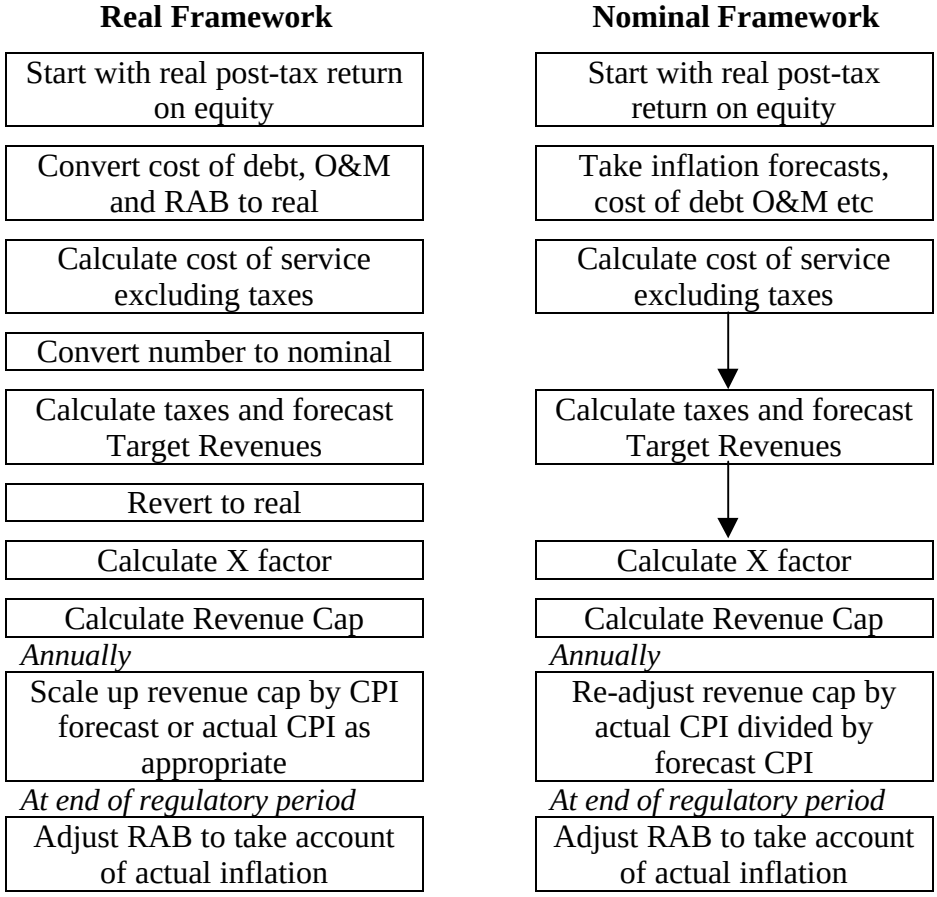
A key argument in favour of the use of a nominal rate of return within a regulatory framework is that financial market commentators and the business community better understand it. Even if it varies as a result of the inflationary environment prevailing at the time of a decision, that aspect is well understood by the markets and maintains consistency with other published rates of returns in financial journals and newspapers. The nominal approach in conjunction with the CPI-X adjustments removes inflation risk for the business in just the same way as for the real framework.

Another key argument in favour of the nominal framework is that the calculations involved in deriving target revenues are more direct and transparent. The post-tax nominal return on equity used as the starting point for revenues comes directly from the CAPM benchmarks which are normally estimated within a nominal framework using nominal data. Also other data from the business such as running costs and capital expenditures and their accounts are normally expressed in nominal terms and can be used directly. Further, when assets are revalued for regulatory purposes such valuations have traditionally been expressed in dollars of the day. Any real framework requires a conversion of all nominal data. Secondly, no inflation adjustments are required in the assessment of tax liabilities.

It may be argued that conversion between nominal and real quantities is not a demanding exercise. Of course this is true, but it still leaves the nominal approach with the advantage of transparency, while the economists can convert to real at their leisure to assist with their analysis – even within the nominal framework.

The flowchart below summarises the steps that distinguish a real framework from a nominal framework in terms of calculating revenue caps. The oft-claimed greater simplicity of the real approach is far from obvious.

Flowchart 2:



9. Conclude nominal treatment is better

The Commission acknowledges that the use of a real rate of return approach confers no advantage over the use of a nominal rate of return. However, use of a nominal approach provides for a somewhat more direct approach to the calculation of the rate of return and therefore greater transparency and market understanding of the nominal rate of return.

It has been argued that the market now understands real pre-tax rates of return. However, this has yet to be tested in a different inflationary environment in Australia. In any event it only applies to a LT-real pre-tax rate of return framework which has been seen in this paper to present major regulatory problems and inconsistencies. Given that the Commission would not want to encourage persistence with such an approach where a superior alternative is available the argument withers somewhat. In moving to a real post-tax framework it would be interesting to see what reaction the use of a real post-tax WACC or real post-tax return on equity will receive by commentators, given that both these numbers will be well below those featured in the earlier real LT-pre-tax decisions.[17]

[17] The real pre-tax WACC and the nominal post-tax return on equity were featured in these decisions.

Finally, it is the transparency aspect of the nominal framework that makes it the preferred approach. This is readily appreciated by considering a potential question that could emerge as a result of future regulatory decision using a real framework. The question is:

- Over the past five years the regulatory accounts show that depreciation has accounted for 30 per cent of allowed revenues, an accumulated amount of 20 per cent of the initial asset base; yet at the next review the asset base has not changed and there has been no capital expenditure. How many times do users have to pay for the assets employed by the business?

The answer is simple enough for an economist but may not be appreciated by users, some commentators or politicians.

In the case of a nominal framework, such a question will never arise since the accumulated depreciation allowances plus new capital expenditures will always equal the change in the value of the RAB.

Appendix A: Details of assumptions used in illustrative examples

Key Assumptions:

Basic Parameters	**Baseline**	**Alternative(s)**
Initial Cost of Asset ($m)	100	-
Real risk free rate (rr_f) (% pa)	4.0	-
Inflation (f) (% pa)	2.0	4.0
Nominal Debt Margin (d_m) (% pa)	1.0	-
Nominal Post Tax Return on Equity (r_e) (% pa)	12.0	-
Utilisation of Imputation Credits (γ) (%)	0	50
Tax life of asset (years)	14	various
Corporate Tax Rate (T_c) (%)	36	-
Maintained proportion of debt funding (D) (%)	60	-
Derived Parameters		
Nominal cost of debt (% pa)	7.0	12.2
Real cost of debt (rrd) (% pa)	4.9	
Real Post Tax Return on Equity (rr_e) (% pa)	9.8	
Nominal Post-Tax WACC (% pa) (with debt shield)	7.5	14.2
Nominal Vanilla WACC (ie w/o debt shield)	9.0	11.6

Base Depreciation Scenario: For the purpose of illustrating alternative regulatory frameworks the relevant natural monopoly technology required to provide services consists of a single asset with a working life of 40 years. For regulatory purposes the regulatory asset value is assumed to decline uniformly over time in **real** terms. The presence of inflation means that in nominal terms the decline in the RAB is initially slow but accelerates towards the end of the asset's life (see chart illustration).

Second Depreciation Scenario: To emphasise that the conclusions of the analysis do not depend on a particular approach to the roll-forward of the RAB over time an alternative scenario is also considered. In this alternative scenario it is forecast that by-pass alternatives will be available for the provision of the services at the end of 10 years. At that stage the business will remain viable only if its pricing can be reduced to be competitive with the alternative technology. The regulatory solution is to allow faster regulatory depreciation during the first 10 years so that the real value of the regulatory asset base is reduced to 50 percent by the end of year 10. After year ten the regulatory depreciation is reduced to allow full depreciation only over the full life of the asset. The asset is not expected to be replaced in view of the availability of the alternative technology.

Third Depreciation Scenario: This is similar to the base scenario except that the asset value is assumed to decline uniformly over time in **nominal** terms. However it has greater similarity to scenario 2 (defined in real terms) in terms of the effective profile of the RAB over time.

Note: The second depreciation scenario is not critical to most of the analysis. However, the depreciation arrangement differs from that normally applied under existing frameworks and serves to emphasise that the depreciation arrangements are not necessarily tied to a particular framework. This example represents an ad hoc solution to a particular regulatory problem and as such may not be the best solution. Nevertheless, it introduces a more flexible approach to depreciation which can be generalised to provide superior regulatory outcomes. The third depreciation scenario is one frequently associated with a nominal framework. The fact that it can be equally well applied in a real framework serves to re-emphasise the fact that the methodology adopted for the roll-forward of the RAB can be independent of other aspects of a regulatory framework.

The values of the regulatory asset base in both real and nominal terms under these three scenarios is graphically illustrated below

Graphical illustration of time profile of the regulatory asset base over time for the stylised scenarios

Chart A1: Real value of regulatory asset base (in beginning of year 1 prices)

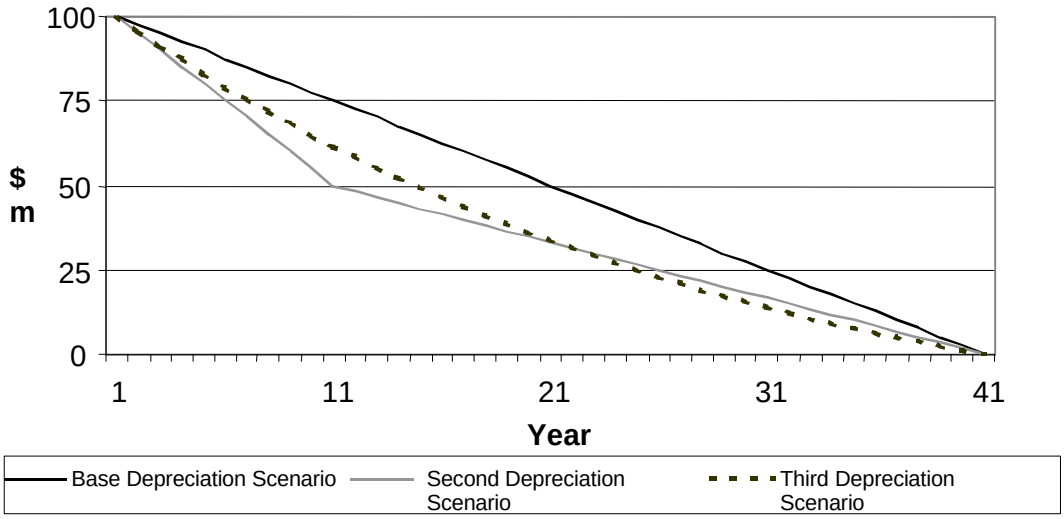
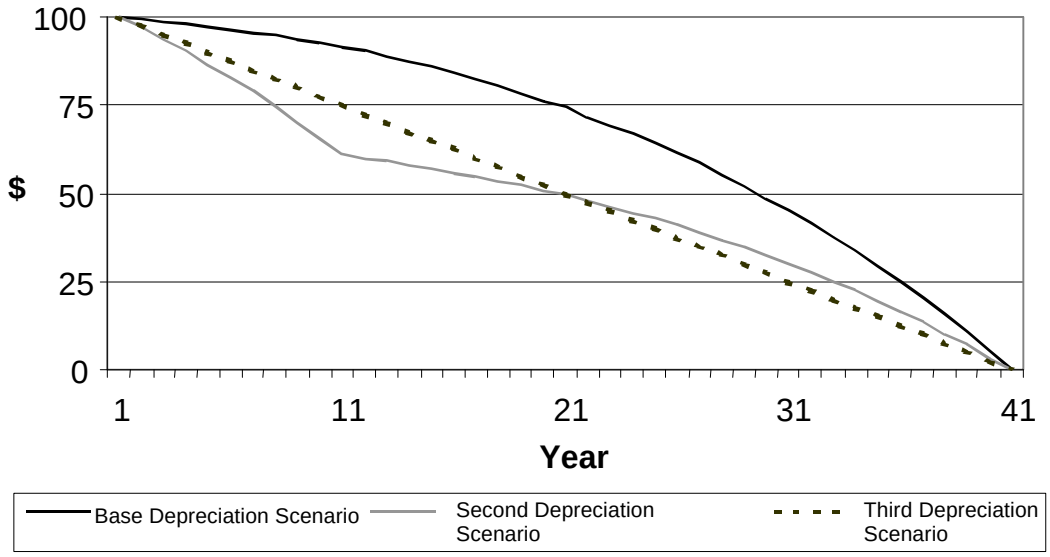


Chart A2: Nominal value of regulatory asset base



PART B

Taxation and the cost of capital: A review of overseas experience

Report for the Commission prepared by NERA

1. Introduction

In October 1998, the Australian Competition and Consumer Commission (ACCC) released its Final Decision on the Victorian Gas Access Arrangements. Appendix E of the Final Decision set out a range of issues surrounding the conversion of nominal, post-tax estimates of the WACC into a real, pre-tax WACC formulation, and highlighted some of the difficulties experienced with such an approach. In the light of these difficulties, the ACCC flagged the need for a future review of the treatment of taxation in estimating the WACC.

As part of this review, NERA has been asked by the ACCC to provide a commentary and analysis of the approach taken by regulators overseas in relation to:

- nominal versus real approaches to the WACC (and associated frameworks for revenue determination);
- pre-tax versus post-tax WACC formulations; and
- the use of short versus long-term estimates of the effective tax rate.

The remainder of this paper is structured as follows. Section 2 briefly outlines the underlying reasons for the tension between the regulatory framework and the treatment of taxation.

Section 3 describes the approaches taken by the various UK regulators. The MMC, Offer and Ofgas have all adopted a real, pre-tax rate of return, based on the same simplified conversion formula. By contrast, Oftel, Ofwat and the Office of the Rail Regulator (Orr) estimate the cost of capital on a post-tax basis, and allow separately for the cost of tax, either as an addition to the allowed rate of return, or as an element of the cashflows used to determine the revenue requirement.

Section 4 covers the US approach, which has generally been to set a nominal, post-tax return, and to include a long-term estimate of the effective tax rate in the company's operating costs.

Section 5 briefly summarises experience in Argentina, Mexico and the Philippines. Section 6 concludes.

2. WACC and the treatment of taxation

The debate surrounding the use of pre- or post-tax formulations of the rate of return, the appropriate conversion formula and the application of statutory or effective tax rates, stems from:

i a fundamental tension between regulation on the basis of CPI-linked real revenues and a taxation system which operates in nominal terms; and

ii differences in timing between the depreciation allowed for taxation and that allowed for regulatory purposes.

In determining the allowed revenue for a utility business, regulators are generally aiming to set revenue at a level that allows the business to earn a reasonable post-tax rate of return on the capital invested, whilst also covering its operating costs and financing its tax obligations. The level of regulated revenue must take into account increases in the general price level.

In a regulatory formulation of costs and revenues, the 'effective' rate of taxation is the percentage of regulatory profits that is paid out in tax (rather than the percentage of taxable

profits paid out in tax, which, by definition, will always reflect the statutory tax rate). In a regulatory regime based on CPI-linked real revenues, the effect of inflation on the relative balance of costs (where costs include the cost of tax) is implicitly assumed away. However, the level of inflation is an important factor in determining the effective tax rate.

The issue is further complicated where the profile of taxation is not constant over time, i.e. as a result of accelerated depreciation allowances for new capital investment. Such allowances give rise to a difference in any one year between depreciation allowed for tax and regulatory purposes, altering the effective tax rate on regulatory profits in both the short term, and the longer term.

The interactions between inflation, the effective tax rate and the time profile of taxation all need to be taken into account in setting the allowed rate of return.

2.1 Impact of inflation on the effective tax rate

Under regulatory arrangements where revenues are indexed to the CPI and determined using an estimate of the real WACC, rising price levels affect the effective rate of taxation in two ways:

i by driving a wedge between the depreciation allowed for regulatory purposes and the depreciation allowed for taxation purposes; and

ii by its impact on the tax advantage enjoyed by debt financing.

The level of inflation will determine to what extent these two effects are material.

Neither of these points apply in a regulatory framework based on nominal returns on a historic cost asset base.

2.1.1 Depreciation

Under a real, CPI-linked regulatory regime, the presence of inflation results in a disparity between the depreciation allowed for regulatory purposes and the depreciation allowed for tax purposes, *even where there may be no difference between the time profile of depreciation allowed for regulatory and for tax purposes.*

For taxation purposes, the capital base is always considered in historical cost terms, rather than in current cost terms. Depreciation is therefore also calculated on the basis of historic cost. An increase in the rate of inflation does not therefore affect the nominal level of tax depreciation.

In a real, CPI-linked regulatory environment, however, the asset base is denominated in current cost terms and, as a consequence, regulatory depreciation is also denominated in current cost terms. An increase in inflation therefore increases the nominal level of regulatory depreciation in line with the increase in the CPI.

This difference between the depreciation allowed for taxation purposes and that allowed for regulatory purposes drives a 'wedge' between taxable profits and regulatory profits. In theory, this interaction should be allowed for in converting from a post-tax to a pre-tax return.

In a nominal regime, the regulatory asset base is determined in historical cost terms, and is not linked to the CPI. The asset base used for regulatory purposes and taxation purposes is

therefore identical, and the actual amount of both regulatory depreciation and tax depreciation will be unaffected by a rise in the general price level. The 'wedge' problem discussed above therefore does not arise, and any conversion between pre- and post- tax return does not have to allow for the impact of inflation.

2.1.2 Nominal interest payments are tax deductable

The second way in which inflation affects the effective tax rate is through the tax advantage for debt funding.

Under a real, CPI-linked regulatory regime, allowed returns are determined in real terms, and the 'inflation compensation' component of an investor's return is delivered through indexed adjustments to the revenue stream. Implicit in the use of a real WACC, however, is an assumption that the tax advantage to debt over equity applies only to the real cost of debt. In fact, it is the nominal cost of interest that is deductable for tax purposes.

The use of a real WACC therefore understates the tax deductibility of debt and so, all things equal, overstates a businesses' tax liability. On this account, inflation therefore reduces the effective tax rate on regulatory profits determined under a real, CPI-linked regulatory regime.

While this effect serves to offset the impact on the effective tax rate of 'index-linked' depreciation (discussed in section 2.1.1 above), whether this is more or less than offsetting depends upon the gearing assumption used in the WACC formulation, and on the rate of inflation.

In a regulatory regime which operates in nominal terms, this complication does not arise because the WACC formulation offers an unbiased estimate of the tax advantage of debt.

2.2 The time profile of taxation: the 'S-curve' effect

We noted above that differences in the profile of taxation over time also have an impact on the effective tax rate. In particular, regulatory depreciation may differ from the depreciation allowed for taxation purposes, due to accelerated depreciation allowances for new capital investment.

Under an accelerated depreciation scheme, companies are allowed to depreciate new assets faster than under the regulatory regime, either as a result of shorter assumed asset lives, or a steeper depreciation profile than the standard straight-line profile typically adopted by regulators. In the absence of inflation, higher depreciation payments in the early years result in a reduction in the business' taxable profit and therefore the level of taxes paid. The effective rate of taxation (i.e. the percentage of taxes paid in relation to regulatory profits) will therefore be lower than the statutory rate. Where the regulator has set the allowed post-tax rate of return on the basis of the statutory rate, the rate of return actually earned by the business during the early years of an asset's life will therefore be greater, since the businesses tax payments are less.

Conversely, towards the end of an asset's life, the depreciation allowed for taxation purposes will be lower than that allowed for regulatory purposes. Taxable profit will therefore be higher than regulatory profit, and the effective rate of tax paid will exceed the statutory rate, lowering the achieved post-tax rate of return.

This effect is known as the 'S-curve' effect, and is common to virtually all regulatory regimes, irrespective of whether they use a real or a nominal rate of return. An issue which arises, therefore, is the appropriate tax rate to use in setting regulatory revenues – the statutory or the effective tax rate – and, if the latter, whether the effective tax rate should be calculated over the short or the long run.

2.3 Issues for regulation

The above discussion highlights some of the issues which arise for regulation in trying to take into account the impact of taxation on the allowed rate of return.

The first point to note is that many of the complexities which arise as the result of the interaction between a CPI-linked real regulatory regime and a nominal tax regime, do not apply under a regulatory regime which is based on a nominal return earned on an historic cost asset base. Moreover, even under a CPI-linked regime, the materiality of these interactions will depend on the actual level of inflation.

The second point of debate relates to whether regulators should determine the allowed rate of return on a pre- or post-tax basis. Regulators need to ensure that required revenues cover both a reasonable post-tax rate of return on the assets involved, and cover the corporate income taxes businesses are required to pay (which will itself be a function of the allowed rate of return and the asset base). The pre-tax approach focuses on 'scaling-up' the post-tax rate of return to a pre-tax rate of return.

The problem of scaling-up from a post-tax to a pre-tax WACC is fundamentally an algebraic one. Various conversion formulas are used to try and reconcile pre- and post- tax WACC formulations. However, none of the conversion formulae commonly proposed is complex enough to account for all of the effects discussed above. There is, therefore, a trade-off between the complexity of the formula and its degree of accuracy in accounting for the full impact of taxation on the return earned.

> If the WACC is set on a post-tax basis, this seemingly avoids the need for a complex conversion formula. In this case, however, taxation costs need to be directly incorporated in allowed revenue, as an additional operating cost. Tax costs can be estimated using a financial model of expected cashflows. However, as noted above, the income taxes paid by a company will be a function of the allowed rate of return and the asset base. In a real, CPI-linked regulatory system, projections of the cost of tax require an assumption on the expected rate of inflation, and the cashflows allowed to cover the cost of tax then need to be deflated by the expected inflation rate.
>
> Neither the pre-tax nor the post-tax WACC formulations therefore avoids the need for regulators to consider the financing and taxation structures of the business, in order to derive an unbiased estimate of the cost of tax.

The remainder of the paper describes how overseas regulators have approached the issue of taxation in determining the regulatory cost of capital.

3. UK experience

3.1 Nominal vs real WACC

All of the UK regulators have adopted a real approach to the WACC, with the exception of Oftel in the case of BT.

Prior to the 1997 review, Oftel set a nominal return for BT on a historic cost asset base.[18] In its December 1995 consultation paper, Oftel proposed a move from a historic cost basis for asset valuation to a current cost basis. Oftel formally adopted a regulatory framework based on current cost asset valuations in its 1997 determination. However, it has continued to assess and present the cost of capital on a nominal basis.

3.2 Pre-tax vs post-tax WACC

UK regulators have been split between the adoption of pre-tax and post-tax rates of return.

3.2.1 Pre-tax approach: the 'MMC tax adjustment'

The difference between the real pre-tax cost of capital and the real post-tax cost of capital is known in the UK as the 'tax wedge'. Determining the size of the tax wedge has been a contentious issues in the UK regulatory cost of capital debate.

In its 1993 inquiry into British Gas (BG), the MMC set out a formal 'tax wedge model'.[19] The size of BG's tax wedge was estimated using a simple formula based purely on the relative values of corporation tax and rate of imputation. This formula has become known as the 'MMC tax adjustment':

$$\text{Pre-tax cost of equity} = \text{post-tax cost of equity} * (1-t_s)/(1-t_c)$$

where:

t_s = the rate of imputation

t_c = corporation tax rate

The use of this tax adjustment formula has become quite widespread among UK regulators. The MMC applied the same tax adjustment in its price review of Scottish Hydro Electric (1995), British Airports Authorities (1996), Northern Ireland Electricity (1997), Manchester Airport (1997), British Gas (1997) and, most recently, Cellnet and Vodafone (1998).

Offer used the MMC tax adjustment in its 1994/95 price review of the Regional Electricity Companies and also in its price review of National Grid Company in 1996.

Ofgas also adopted the MMC tax adjustment formula in its price review of British Gas in 1996.

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[18] See for example Oftel, *Pricing of Telecommunication Services from 1997*, page 60: 'In recent price determinations [..] Oftel has implicitly used a nominal pre-tax cost of capital of 15 per cent applied to an HCA asset base'.

[19] In its 1992 decision in relation to BT, Oftel noted the existence of the 'tax wedge' problem, and proposed a formula for a pre-tax WACC, which is algebraically equivalent to the 1993 MMC adjustment formula.

Application of the MMC formula based on the tax rates prevailing prior to July 1997 resulted in a tax adjustment of 1.194. This was calculated using the then current rates of 33 per cent for corporation tax and 20 per cent for ACT.[20]

In the July 1997 budget, changes to the UK tax system were announced. In particular, the rate of corporation tax was reduced, and it was announced that the ACT credit for tax exempt or corporate shareholders was to be abolished from 1 April 1999, while the credit to individual shareholders was to be reduced to 10 per cent.[21] In the Vodaphone/Cellnet inquiry (1998), the MMC increased the tax adjustment to 1.429 based on a forward looking corporate tax rate of 30 per cent and ACT credit rate of 0 per cent. By setting t_s to 0 per cent, the MMC have implicitly assumed that it is pension funds and other corporate shareholders who are the marginal investors. No account is taken of the continuing 10 per cent ACT credit received by individual shareholders. However, the MMC note that:

> It is open to question whether the ACT offset against mainstream corporation tax should have been removed in full. However, as the changes are relatively recent and share price patterns have been relatively volatile it is not possible to resolve this question definitely at this stage. For the purposes of the present inquiry we must assume no offset against the main rate of tax.[22]

3.2.2 Weaknesses in the MMC adjustment formula

The MMC tax adjustment formula is based on the following simplifying assumptions:

- no capital allowances (i.e. no accelerated depreciation);
- that the company is in a fully tax paying position;
- a dividend cover of 1 (i.e. a 100 per cent payout ratio); and
- no inflation.

These simplifying assumptions have been widely acknowledged by companies, regulators and the MMC.[23] For example, in Ofgas's 1996 price control review of BG TransCo, the regulator noted that:

> [The calculation of the tax wedge] has been simplified because, in theory, the tax wedge will be company specific and will depend on the company's dividend policy and capital allowances. [24]

In Oftel's 1997 price control review, the regulator notes that:

> This [MMC] adjustment is based on a number of simplifying assumptions e.g. that all profits are paid out as dividends. The correct adjustment will depend on BT's cash flow profile over the forecast period, among other things.[25]

For most of the utility companies that have been considered, the assumption that the company is in a fully tax paying position with no surplus ACT has generally been appropriate (and

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[20] Prior to April 1999, the UK operated a partial imputation system for the taxation of companies and their shareholders. The tax on company profits was paid in two instalments. Advance corporation tax (ACT) on dividends was payable at a rate of 20/80ths of the actual dividend paid. This tax was then deducted from the total corporation tax bill due nine months after the end of the company's accounting period.

[21] July 1997 budget.

[22] MMC report on Vodaphone/ Cellnet, (1998) page 66.

[23] For example, MMC Decision on Scottish Hydro May 1995; MMC decision on NIE, March 1997; Ofgas 1997 Price Control Review of BG Transco, Consultation Document 1996, MMC Decision on BG plc, May 1997; OXERA, Tax and the Cost of Capital, The Utilities Journal, January 1998.

[24] 1997 Price Control Review British Gas' Transportation and Storage, Consultation Document, May 1996.

[25] Pricing of Telecommunications Services from 1997: Annex E: Financial Modelling, Oftel, December 1995.

rarely contested).[26] The other assumptions are, however, unrepresentative of the actual situation faced by the UK utilities.

Under the UK taxation system, capital allowances (i.e. allowances for accelerated depreciation) are set against actual profits in computing taxable profits.[27] Few public estimates have been made of the impact of capital allowances on the size of the tax wedge, which will vary across companies depending on the amount of capital investment being undertaken. By ignoring capital allowances, the MMC tax wedge model *overstates* the size of the tax wedge.

The second simplifying assumption is that the regulated utility has a dividend cover of one, which implies that all profits are taxable at the imputation tax credit rate. In practice this assumption is incorrect since most utility companies have a payout ratio of only 40-50 per cent, implying a dividend cover of 2-2.25. The assumption in the MMC tax adjustment that the dividend cover is equal to 1 therefore *understates* the size of the tax wedge.

Whittington (1997) offers the following perspective:

> A disputable assumption commonly made in grossing up the cost of capital for corporation tax is that the whole of the equity stream attracts imputation relief. In fact only the proportion distributed as dividends receives imputation relief, and retentions do not, so that assuming full imputation relief reduces the grossing up factor and therefore the pre tax cost of capital. The 'full distribution assumption' might be justified on the ground that ultimately all equity returns are distributed and should be valued as if they currently attract imputation relief. However, it is surprising that companies have not disputed this assumption more strongly in the past.[28]

The final simplifying assumption incorporated in the MMC tax adjustment model is that there is no inflation. The MMC tax adjustment formula is applied to the real, post-tax cost of equity in order to calculate the real pre-tax cost of equity. This is strictly incorrect, since companies pay tax on nominal profits.[29] In addition, as discussed in section 2.1.1, depreciation for tax purposes is determined in relation to historical cost. Depreciation allowances can therefore only be carried forward at historical values. Both of these factors would imply an increase in the size of the pre-tax cost of equity, to reflect the impact of inflation. On the other hand, interest deductions are set against nominal debt payments.[30] Taking account of inflation may therefore decrease the cost of debt. The overall impact on the pre-tax WACC will depend on the level of gearing.

Prior to the change in capital allowances and the abolition of the imputation system, it was argued that the impact of the above assumptions largely cancelled each other out. However, the changes to the tax system mean that companies and other commentators have argued that the MMC tax adjustment formula is no longer appropriate. In a recent article, OXERA commented that:

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[26] Surplus ACT refers to the situation where the imputation tax credit on dividends cannot be fully offset against a company's mainstream corporation tax liability.

[27] Prior to the November 1996 Budget, the capital allowance for plant and machinery (i.e. the rate at which assets could be depreciated for tax purposes) was 25 per cent. This was reduced in the 1996 Budget to 6 per cent.

[28] 'Regulatory Asset Value and the Cost of Capital' IEA Lectures on Regulation VII 1997.

[29] The correct approach would be to add anticipated annual inflation over the period to the real post-tax cost of equity, to give a nominal post-tax cost of equity, then apply the tax adjustment to give a nominal pre-tax cost of equity and then subtract anticipated inflation to give a real pre-tax cost of equity.

[30] Ofwat's 1991 tax wedge model takes into account the effect of expected inflation on interest tax shields.

> It is clear that 1.194 is no longer appropriate, if it ever was … Given the problems with the existing MMC tax-wedge formula it may be time to consider devising a new formula that takes account of the full impact of the taxation system on regulated utilities.[31]

Offer, in its consultation papers issues in relation to its forthcoming review of the electricity distribution businesses, has noted that:

> It will be necessary to consider whether such simplifying assumptions remain valid for the distribution businesses and whether the allowance for tax in the calculations makes an appropriate contribution to corporation tax …[32]

However, as noted above, the MMC has continued to apply the same tax adjustment formula in its recent decision on Cellnet and Vodaphone (1998).

3.2.3 Pre-tax approach: Ofwat's model

In the lead up to the 1994 water industry price review, Ofwat put forward a more complex tax wedge model that takes account of capital allowances, inflation and the dividend cover ratio.[33] A simplified version of this model is:

Pre-tax cost of equity = (post-tax cost of equity + CPI) * $(1-t_c d)*(1-t_s/DC) / (1-t_c*d)$ - CPI

where:

t_s = the rate of imputation

t_c = corporation tax rate

CPI = expected inflation

d = rate at which capital can be depreciated for tax purposes

DC = dividend cover ratio.[34]

Considerable debate ensued between Ofwat and the water industry about the inputs in the Ofwat tax wedge model and in particular the appropriate assumptions about dividend cover and assumptions about gearing.[35]

The debate over the Ofwat tax wedge model was never really resolved and in the end Ofwat did not use the model in its 1994 review.

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[31] 'Tax and the Cost of Capital', The Utilities Journal, OXERA, January 1998.

[32] Offer, Reviews of Public Electricity Suppliers 1998 to 2000, *Price Controls and Competition*, Consultation Paper, July 1998.

[33] 'Cost of Capital: A Consultation Document', Ofwat 1991. In the case of the water companies, the impact of capital allowances on the amount of taxation paid was significant, resulting in actual tax payments being much less than assumed tax payments at the statutory rate. The assumption of no capital allowances underlying the MMC adjustment formula was therefore seen as inappropriate for the water businesses.

[34] The term $t_c d$ is the rate of corporation tax multiplied by the rate at which capital can be depreciated for tax purposes (i.e. the rate of capital allowances). At the time of the Ofwat consultation paper, t_c was 33 per cent whilst the rate of capital allowances was 25 per cent. Hence, $t_c d$ was calculated as 8.3 per cent. The problem with this formula is that it only applies to one year. For example, if companies spend $100 in year 1, the capital allowances in year 1 are 25 per cent * $100 = $25. In year 2, capital allowances are 25 per cent of the reminder, i.e. $75. The dynamic path of capital allowances is not therefore captured by the above formula.

[35] Water Services Association (1991) 'The Cost of Capital in the Water Industry'.

Recent changes in the UK tax system have led some commentators to argue that Ofwat's tax wedge model should be used instead of the MMC tax adjustment formula to estimate the tax wedge.[36]

3.2.4 Post-tax approach

Ofwat, Oftel and the Office of the Rail Regulator have all set the cost of capital on a post tax basis.[37] (Offer also made a submission to the MMC in the Scottish Hydro Electric (1995) case to the effect that attention should focus on the post tax rate of return; however, this was not followed by the MMC in its final recommendation.)[38]

As noted above, in its 1994 review, Ofwat decided against using its conversion formula for setting prices, and instead estimated the cost of capital on a post tax basis. This post-tax return was then grossed up to a pre-tax WACC by allowing a (small) percentage mark-up, common across all companies, to reflect the impact of taxation. The percentage mark-up was estimated on the basis of company specific financial modelling of expected revenue flows over the next five years.[39]

Following consultation, Ofwat has decided to retain the post-tax approach to the cost of capital for its 1999 periodic review. It noted that:

> most respondents did not express a strong preference [for a pre- or post-tax approach], providing allowance is made for company specific tax positions, although some City commentators favoured a post-tax basis.[40]

However, rather than allowing a generic percentage mark-up on the post-tax return to reflect the impact of taxation, Ofwat intend to estimate the tax costs on an individual basis for each company from financial modelling of the company's expected cashflows over the regulatory period.

In Oftel's first consultation paper for its 1997 review, Oftel presented the cost of capital on a pre-tax basis, using the MMC adjustment formula. BT argued that the assumptions underlying the MMC conversion formula were inappropriate for BT and too simplistic. Oftel agreed, and consequently adopted a post-tax rate of return in its 1997 price determination for BT:

> [Oftel] considers that the appropriate method for estimating a cost of capital and applying it for the purposes of computing price controls is to use a post tax cost of capital and to assess post tax returns in relation to this. [..] This approach has the added advantage of removing the need for debates about the appropriate adjustments.[41]

However, Oftel noted that:

> The computation of after-tax returns requires detailed knowledge of the tax treatment of the company's assets [..]

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[36] 'Tax and the Cost of Capital', The Utilities Journal, OXERA, January 1998.

[37] Before 1997, Oftel set returns on a pre-tax basis.

[38] Scottish Hydro-Electric plc: A report on a reference under section 12 of the Electricity Act, MMC May 1995.

[39] Ofwat, *1994 Periodic Review*.

[40] Ofwat, *The framework and business planning process for the 1999 periodic review*, February 1998.

[41] Oftel, Pricing of Telecommunications Services from 1997, Oftel's Proposal for Price Control and Fair Trading, June 1996. Details of how BT's tax liabilities are assessed were not released.

The UK Office of the Rail Regulator (Orr) recently announced that it intends to target a post-tax cost of capital in its review of Railtrack's access charges.[42] This approach has been supported by Railtrack.

3.3 Estimates of the effective tax rate

As is clear from the above discussion, the tax-adjustment formula adopted by the MMC, Offer and Ofgas is based on statutory tax rates, and ignores any differences in the profile of tax payments over time (i.e. through the application of accelerated depreciation). Since the statutory tax rate is likely to be greater than the effective tax rate (in a low-inflation environment), the MMC tax adjustment formula model overstates the size of the tax wedge.[43]

For its 1999 price review, Ofwat intend to estimate the rate of return on a post tax basis and include a projected tax cost element in the revenue requirement to reflect the company's specific tax position over the five year regulatory period.[44] Ofwat argue that, given the changes to the UK tax regime, and in particular the using up of capital allowances, the water companies will be faced with rising actual tax rates over the regulatory period, which will differ between companies. Ofwat's approach is therefore to model the short-run effective tax payments for each company. There will be no ex-post adjustment to reflect any differences between assumed and actual tax payments over the period

In its 1998 consultation paper Ofwat noted that individual companies' tax projections will be adjusted to take account of Ofwat's views about efficient capital structures, and through the application of yardstick adjustments in exceptional cases. This implies some 'benchmarking' of tax costs at the forthcoming price review, although it is not clear how such adjustments will be made. Orr are also intending to include a projected tax cost as part of its estimate of Railtrack's revenue requirement. Railtrack had argued for taxation to be treated as a cost pass through item, with an adjustment made at the end of the regulatory period for any difference between the projected tax costs allowed in the revenue requirement and the actual tax costs incurred. However, Orr has decided that it is not appropriate to treat tax as a pass through item, since this removes the ability of government to influence Railtrack's behaviour through changes in taxation, in the same way that it does with other companies.[45] Orr has instead decided to incorporate a forecast of corporation tax payments in the company's required revenue, based on the regulator's own assumptions about gearing, and not to allow adjustments ex-post.

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[42] Office of the Rail Regulator, *The Periodic Review of Railtrack's Access Charges – Third Paper*, December 1998.

[43] The overstating of the tax wedge is likely to be most significant in a 'start-up' situation, where accelerated depreciation charges for tax purposes exceeds accounting depreciation. In a 'steady state' situation, it is likely to be less of a problem.

[44] Ofwat, *Prospects for Prices*, consultation paper, October 1998.

[45] In reaching this conclusion, Orr notes that 'It is [the Regulator's] view that tax is an instrument of government policy which can influence the way companies behave as well as providing a source of income for government', *The Periodic Review of Railtrack's Access Charges: The Regulator's Conclusion on the Financial Framework*, p.30, Dec 1998.

4. US experience

4.1 Nominal vs real WACC

US regulatory bodies determine the allowed rate of return in nominal terms.

The allowed nominal return is applied to the (depreciated) actual historic cost incurred by the builder of the asset (i.e. a DAC asset base using historical, as opposed to current, asset values). By permitting investors to earn a *nominal* return on the historic cost of assets, investors are compensated for both their opportunity cost of capital and for increases in the general price level.[46]

US regulators derive the cost of capital by calculating the cost of debt and estimating the cost of equity. Applying these to the actual or expected capital structure of the utility determines the weighted average cost of capital.[47] The cost of debt is measured directly, by determining the actual level of interest obligations that will arise from the business' outstanding debt instruments. Since debt obligations are known, there is no particular uncertainty about the cost of debt capital, and the cost of debt is not therefore a controversial aspect of US utility regulation.[48] In contrast, estimates of the cost of equity do attract significant debate.

4.2 Pre-tax vs post-tax WACC

Regulatory commissions in the US have adopted a post-tax cost of capital formulation.

The Supreme Court ruled in 1922 that taxes, including federal income taxes, were operating costs, rather than reductions in investors' returns.[49]

In estimating the income tax cost, it is necessary to have regard to the post-tax return permitted on the asset base. In practice, the US approach has been to combine the various sources of capital into a single weighted average. This weighted average cost of capital is then grossed-up by a 'tax factor' representing the income taxes that will have to be paid on the utility's income.[50] It is the grossed-up figure that is multiplied by the asset base to arrive at both the capital cost component of the permissible revenues and the income tax component to be allowed as an operating cost.

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[46] A comprehensive discussion of these practices in the United States appears in Phillips, C.F.Jr, *The Regulation of Public Utilities*, Third Edition, Public Utilities Reports, Arlington, VA, 1993 ('Phillips'). The specific section pertaining to historical cost asset valuation appears in Chapter 8, pages 331-338 ('Property Valuation: Economic Concepts').

[47] The way in which most jurisdictions in the US calculate the cost of capital, utilising various forms of debt (i.e. long-term and short-term) and equity (i.e. common and preferred) capital is shown in Phillips, page 389.

[48] Earlier debate considered whether the cost of debt should be set in relation to the utility's actual capital structure, or to a hypothetical efficient capital structure. During the 1950s and 1960s many commissions adopted a hypothetical capital structure, particularly in telephone cases. However, since the 1970s it has been common practice to use actual or expected capitalisation (see Phillips, pages 389-391, contains a full discussion).

[49] Galveston Elec. Co. vs Galveston, 258 US 388,399 (1922), reported in Phillips page 259.

[50] The tax factor is typically a variation of a standard (1/(1-income tax rate) formula. Since the US approach is to determine nominal returns on a historical asset base, the interaction between inflation and the effective tax rate does not arise (see discussion in section 2.1). The algebra required to convert from a post-tax to a pre-tax rate of return is therefore less complex than under a real CPI-linked regime such as the UK.

4.3 Estimates of the effective tax rate

Under the Revenue Act of 1954, US companies have been permitted to adopt accelerated depreciation in calculating taxable income.[51] As discussed in section 2.2, such schemes affect the time profile of taxation, but not the total amount of taxes payable. In particular, under an accelerated depreciation scheme companies face lower tax payments in the earlier years which are offset by higher payment in later years. The difference in the tax profile over time raises the issues of whether the tax allowed for rate-making purposes should reflect actual tax payments (the 'flow through' approach), or a long-term average rate of tax over the whole period (the 'normalisation' approach).

The flow-through approach includes only taxes actually paid by the utility in the allowance made for operating costs. Under this 'pay-as you-go' approach, in the absence of other offsetting factors, allowed utility rates would rise over the period, in line with the increase in tax payments.

The alternative approach ('normalisation') is to allow within operating costs the long-term average rate of taxation, rather than the actual taxes paid in any period. The long-term rate of taxation is calculated as the taxes that would apply if depreciation were applied on a straight line basis over the entire asset life assumed for accounting purposes.[52]

The normalisation approach results in a more stable pattern of prices over time. However, in the earlier years, normalisation results in the utility 'over-recovering', ie receiving a greater allowance for taxation than the taxation actually due, and thereby accumulating cash reserves. This over-recovery is reversed over the latter part of the period, when actual taxation exceeds the amount included for rate-making purposes. The excess revenue accumulated in the first part of the period can therefore be considered as an allowance for deferred taxation.

Normalisation requires the regulated company to create and maintain a special asset account for deferred taxes on its books. The utility is not permitted to earn a return on these deferred taxes. The amount of deferred taxation is either deducted from the utility's rate base or included in a utility's capitalisation at a zero cost of capital (thereby lowering the overall WACC). The benefits of accelerated inflation therefore are passed through to consumers

Prior to the Tax Reform Act of 1969, US regulatory commissions were split over the proper method to employ for rate-making purposes.[53] As of 1967, twenty-three state commissions had either ordered or favoured the flow-through method, twenty permitted various forms of normalisation and two permitted either method. At the Federal level, the Federal Power Commission permitted normalisation prior to 1964, but then adopted the flow-through method, whilst the Federal Communications Commission consistently favoured the flow-through approach.

The 1969 Tax Reform Act required public utilities to use either straight line depreciation or accelerated depreciation with normalisation for tax purposes. Most regulatory commissions therefore began to adopt normalisation for rate-making purposes from 1970, although some

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[51] Phillips, page 22.
[52] Phillips, pages 282 to 286.
[53] A fuller discussion can be found in Phillips, pages 22 to 27.

continued to use flow-through on pre-1970 property. The normalisation approach is therefore now the more common of the two.[54]

Normalisation was initially the subject of some controversy. In cases in the mid 1960s and early 1970s, consumer groups in particular argued that normalisation resulted in utility consumers paying 'phantom taxes', ie that if the utility business continues to grow, there will always be more revenues collected to cover the deferred tax expense than deferred taxes paid out.[55]

Commentators have responded that the 'phantom tax' argument is fallacious:

> The error of the phantom tax argument may be seen by analogy with the growth of a long-term debt account. As any issue of long-term debt reaches maturity, it must be repaid. At the same time, new plant additions may require that capital be raised through additional long-term borrowing to finance the additions. That new issues may exceed repayment of maturing debt over any period so as to result in net growth of long-term debt in no way means that the debt is not being repaid nor that, in the future, when the new issues matures, it will not have to be repaid.[56]

The flow-through approach also attracted criticism. Utilities argued that a pay-as-you-go approach damaged their financial integrity, since it resulted in a large amount of future unprovided for costs hanging over the business and future economic conditions or regulatory commissions might not allow the rate increases required to meet these costs.[57]

The long history of regulation in the US has, however, allowed a consensus to emerge on the treatment of taxation, and the normalisation approach is now seen as largely non-contentious.

The use of long-term effective tax rates raises related issues, such as the appropriate treatment of permanent changes in tax rates. The reduction in the top rate of US federal corporation tax in 1986 resulted in a situation of excess deferred income tax reserves: ie additional revenue that had been received by utilities in earlier years, which would not now be needed to meet the reduced level of future tax payments. The Tax Reform Act of 1986 explicitly addresses the issue of excess deferred taxes, and requires that the excess itself be fully normalised.[58] In this way, permanent changes in actual tax rates are passed through to consumers over time.[59]

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[54] Phillips, pages 26-27. Also, Goodman, L.S., The Process of Ratemaking, 1988, page 716.

[55] Hahne and Aliff, *Accounting*, reported in Phillips, pages 23-24.

[56] Hahne and Aliff,, op cit.

[57] The Bell System, reported in Phillips, page 26.

[58] Rate-Making Trends in the 1980s, B. Radford (ed), Public Utilities Reports, Inc.

[59] The pass-through of permanent tax changes is in contrast to the approach taken by Ofwat and Orr in the UK, where taxes are treated as a cost, but modelled at the start of the regulatory period, with no ex-post adjustment for differences between actual and forecasted taxes (e.g. as a result of a change in the tax regime).

5. Other overseas experience

5.1 Argentina

In both the electricity and gas sectors in Argentina, the relevant regulator sets a real, pre-tax rate of return.[60] Current tax rate are used, rather than any long-term estimate of the effective tax rate. However, there is a factor in the price cap formula which allows changes to tariffs if there is a change in the tax structure.

5.2 Mexico

The gas sector in Mexico is also regulated on the basis of a real, pre-tax return. Again, statutory tax rates are used in the calculation.[61]

5.3 Philippines

The metropolitan waterworks and sewerage and sewerage system in Manila was privatised by means of a long term concession contract. Under the terms of the concession agreement, the Regulatory Office of the Metropolitan Waterworks and Sewerage System (MWSS) is responsible for determining the Appropriate Discount Rate (ADR) to be used in price determinations.

Under the Concession Agreement, the ADR is defined as 'the real … weighted average cost of capital (after taxes payable by the concession business)'.[62] That is, the MWSS determines a real, post-tax rate of return for the concession business. Taxes are treated as an element of business expenditure.[63]

6. Summary

The debate surrounding the use of pre- or post-tax formulations of the rate of return, the appropriate conversion formula and the application of statutory or effective tax rates, stems from:

i a fundamental tension between regulation on the basis of CPI-linked real revenues and a taxation system which operates in nominal terms; and

ii differences in timing between the depreciation allowed for taxation and that allowed for regulatory purposes.

In section 2 of this paper we noted that regulatory regimes based on historic cost asset values (such as the US) avoid the first of these complications. However, the second factor is common to both historic cost regimes and those based on CPI-X linked asset values.

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[60] Argentina Electricity Transmission: Resolucion ENRE # 1650/98, November 4, 1998; Argentina Natural Gas Distribution: Resolucion ENARGAS # 464/97, June 30, 1997.

[61] Various documents issued by the regulator, CRE, prior to the privatisation of the gas companies explain how the rate of return should be calculated. None of the privatised companies has yet gone through a tariff review: current returns reflect those included in the successful tenders.

[62] Concession Agreement, Article 1, Definitions.

[63] Concession Agreement, Article 1, Definitions, 'Expenditures'.

Regulators have tended to adopt one of two approaches in addressing the issue of taxation in determining the rate of return. The first is to incorporate the impact of taxation via an algebraic formula to convert the required post-tax return to a pre-tax return. There is a trade-off between the complexity of such a formula and its accuracy in fully capturing the impact of taxation on the return earned by the regulated business.

The second approach has been to apply a post-tax rate of return directly, and to then allow separately for taxation as one of the regulated business' operating costs. In order to do this, however, the business' expected cashflows need to be modelled, and again there is a trade-off between the complexity and the expected accuracy of this modelling.

Table 6.1 summarises the approach taken by regulators overseas towards the treatment of taxation in estimating the cost of capital.

In the UK, the MMC, Offer and Ofgas have all adopted a real, pre-tax rate of return, based on the same simplified conversion formula. Ofwat and the Office of the Rail Regulator (Orr) estimate the cost of capital on a real, post-tax basis, and have allowed separately for the cost of tax, either as an addition to the allowed rate of return, or as an element of the cashflows used to determine the revenue requirement. Oftel is the only UK regulator to have changed its approach. In its 1992 decision Oftel determined the WACC on a nominal, pre-tax basis. In Oftel's 1997 decision it moved to a nominal, post-tax approach, following concerns about the accuracy of the conversion formula when applied to BT.

Table 6.1: Summary of approaches taken to WACC

	WACC Formulation				**Tax Rate Used**	
	Real	**Nominal**	**Pre-tax**	**Post-tax**	**Statutory**	**Effective**
US		All		All		Long-run
UK	Majority	Oftel	MMC Offer Ofgas Oftel (pre-1997)	Ofwat Oftel (post 1997) Orr	MMC Offer Ofgas	Ofwat, Orr: short run
Argentina	Gas Electricity		Gas Electricity		Gas Electricity	
Mexico	Gas		Gas		Gas	
Philippines	MWSS			MWSS	MWSS	

In the US regulators estimate the allowed return on a nominal, post-tax basis, and include a long-term ('normalised') estimate of the effective tax rate as part of the business' operating costs. The long history of regulation in the US has allowed a consensus to emerge on the appropriate treatment of taxation, and the issue is now seen as largely non-contentious.

The issue of what is the most 'appropriate' approach to take in setting the WACC therefore seems to be largely dependent on the underlying regulatory framework (current or historic cost asset base) and the extent to which assumptions underlying alternative conversion formulae between post- and pre- tax WACCs are thought to be appropriate in practice.