THE COST OF CAPITAL

FOR THE

DAMPIER TO BUNBURY NATURAL GAS PIPELINE

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Prepared for

Epic Energy

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1. Summary

The Brattle Group has been asked by Epic Energy to estimate the cost of capital for the Dampier to Bunbury Natural Gas Pipeline (DBNGP). In developing the estimate, we have been asked to take account of regulatory precedent in Australia. In particular, we have been asked to make use of the Capital Asset Pricing Model.[1] Based on our analysis, which is explained in detail in this report and its accompanying appendices, we conclude that a reasonable, conservative estimate of the pre-tax, real cost of capital for the DBNGP is 8.5 percent.[2] This estimate does not incorporate any premium for regulatory risks, such as stranded asset risk. To the extent that compensation for such risks is not provided elsewhere, it would be necessary to adjust upward the allowed rate of return.[3]

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[1] Empirical and theoretical research in the United States have shown the standard "textbook" version of the Capital Asset Pricing Model may under-estimate the cost of capital for utility companies. Empirical applications of the Arbitrage Pricing Model in the US (the leading alternative to the CAPM in academia) similarly indicate higher estimates of the cost of capital for utilities than the standard CAPM. Further empirical work in Australia is necessary to test the applicability of these findings in Australia.

[2] This estimate results from rounding our best point estimate, 8.6 percent, down to the nearest quarter point.

[3] We have not quantified the magnitude of the necessary adjustment. The exact premium required depends on the magnitude of the exposure to asymmetric risk, which is not revealed by data on the cost of capital and is idiosyncratic to particular firms and markets. Even seemingly small asymmetric risks can lead to surprisingly large required premia. See Kolbe, A. L. and Tye, W. B. (1991) "The Duquesne Opinion: How Much 'Hope' is There for Investors in Regulated Firms?," Yale Journal on Regulation, 8(1), pp. 113-157.

In Australia, a recent report in consultancy to the ACCC stated that for electric transmission providers: "[i]n the event such risks are not explicitly addressed elsewhere in the regulatory framework, a WACC premium to accommodate the expected losses of upwards of 1 percent may not be unreasonable." (*A Critique of the WACC Parameters Proposed for Transgrid, A Report for the ACCC,* NERA, May 1999).

Table 1 below summarises the main inputs used in our calculations.

Table 1: Summary of inputs to calculation

Parameter		Value	Source/Derivation	Relevant Part of Report
Asset beta	[1]	0.58	Derived from US pipeline data	7.1, 7.2 & App 2
Debt beta	[2]	0.12	ORG	7.4
Gearing Ratio	[3]	55%	IPART	4.5
Risk free rate	[4]	6.4%	Current yield on 10-year bonds	5
Market risk premium	[5]	6.5%	Historical estimates give range 6-7%	6
Corporate Debt Premium	[6]	1.2%	Recent IPART and ACCC decisions	9
Company tax rate	[7]	36%	ATO	4.4.3
Payout ratio (α)	[8]	70%	IPART	8.6
Franking ratio (k)	[9]	80%	ATO data	8.2
Utilisation ratio (θ)	[10]	55%	ATO data + dividend drop-off studies	8.3
Value of credits (γ)	[11]	44%	$\gamma = k \times \theta$	8.5
Inflation	[12]	2.5%	yield differentials on indexed & non-indexed bonds	10

Table 2 shows our base case results, and the effect of a number of different sensitivity tests.

Table 2: Estimated pre-tax real WACC

Base Case	[1]	**8.60%**
Alternative Scenarios		
Market Risk Premium = 6.0%	[2]	**8.26%**
Market Risk Premium = 7.0%	[3]	**8.95%**
Gearing = 50%	[4]	**8.70%**
Gearing = 60%	[5]	**8.50%**
Gamma = 40%	[6]	**8.71%**
Debt Beta = 0.06	[7]	**8.89%**

2. Introduction

2.1. The Brattle Group

The Brattle Group is an international economic and management consulting firm. Our specialities include financial economics, regulatory economics, and the gas and electric industries. Members of the firm have authored or co-authored a number of standard references and many articles on these topics. In the area of cost-of-capital estimation these include:

- Richard A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, New York: McGraw-Hill Book Company, (1981, 2nd Ed. 1984, 3rd Ed. 1988, 4th Ed. 1991, 5th Ed. 1996, 6th Ed. 1999).
- A. Lawrence Kolbe and James A. Read, Jr., with George R. Hall, *The Cost of Capital: Estimating the Rate of Return for Public Utilities*, Cambridge, MA: The MIT Press, (1984).
- A. Lawrence Kolbe, William B. Tye, and Stewart C. Myers, *Regulatory Risk: Economic Principles and Applications to Natural Gas Pipelines and Other Industries*, Boston: Kluwer Academic Publishers, (1993).
- *The Utility Capital Budgeting Notebook*, EPRI TR-104369, Palo Alto, CA: Electric Power Research Institute, (1994) (Principal Investigators A. Lawrence Kolbe and James A. Read, Jr.).

All of the above authors except George R. Hall and Richard Brealey are Principals of *The Brattle Group*. Professor Brealey resigned as a Principal of the firm to accept his current appointment as Special Advisor to the Governor of the Bank of England.

2.2. Defining the cost of capital

The cost of capital of a project can be defined as the expected rate of return in capital markets on alternative investments of equivalent risk. It is the rate of return that investors require based on the risk-return alternatives available in competitive capital markets. Three key points are implied by the definition:

1. Since the cost of capital is an *expected* rate of return, it cannot be directly observed; it must be inferred from available evidence.

2. Since the cost of capital is determined *in capital markets* (*e.g.*, the Australian Stock Exchange), data from capital markets provide the best evidence from which to infer it.

3. Since the cost of capital depends on the return offered by alternative investments of equivalent risk, measures of the risks that matter in capital markets are part of the evidence that needs to be examined.

Regulated target return levels that give investors a fair opportunity to earn the cost of capital are the lowest levels that compensate investors for the risks they bear. Over the long run, an expected return above the cost of capital makes customers overpay for service. Regulators normally try to prevent such outcomes. At the same time, an expected return below the cost of capital short-changes investors. In the long run, such a return denies the company the ability to attract capital, to maintain its financial integrity, and to expect a return commensurate with that on other enterprises attended by corresponding risks and uncertainties.

More important for customers, however, are the economic issues an inadequate return raises for them. In the short run, deviations of the expected rate of return from the cost of capital create a "zero-sum game" — investors gain if customers are overcharged, and customers gain if investors are short-changed. In the long run, however, inadequate returns are likely to cost customers — and society generally — far more than is gained in the short run. Inadequate returns lead to inadequate investment, whether for maintenance or for new plant and equipment. The costs of an undercapitalised industry can be far greater than the gains from short run shortfalls from the cost of capital. Moreover, in capital-intensive industries (such as natural gas pipelines), systems that take a long time to decay cannot be fixed overnight. Thus it is in the customers' interest not only to make sure the return investors expect does not exceed the cost of capital, but also to make sure that it does not fall short of the cost of capital.

Of course, the cost of capital cannot be estimated with perfect certainty. However, a regulator that on average sets rates so investors expect to earn the cost of capital treats both customers and investors fairly, and acts in the long-run interests of both groups.

3. Company Sample

Because of a lack of sufficient data within Australia on publicly traded gas pipelines, it is necessary to look elsewhere for evidence on the cost of capital. The best capital markets data on gas pipelines is available in the United States. Our analysis therefore focuses on a sample of US companies owning gas pipelines. Although we are using a sample of US companies, it is important to note that we are not estimating the cost of capital for a US gas transmission pipeline. Rather, we use data on gas transmission companies traded in the US to estimate the cost of capital for a gas pipeline in Australia, owned by Australian investors, which we understand to be the relevant regulatory standard.

The ideal sample would be a set of companies that are publicly traded "pure plays" in this line of business. Publicly traded firms are ideal because the best way to infer the cost of capital is to examine evidence from capital markets on companies in the given line of business. While there are several publicly traded firms that have substantial gas transmission businesses in the US, there are not pure plays. Absent a sample of pure plays, the traditional sample of five companies which own natural gas pipelines was utilised. These companies are: Coastal Corp., El Paso Energy Corp., Enron Corp., Sonat Inc., and Williams Companies Inc. This is the same sample used by the United States Federal Energy Regulatory Commission Staff.[4] The Staff chose the sample they believed most indicative of risks faced by gas pipelines. According to Staff, the companies are ones which:

1. have one or more interstate gas pipeline subsidiaries under FERC jurisdiction;
2. are included in gas industry averages by Value Line, Moody's and S&P; and
3. "whose transmission of natural gas accounted for, on average over the 1994-1996 period, approximately 50 % or more of the total dollars in at least one of the two areas, operating income, and total assets."

If Australian market data is to be used for the cost of debt, the risk free-rate, and the market risk premium, and the effects of the Australian tax regime are to be incorporated in the analysis, the relevant question is "what is the risk of gas pipeline assets in the context of the Australian market?" We analyse the sample companies to answer this question. The details are presented in our discussion of the equity beta, below.

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[4] Prepared Direct Testimony of Commission Staff Witness, George M. Shriver III, *Koch Gateway Pipeline Company*, Docket No. RP97-373, (December 1997).

4. Australian WACC Analysis

The appropriate formula for the weighted average cost of capital in the Australian market has been the subject of considerable debate. Two particularly important issues are the effect of the imputation tax on the cost of capital and the translation of evidence from other markets into parameter estimates appropriate for Australia.

Much of the focus in Australia to date has been on alterations to the textbook WACC formulae to account for the imputation tax. Previous work on incorporation of the Australian dividend tax credit into the weighted-average cost of capital appears to have focused on a reduction of the corporate tax rate by a factor, *g*, that represents the combined effect of the fraction of earnings paid out as dividends and the fraction of resident versus non-resident investors, under the assumptions of constant perpetual debt and 100 percent payout ratio.[5] However, this does not seem to be a fully realistic approach: in reality the payout ratio is significantly less than 100%, the dividend tax credit occurs at the personal level, and companies in practice do adjust their debt levels as their value changes over time.[6]

Our analysis extends the standard method of estimating the WACC to take these issues into account. In principle, these extensions should not be controversial. There can be no question that the capital markets equilibrium is based on the decisions of investors who are driven by their desire to maximise after-tax (including personal tax) returns. Under a classical tax system and with the particular range of tax rates found in the United States, it has been shown that applying the CAPM at a company level (that is, without modelling personal tax effects) does not materially change the resulting estimates of the

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[5] See, for example, R. R. Officer (1994), "The Cost of Capital of a Company under an Imputation Tax System", *Accounting and Finance* and G. Peirson, R. Bird, R. Brown and P. Howard (1995), *Business Finance*, 6th ed., Sydney: McGraw-Hill.

[6] Hathaway and Officer, (N. J. Hathaway and R. R. Officer, "The Value of Imputation Tax Credits", working paper, Finance Research Group, Melbourne Business School, 1999), demonstrate that the credits have the effect of reducing corporate tax on franked dividends for Australian residents, thereby making them taxable at the individual's personal rate. Thus, in some ways an adjustment to the corporate tax rate seems natural. However, even earnings that consisted entirely of franked dividends to Australian-resident investors would have a tax burden consisting of the timing difference between corporate tax payments and personal tax credits. Moreover, adjustment of the corporate tax rate for personal dividend tax credits without consideration of personal taxes on capital gains or interest is intrinsically a partial analysis.

cost of capital. Perhaps surprisingly, our work modelling personal taxes in Australia under the imputation tax system with the present tax rates and dividend payout ratios shows results only very slightly different from a company-level analysis. Nonetheless, it should be clear that the appropriate analysis includes consideration of the effect of personal taxes on the cost of capital and that the bias in using a company-level analysis will be affected by changes in the basic parameter values, such as tax rates, which may change over time.

4.1. Defining and Measuring Returns under an Imputation Tax System

We begin with the simple observation that the definition of returns to shareholders is different under an imputation tax system from that under a classical tax system. Under a classical system, returns consist of capital gains and dividends. Under an imputation system, a third component is added: returns consist of capital gains, dividends *and* imputation tax credits.[7] The combined value of a dividend and its associated franking credit is sometimes referred to as the "grossed up dividend," and similarly the total return to shareholders (capital gains plus grossed up dividends) is the "grossed up return."

The measurement of returns must also change to take into account the effect of franking credits. The total return after company-level taxes and before investor-level tax is given simply by adding the capital gain and grossed up dividend. Measuring returns after both company and investor-level taxes return is more difficult, since it involves determining the effective tax rate on franking credits and capital gains.

We note that in applying the CAPM to an economy with an imputation tax system, the issues mentioned here come into play repeatedly. First, in estimating an asset beta it is necessary to regress the return on the asset in question against the market returns, and for both the asset and the market as a whole returns should be measured to include franking credits. Second, in applying the CAPM to determine the cost of equity based on the estimated beta and the market risk premium, measurement of the market risk premium should include the value of franking credits.

[7] Imputation tax credits, also referred to as franking credits, represent the "face value" of the tax credit that arises from a "franked" dividend under the imputation tax system.

4.2. WACC formula

There have been several versions of the formula for the WACC developed to account for the Australian imputation tax regime. The ACCC cites the WACC formula developed by Officer:[8]

$$WACC = \left(\frac{E}{V_L}\right) R_E \left(\frac{1-T_C}{1-(1-g)T_C}\right) + \left(\frac{D}{V_L}\right) R_D (1-T_C) \tag{1}$$

The relevant terms are defined as follows:[9]

D = Market value of debt.
E = Market value of equity.
V_L = Total value of the leveraged firm.
T_C = Company tax rate.
R_D = Required return on firm debt.
R_E = Required return on equity.
g = Value of franking credits.

Note that R_E represents the required return on equity *measured in grossed up terms*, as discussed above. The value of franking credits is understood to mean their value in capital markets, as discussed further below, and is measured by the γ parameter.

The Officer formula assumes that all income is paid out as dividends, an unrealistic assumption. However, it is easily generalised to a less than 100% dividend payout ratio:[10]

$$WACC = \left(\frac{E}{V_L}\right) R_E \left(\frac{1-T_C}{1-(1-ag)T_C}\right) + \left(\frac{D}{V_L}\right) R_D (1-T_C) \tag{2}$$

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[8] Officer (1994), p.5.

[9] Our notation is adapted from I. A. Cooper and K. G. Nyborg (1999), "Discount Rates and Tax", *IFA Working Paper 283-1998*, London Business School. See also R. A. Taggart (1991), "Consistent Valuation and Cost of Capital Expressions with Corporate and Personal Taxes", *Financial Management*, pp. 8-20.

[10] Appendix 1 derives this expression (and shows that it is correct even once personal taxes are taken into account).

where:

$$a = \text{Payout ratio.}$$

4.3. An Alternative Approach to Estimating the WACC

As various people have pointed out, the WACC could in principle be calculated correctly using either a formula based on the "grossed up return" R_E or one based on the return excluding the value of franking credits, which we write $\hat{R}_E$.[11] In the latter case, we would use the (seemingly simpler) WACC formula:

$$WACC = \left(\frac{E}{V_L}\right)\hat{R}_E + \left(\frac{D}{V_L}\right)R_D\left(1 - T_C\right) \tag{3}$$

In this case all returns would have to be measured excluding the value of franking credits. In particular, the estimation of asset betas and the market risk premium used in applying the CAPM would now have to *exclude* the value of franking credits.

The choice between these two approaches depends primarily upon whether it is easier to estimate R_E or $\hat{R}_E$. In this case, neither can be estimated directly because of the lack of sufficient data on historical returns of natural gas pipelines in Australia. We use an approach based on US data, which is better suited to estimating R_E rather than $\hat{R}_E$. It provides an estimated beta which is based on total returns before investor-level taxes, and the natural Australian analogy would be to the beta based on "partially grossed-up returns," since they represent the total (pre-investor level taxes) return in Australia, just as the total returns do in the US.

4.4. Pre-tax and/or real WACC

We understand that the regulatory return will be calculated using a pre-tax real WACC. That is, the allowed return to investors will be given by:

(Pre-tax real WACC) x (Regulatory Asset Base) + Regulatory Depreciation (4)

It will therefore be necessary to convert the after-tax nominal WACC figure into a real pre-tax one.

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[11] See for example, Officer (1994), pp. 6-8, or P. H L. Monkhouse, "The Valuation of Projects under the Dividend Imputation Tax System", *Accounting and Finance*, November 1996, pp. 195-7.

The correct method of conversion is to first subtract inflation from the nominal after-tax WACC, then "gross up" for taxes. Other proposed methods lead either to over-estimates of the cost of capital, in the case of the gross up, or under-estimates, in the case of the inflation adjustment.

4.4.1. Treatment of inflation

The real cost of capital is given by the "Fisher formula":

$$r_R = \frac{1+r_N}{1+i} - 1 \tag{5}$$

where r_R is the real cost of capital, r_N is the nominal cost of capital, and i is inflation. However, many regulatory accounting systems that use a real rate of return involve a one year timing gap between the beginning-of-year regulatory "allocation" of return to investors, and the end-of-year payout of that return. Myers et. al. (1984 and 1985)[12] show that in these circumstances, in order to give investors the correct nominal return, the real return given by the real cost of capital needs to be turned into end of year dollars, by multiplying by a factor of $(1+i)$. The allowed rate of return is therefore given by:

$$r_R \times (1+i) = \left(\frac{1+r_N}{1+i} - 1 \right) \times (1+i) = r_N - i \tag{6}$$

as shown in the example in Table 3a.

Table 3a: Fisher cost of capital and Myers et al allowed return.

Nominal Cost of Capital	[1]	10.0%
Inflation	[2]	4.0%
Fisher Real Cost of Capital	[3] (1+[1])/(1+[2])-1	**5.8%**
Myers et al Allowed Return on Capital	[4] [3]x(1+[2])	**6.0%**

[12] S. C. Myers, A. L. Kolbe, W. B. Tye (1984), "Regulation and Capital Formation in the Oil Pipeline Industry," *Transportation Journal*, Vol. 23, No. 4, pp. 25-49 and S. C. Myers, A. L. Kolbe, W. B. Tye (1985), "Inflation and Rate of Return Regulation," *Transportation Economics*, Vol. 2, pp. 83-119.

Table 3b contains a numerical example to demonstrate this effect. Bear in mind the fundamental principle that the present value of the expected future cash flows from an investment discounted at the cost of capital should equal the value of that investment. Using the real cost of capital as the allowed return fails to satisfy this principle—it is necessary to make the adjustment for inflation.

Table 3b: Rates of return on a current-cost rate base (Fisher vs Myers et al).

			0	1	2
Asset base (BOY)	[1]		$1,000	$1,040	$541
Depreciation	[2]	50% x [1]		$520	$541
Asset base (EOY)	[3]	[1] - [2]	$1,000	$520	$0
Fisher return	[4]	$5.8\%x[3]_{t-1}$		$58	$30
Fisher cash flow	[5]	[2]+[4]		$578	$571
Fisher NPV	[6]	PV(10%,[5])	**$997**		
Myers et al return	[7]	$6\%x[3]_{t-1}$		$60	$31
Myers et al cash flow	[8]	[2] + [7]		$580	$572
Myers et al NPV	[9]	PV(10%,[8])	**$1,000**		

Notes and Sources:
Assumes an initial investment of $1,000 in an asset with 2 year life, nominal cost of capital 10%, inflation 4%.

4.4.2. Conversion to pre-tax

Once inflation has been subtracted from the nominal post-tax cost of capital, the resulting real post-tax figure can be grossed-up for taxes simply by dividing by the quantity (1-T_C). Performing the calculation in the reverse order, that is grossing up the nominal post tax cost of capital and subtracting inflation will overcompensate investors, as the example in Table 4a illustrates.

Table 4a: Effect of grossing-up for taxes before subtracting inflation.

			0	1	2	3	4	5
Asset base (BOY)	[1]	1.04 x $[1]_{t-1}$	$1,000	$1,040	$1,082	$1,125	$1,170	$1,217
First subtract inflation								
Return	[2]	9.375% x $[1]_{t-1}$		$94	$98	$101	$105	$110
Tax at 36%	[3]	36% x [2]		$34	$35	$37	$38	$39
Net Income	[4]	[2]-[3]		$60	$62	$65	$67	$70
NPV	[5]	PV(10%,[4])	$245					
Final asset base	[6]	last [1]						$1,217
NPV	[7]	PV(10%,[6])	$755					
Total NPV	[8]	[5]+[7]	**$1,000**					
First gross up for taxes								
Return	[9]	11.625% x $[1]_{t-1}$		$116	$121	$126	$131	$136
Tax at 36%	[10]	36% x [9]		$42	$44	$45	$47	$49
Net Income	[11]	[9]-[10]		$74	$77	$80	$84	$87
NPV	[12]	PV(10%,[11])	$303					
Final asset base	[13]	last [1]						$1,217
NPV	[14]	PV(10%,[13])	$755					
Total NPV	[15]	[12]+[14]	**$1,059**					

Notes and Sources:
Assumes an initial investment of $1,000 in an asset with 5 year life, nominal cost of capital 10%, inflation 4%.
[2]: 9.375% is the pretax real WACC corresponding to a 10% nominal after-tax WACC, using a 36% tax rate (9.375 = (10 - 4)/(1 - .36)).
[9]: the 11.625% comes from grossing up for taxes and then subtracting inflation (it is 10/(1 - .36) - 4).

4.4.3. The effective tax rate

In estimating the pre-tax real cost of capital, we have used the marginal corporate tax rate T_C. In principle, the effective corporate tax rate should be used. Estimating the effective tax rate, however, requires a great deal of very detailed information and its value can change considerably over time depending on the asset mix, tax laws, interest rates and inflation. These factors can cause the effective tax rate to be either higher or lower than the marginal rate. For example, the benefits of accelerated depreciation cause the effective tax rate to be less than the marginal tax rate.

For companies with regulated real returns, however, depreciation allowances based on nominal (that is inflation-adjusted) asset values will exceed those permitted for tax purposes. In other words, current income for regulated utilities will increase with inflation as assets are written up, all else equal, but because the tax depreciation allowance does not similarly increase, a portion of the regulatory depreciation allowance is taxed.[13] Table 4b illustrates, by comparing different examples of hypothetical tax depreciation schedules, how the combination of these factors can affect the effective tax rate, leading to a return on investment that may fall above or below the required return. Under "Schedule A" tax depreciation coincides with regulatory depreciation and investors earn their cost of capital. Under "Schedule B" tax depreciation is accelerated but involves no write-up for inflation, and the net effect is to lower the return to investors (i.e., to raise the effective tax rate above the 36% used in calculating the cost of capital). Under "Schedule C" the tax depreciation is more heavily accelerated, and this outweighs the effect of inflation, leading to a higher return on capital (i.e., an effective tax rate of less than 36%).

Table 4b: Impact of accelerated depreciation vs inflation.

			0	1	2	3	4	5
Asset base (BOY)	[1]	1.04 x $[1]_{t-1}$	$1,000	$832	$649	$450	$234	$0
Regulatory Depreciation (EOY)	[2]		$208	$216	$225	$234	$243	
Return	[3]	9.375% x $[1]_{t-1}$		$94	$78	$61	$42	$22
Tax at 36%	[4]	36% x [3]		$34	$28	$22	$15	$8
Net Income	[5]	[3] - [4]		$60	$50	$39	$27	$14
NPV of Net Income	[6]	PV(10%,[5])	**$152**					
Schedule A								
Tax Depreciation	[7]	*See note*		$208	$216	$225	$234	$243
NPV of Depreciation	[8]	PV(10%,[7])	**$848**					
Total NPV	[9]	[6] + [8]	**$1,000**					
Schedule B								
Tax Depreciation Schedule	[10]	*See note*	35%	35%	10%	10%	10%	
Tax Depreciation	[11]	$1,000 x $[10]_{t-1}$		$350	$350	$100	$100	$100
NPV of Depreciation	[12]	PV(10%,[11])	**$813**					
Total NPV	[13]	[6] + [12]	**$965**					
Schedule C								
Tax Depreciation Schedule	[14]	*See note*	50%	50%	0%	0%	0%	
Tax Depreciation	[15]	$1,000 x $[14]_{t-1}$		$500	$500	$0	$0	$0
NPV of Depreciation	[16]	PV(10%,[15])	**$868**					
Total NPV	[17]	[6] + [16]	**$1,020**					

Notes and Sources:
Assumes an initial investment of $1,000 in an asset with 5 year life, nominal cost of capital 10%, inflation 4%.
[2]corresponds in real terms to straightline depreciation over 5 years.
[3]: 9.375% is the pretax real WACC corresponding to a 10% nominal after-tax WACC, using a 36% tax rate (9.375 = (10 - 4)/(1 - .36)).
[7]: Schedule A assumes for illustrative purposes that tax depreciation is same as regulatory depreciation.
[10], [14]: Schedules B and C both involve accelerated depreciation, but no write-up for inflation.

The effective tax rate in practice is highly dependent on the specific time pattern of past and future investments by the regulated firm and on the rate of inflation. A slowly-growing firm that ends up with mostly old assets will need a much bigger additional tax

[13] S. C. Myers, A. L. Kolbe, W. B. Tye (1985), "Inflation and Rate of Return Regulation", *Transportation Economics*, Vol. 2, pp. 83-119.

allowance than a rapidly growing firm that ends up with mostly new assets. The combination of slow asset growth and high inflation, for example, can lead to an effective tax rate well above the marginal rate.

A fully satisfactory estimate of the effective tax rate can only be achieved by detailed modelling of the business in question. We understand also that a series of major tax reforms are being proposed and enacted in Australia which will affect the marginal effective tax rate in the future. Some of these changes, such as a lowering of the statutory company tax rate, will lower the effective rate while others, such as the elimination of accelerated depreciation, will increase it.[14] In the absence of a full, detailed modelling of the tax flows and the resolution of the proposed reforms, our analysis uses the marginal rate of company tax. We have convert the after-tax nominal WACC to a pre-tax real one as follows:

$$\text{pre-tax real } WACC = \left(\text{after-tax nominal } WACC - \text{inflation}\right) / \left(1 - T_C\right) \qquad (7)$$

4.5. Gearing levels

Our analysis has assumed a gearing level of 55%. This is consistent with evidence from domestic and overseas markets, where we observe gearing levels typically in the range of 50%-60%, as shown in Table 5 below. It is also consistent with recent regulatory findings in Australia.

Table 5: Gearing Ratios for Sample Sets of Comparable Companies

Sample		Number of companies	Current Gearing Ratio (Unweighted Average)
Australian Energy Utilities	[1]	4	52%
Canadian Natural Gas Utilities	[2]	3	63%
American Natural Gas (Diversified) Companies	[3]	19	48%
American Natural Gas Distribution Companies	[4]	24	51%
United Kingdom	[5]	1	62%
FERC pipeline sample	[6]	5	36%

Sources:
[1]-[5]: figures provided by Epic.
[6]: Debt book value and number of shares outstanding: Compustat.
[6]: Share prices: Compuserve and Tradeline.

[14] Treasurer of the Commonwealth of Australia, *Press Release No. 58 – The New Business Tax System*, (21 September, 1999).

Within a reasonable range, the exact gearing level used should not be of great importance, since both economic theory and empirical analysis suggest that the cost of capital is relatively insensitive to gearing levels. For example, it is common to observe a wide range of capital structures within a single industry, even when the level of competition in the industry is such that one would expect firms with inefficient capital structures to be driven out. It is likely that debt lowers the weighted average cost of capital at low gearing ratios. At high gearing ratios, increasing the gearing ratio adds costs for the firm, such as a growing risk of financial distress or a reduction in the flexibility to take advantage of business opportunities, that eventually offset any net tax benefits. Thus, the WACC is likely to decrease at low gearing ratios, stay constant over a broad middle range of gearing ratios, and increase at high gearing ratios. Under an imputation tax system such Australia's, the WACC is less sensitive to gearing than under a classical taxation system, but the same pattern will hold.[15]

4.6. The impact of ownership on WACC parameters

The identity of the owners of a company is irrelevant to determining its cost of capital. For example, it would be wrong to claim that because of the imputation system an Australian company with foreign owners faces a higher cost of capital than one owned by Australian residents. To see this, imagine two Australian companies, one ("Company A") with foreign shareholders and the other ("Company B") with Australian shareholders. Suppose that company A provides its shareholders with a return of 10%.

In this case, the (fallacious) argument for the proposition that company B has a lower cost of capital than company A runs as follows. Company B must also provide a return of 10%. However, since Company B's shareholders are Australian, the return it provides its shareholders can be augmented by franking credits. With company tax at 36%, Company B only has to provide dividends that give a return (excluding the value of franking credits) of 6.4%. Provided these dividends are fully franked, the total return to

[15] In estimating the cost of capital for the DBNGP we have conservatively assumed that the higher gearing ratio (relative to US pipelines) will create further tax benefits, leading to a lower weighted average cost of capital.

shareholders will be equal to 10%.[16] The cost of capital to this firm is therefore only 6.4%.

This argument is however simply wrong: why would resident Australian investors hold shares in Company B, when they could buy shares in Company A instead? Company A provides its foreign shareholders with a return of 10%, but this will translate into a return that is greater than 10% for Australian shareholders, because they will be able to get franking credits associated with Company A's dividends.[17] Australians would therefore purchase the higher-yielding, foreign-owned company, pushing up its share price and equalising the two companies' yields.

However, the need to attract significant amounts of foreign investment in Australia may well have implications for the cost of capital of Australian companies.[18] In the example above, both companies face the same cost of capital: they have to provide a return sufficient to satisfy investors, including foreign investors. Since Australian investors obtain the same cash return *plus* the value of imputation credits, their total return from investing in Australian companies is likely to be higher than that accruing to foreign investors. Imputation credits have value, but that value goes to Australian investors not Australian firms. Consequently, in this analysis the existence of imputation credits does not affect the cost of capital of Australian firms. The cost of capital in Australia is determined by the world economy, because Australia is a comparatively small, open economy.

This view has been endorsed by a number of academic economists in Australia and other countries with similar "non-classical" systems. Officer has written that "[i]n an open capital market such as Australia, where the size of the market relative to offshore

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[16] Recall that the total return to shareholders is calculated by "grossing up" the cash dividend. In this case, the calculation gives a total return of 6.4%/(1-.36) = 10%.

[17] There are some theoretical exceptions to this statement, but none of them is of practical significance. Company A would not be able to provide franking credits if it never paid out any dividends at all, or if it never paid any company tax at all, but neither circumstance is likely. Its management might also choose not to frank credits even when they could, but since this would raise their cost of capital while providing no benefit, there is no reason to think they would do so.

[18] Approximately 30 percent of shares traded on the Australian Stock Exchange are owned by foreigners. In addition, much of the capital raised in the privatisation of the Australian utility sector has been foreign.

markets implies it is a price taker, we would not expect the cost of capital to change."[19] Boadway and Bruce (1990) produce similar conclusions,[20] as do Devereux and Freeman (1995),[21] who note that this outcome is reversed if imputation credits are given to all shareholders, regardless of residence or nationality, a condition which does not at present apply in Australia.

The last observation is significant since it can be argued that foreign investors could obtain the value of imputation credits, via "short-term trading" or "dividend streaming". According to this hypothesis, Australian taxpayers will purchase shares from foreign investors shortly before the dividend day and resell them shortly after. The premium earned by foreign investors selling just before dividend day would give them at least part of the value of the franking credits attached to the dividend.

Short-term trading around dividend day is widely observed in a number of countries. Under both classical and integrated tax systems, tax-free entities such as pension funds and universities have an incentive to engage in such activity since they will not be taxed on the dividend. Evidence for such behaviour in Australia can be found in Clark and Lai (1993)[22] and in Armstrong, Brown and Clarke (1996).[23]

However, such trading is unlikely to enable most or all foreign investors to obtain the value of imputation credits. Short-term trading imposes transaction costs that may be sufficient to outweigh its benefits. Most importantly, the government has in recent years introduced a package of measures to prevent short-term franking credit trading and dividend streaming, including both a general anti-avoidance rule and a requirement to

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[19] Officer (1994). Officer's arguments are developed in more detail in R. R. Officer (1988), "A Note on the Cost of Capital and Investment Evaluation for Companies Under the imputation Tax", *Accounting and Finance*, pp. 353-375.

[20] R. Boadway and N. Bruce (1990), "Problems with Integrating Corporate and Personal Taxes in an open Economy", *Journal of Public Economics*, Vol. 48, pp. 39-99.

[21] M. Devereux and H. Freeman (1995), "The Impact of Tax on Foreign Direct Investment: Empirical Evidence and the Implications for Tax Integration Schemes", *International Tax and Public Finance*, Vol. 2, pp. 85-106.

[22] A. Clarke and R. Lai (1993), "Ex-Dividend Day Behaviour of Australian Shares Before and After Imputation", *Australian Journal of Management*, 18, 1:1-40.

[23] A. Armstrong, P. Brown and A. Clarke (1996), "Trading Dividends on the Australian Stock Exchange", working paper, University of Western Australia.

hold shares for 45 days in order to qualify for the credits.[24] These measures are expected to reduce the impact of imputation tax credits in capital markets, and thereby on the cost of capital.

Indirect evidence that short-term trading is not a sufficient mechanism to enable foreign investors to access imputation credits can be found by examining the impact of dividend imputation in New Zealand. Before September 1993, New Zealand had a system similar to Australia's, with dividend imputation credits available only to domestic investors. After September 1993, however, these credits were extended to non-resident shareholders. If these shareholders had already been able to obtain the value of imputation credits via short-term trading, then this change would have had little impact. However, Wilkinson, Cahan and Jones (1999) show that following the change firms in New Zealand with high dividend payout ratios had significantly less incentive to minimise corporate taxes.[25]

If a large proportion of foreign investors do not obtain the value of imputation credits through short-term trading, then they remain representative of marginal investors in Australian capital markets. In that case, imputation credits should not lower the cost of capital to Australian firms. Rather, they would constitute a benefit to Australian investors, leading to higher domestic savings but no change in total investment.

Evidence from Australian capital markets suggests that the true position is somewhere between the two extremes: markets do not value franking credits at 100% of their face value, but neither do they value them at zero. As we discuss further below, our analysis therefore incorporates the value of franking credits as inferred from capital market data. However, we note one *caveat*: given the increasing restrictions on trading aimed specifically at capturing the value of imputation tax credits, it must be expected that the value of these credits will decline over time. Since we take no account of new or proposed restrictions, our analysis will overestimate the future market value of franking

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[24] Income Tax Assessment Act 1936, ss. 45, 45A, 45B, 160APHL and 160APHO.

[25] B. R. Wilkinson, S. F. Cahan, G. Jones, "Tax Strategies and Dividend Imputation: The Effect of Foreign and Domestic Ownership on Average Effective Tax Rates", working paper, Department of Accountancy and Business Law, Massey University, New Zealand, 1999. When all shareholders receive imputation credits, the firm is essentially exempt from corporate tax on dividends and therefore has little incentive to minimise taxes (given a high payout ratio). If short-term trading meant that all shareholders were already receiving imputation credits, then this would have held prior to September 1993 and little or no change would have been observed.

credits. It is therefore conservative, i.e., it will tend to underestimate the future cost of capital. We have included in our results a sensitivity analysis to show how the WACC would be affected by a lower value of franking credits (i.e., a lower value for γ).

5. The Risk Free Rate

We follow standard regulatory practice in Australia in using the current yield on 10-year Australian government bonds as the risk free rate. We determined the current yield as the average yield over the last two months, which gives a figure of 6.4%. Bond yields have been rising over this period, however, and the estimate should be updated at the time of the actual determination of the WACC.

6. Market Risk Premium

6.1. Overview

The market risk premium has been the subject of controversy worldwide. Experience (e.g., the October Crash of 1987 in the US) demonstrates that shareholders, even well-diversified shareholders, are exposed to enormous risks. By investing in stocks instead of no-risk Treasury securities, investors expect to do better on average. However, they also risk returns well below those they expected in any year. That is, not only might investors in average risk common stocks fail to earn their expected return, they might lose much of their initial capital as well. This is why investors demand a risk premium.

The most reliable way to estimate the market risk premium is by examining evidence of its historical value. Historical estimates of the Australian equity risk premium over ten-year government bonds generally suggest a range of between 6% to 8%, and we understand that most practitioners are using a range of between 6% to 7%.[26]

Long periods must be used to estimate the market risk premium because stocks are so volatile. The result from any short period is likely to substantially over- or

[26] Modelling by the ACCC and the ORG suggest a range of between 4.5% to 7.5%, but the lower end of this range appears to be based on a dividend discount model, which must yield a downward-biased result. Dividend growth models produce unstable results that are highly dependent on assumptions about future growth. Moreover, due to the facts that (1) many higher-risk companies do not pay dividends and (2) unregulated companies may have valuable growth options, dividend discount models, even if correctly applied given available data estimated, will understate the true market risk premium.

underestimate the risk premium that investors actually required during that period. For example, in any given year, even for several years in a row, the market may yield a lower return than Treasury bills. Clearly, investors do not expect a negative market risk premium. Instead, investors expect that they will earn the market risk premium in the long-run, over many years, but that over any given short period they may end up doing substantially better or worse. Because of market volatility, a short period for the purpose of assessing market expectations may be decades long. To get reliable information on the market risk premium using historical data, then, long periods must be used.

We advise caution in making adjustments that move the market risk premium away from the figure implied by market evidence. Driven in part by the inability to explain the high asset prices in stockmarkets in recent years, economists and non-practitioners have made intuitive arguments about why the market risk premium should be reduced below the historical average. Scholarly attempts to use historical data to identify changes in the market risk premium, however, have not generally succeeded. There is some weak evidence that the market risk premium is higher than average when the stock market is more volatile than average, but the evidence is also consistent with the view that the market risk premium never changes at all. There is simply no reliable way to quantify just how much the market risk premium might differ from the average value at any given time.

6.2. Effect of imputation tax

The introduction of a dividend imputation tax system in Australia raises the question as to whether the use of historical estimates of the market risk premium might be unreliable or biased. The current consensus is best summarised in an ORG paper on WACC:[27]

> [T]he MRP has not been materially affected by the introduction of dividend imputation. It should be noted that the effect of dividend imputation on returns to shareholders is taken into account through the term ? in the WACC formula. Thus, the impact of dividend imputation on WACC is accounted for by inclusion of the *?* term in the WACC calculation, rather than through a downward adjustment to the market risk premium.

For simplicity, our analysis relies on the traditionally-used value measure of the market risk premium. Our base case value for the market risk premium is 6.5 percent,

[27] Officer of the Regulator-General, Victoria, "Weighted Average Cost of Capital for Revenue Determination: Gas Distribution", *Staff Paper Number 1*, (28 May 1998).

toward the lower end of the historical range of 6-8 percent,[28] and the mid-point of the range generally used. We also show the effect of using higher and lower values in our sensitivity analyses.

We have discussed in section 4.1 above the impact of the imputation system on the measurement of individual returns, and on the estimation of the market risk premium. As noted there, part of the return enjoyed by shareholders under an imputation system consists of franking credits. Consequently, the traditional method of calculating the market risk premium is no longer valid. Under a classical tax system, the premium has been calculated by subtracting the risk-free rate of return from the return on a market index such as the S&P500 in the US, or the All Ordinaries Index in Australia. For example, if the average return on the market index is 12.8% and the average risk-free rate is 6%, then the market risk premium is 12.8% – 6% = 6.8%. However, with an imputation tax system the total return from the market in this situation is greater than 12.8%, because the market index does not include the value of franking credits. At the most extreme, if all returns were paid out in fully franked credits to tax-liable domestic investors, then the 12.8% would correspond to a total return to shareholders of 20% (given the current company tax rate of 36%).[29] The true market risk premium would therefore be 20% – 6% = 14%.

The traditional method of calculating the market risk premium therefore can underestimate the true market risk premium under an imputation tax system.[30] As Monkhouse has pointed out in his discussion of the effect of dividend imputation on the risk premium, "the total return on the market has to be re-interpreted to include the net, or

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[28] See R.R. Officer (1988), *Rates of Return to Shares, Bond Yields and Inflation Rates: an Historical Perspective*, University of Melbourne.

[29] The 20% figure is obtained by grossing up the 12.8% return, which consists in this example entirely of cash dividends: 12.8/(1 - .36) = 20%.

[30] For exactly the same reason, the market risk premium as traditionally measured should be expected to decline, *with no corresponding decrease* in the true market risk premium, upon the introduction of an imputation tax system. Research by Professor Brealey in the UK has shown that once personal taxes are fully accounted for, the properly calculated UK market risk premium has tended to be stable over long periods of time and across different tax regimes, including an imputation tax system.

cash, return (consisting of income and capital gains) plus the return obtained, or expected to be obtained, from imputation credits."[31] [32]

7. Equity Beta

7.1. Estimation using sample companies

Recall that the objective of our analysis was to estimate the riskiness, or beta, of gas transmission companies in Australia. The results in turn are used in conjunction with Australian parameters for the CAPM. For example, the market risk premium in Australia is considerably lower than that in the US.

The composition of the Australian stock market is substantially different from that of the United States. For instance, relative to the US economy, the Australian economy has a larger natural resources sector and a smaller high-tech sector. Resource-related stocks tend to be less risky than technology stocks. The Australian market as a whole is less risky than the US market. The result is that a stock which is less sensitive to economic conditions than the S&P 500 in the US (having a beta of less than 1) would be more risky (have a higher beta) relative to the Australian market. By re-weighting the industry sectors of the S&P 500 to mirror the Australian economy, the beta can be estimated more accurately.[33] We created such an index by mapping sub-components of the US market to mirror the component industries of the Australian Stock Exchange All Ordinaries Index (ASX).[34] Betas were then calculated against this "US-ASX-Weighted Index". The results are shown in Table 6a below.

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[31] P.H.L. Monkhouse, "The Cost of Equity Under the Australian Dividend Imputation Tax System," *Accounting and Finance* 33(2), November 1993, p.14.

[32] Our approach involves one further simplification in relation to the effects of personal taxation. If the personal tax rate on income from debt exceeds that on income from equity (as in Australia), the risk-free cost of debt used in the CAPM must be reduced by the net personal tax disadvantage of debt and the market risk premium estimated in the corresponding way. We do not believe that this simplification biases or materially affects the resulting estimates of the cost of capital.

[33] Weights were re-balanced annually based on data provided by the Centre for Research in Finance at the Australian Graduate School of Management.

[34] It has been suggested that one could simply calculate the beta of US companies against an Australian index or make an adjustment for the beta of the Australian index against the US index. This is not correct. Such estimates could show the value of cross-border diversification, but would have to be

Table 6a: Estimated equity betas of US pipelines

Company	Equity Beta (relative to US-ASX-Weighted Index)
Coastal	1.00
El Paso	0.85
Enron	0.93
Sonat	0.59
Williams	0.88
Average	0.85

The specific mappings are provided in Appendix 2. Such an exercise inevitably involves some exercise of judgement. However, sensitivity tests that adjusted for certain apparent inconsistencies (for example, BHP is categorised by the ASX as a Developer and Contractor but is essentially a resource company) revealed that the beta estimates were very stable across possible alternative weightings in the US-ASX-Weighted Index.

7.2. Delevering formula

The equity beta obtained from this exercise needs adjusting to account for the difference between the average leverage of the US firms used in the exercise and the leverage assumption used in determining the regulatory cost of capital. This adjustment can be made in a number of ways, depending upon the underlying assumptions. We use the following formula:[35]

$$b_A = b_E\left(E/V_L\right) + b_D\left(D/V_L\right) \qquad (8)$$

This assumes an "active debt management policy," *i.e.*, that the firm's management will manage its debt so that the gearing ratio remains constant over time. An alternative assumption often employed is that of "passive debt management," where it is the absolute level of debt that remains constant, rather than the proportion. The true picture is likely to

adjusted to reflect additional costs of such investment as well as the relevant tax treatment. Even these estimates would not answer the question typically posed by regulators, which assumes Australian assets owned by Australian investors.

[35] Both this expression and that in equation (9) below can be found in Cooper and Nyborg (1999). See also Taggart, Robert A. Jr. (1991), "Consistent Valuation and Cost of Capital Expressions with Corporate and Personal Taxes," *Financial Management*.

fall somewhere between these two. However, as we show below, in this instance it makes very little difference which assumption one uses.

Using this formula, we estimated asset betas for each of the US pipelines in our sample, as shown in Table 6b below.

Table 6b: Estimated asset betas of US pipelines

Company	Equity Beta (relative to US-ASX-Weighted Index)	D/V	Asset Beta
Coastal	1.00	42%	0.63
El Paso	0.85	47%	0.50
Enron	0.93	26%	0.72
Sonat	0.59	28%	0.46
Williams	0.88	35%	0.61
Average	0.85	36%	0.58

Notes:

Asset beta is derived from the equity beta using expression (8) above: $\beta_A = \beta_E(E/V_L) + \beta_D(D/V_L)$. We use the same debt beta (0.12) for the US as we do for Australia.

The average asset beta of 0.58 is our estimate for the DBNGP asset beta. We then apply formula (8) "in reverse," assuming 55% debt finance, to get an estimated equity beta for the DBNGP of 1.39.

7.3. Sensitivity to alternative delevering formulae

As a check on sensitivity, we have also examined the effect of using a number of alternative approaches to delevering. The three alternative approaches we examined all gave the same or higher estimates of beta and hence a higher estimated cost of capital. Our approach is therefore a conservative one. We detail the three alternatives below.

The first alternative formula assumes a passive debt management policy, as discussed above:

$$b_A = \frac{b_E\left(E/V_L\right) + b_D\left(1 - T_C\right)\left(D/V_L\right)}{1 + T^*\left(D/V_L\right)} \tag{9}$$

where b_D represent the beta of company debt and T^* measures the relative tax advantage of debt over equity:

$$T^{*} = 1 - \frac{(1 - T_{PE})(1 - T_C)}{(1 - T_{PD})} \tag{10}$$

(note that T_{PE} includes the tax advantages of equity arising from the imputation tax system).

The second alternative is the "Monkhouse" formula, which like our expression (8) assumes active debt management. It differs slightly by taking into account the value of gamma (the value of franking credits):

$$b_A = \frac{b_E\left(\frac{E}{V_L}\right) + b_D\left(1 - \frac{R_D}{1+R_D}(1-g)T_C\right)\left(\frac{D}{V_L}\right)}{1 - \left(\frac{R_D}{1+R_D}(1-g)T_C\right)\left(\frac{D}{V_L}\right)} \tag{11}$$

Finally, the following formula has been cited by the ACCC:

$$b_A = \frac{b_E + b_D(D/V)}{\left(1 + \left(1 - (1-g)T_C\right)(D/E)\right)} \tag{12}$$

Table 6c below shows the impact of using these alternative delevering formulae on the estimate of beta.

Table 6c: Estimated DBNGP beta: sensitivity to alternative formulae.

	Our approach	Alternative formulae		
		passive debt policy	Monkhouse	ACCC
	[1]	[2]	[3]	[4]
Asset Beta (all equity finance) [A]	**0.58**	0.63	0.59	0.66
Equity Beta (55% debt finance) [B]	**1.15**	1.16	1.16	1.24

7.4. *Debt beta*

Each of the leverage formulae relies on an estimate of the debt beta, B_D. This parameter has been estimated in Australia to be between 0.06 and 0.12.[36] We use the

[36] IPART used a debt beta of 0.06 in its *Final Decision: Access Arrangement Great Southern Energy Gas Networks Pty Limited*, March 1999, p.29. The ACCC assumed a debt beta of 0.12 in its *Draft Decision: NSW and ACT Transmission Network Revenue Caps 1999/00-2003/04*, 12 May 1999, p.23.

more conservative value of 0.12 and provide a sensitivity analysis using 0.06.[37] While it is difficult to estimate the debt beta with precision, the debt beta should correspond to the debt premium used to estimate the cost of debt, after adjusting for default and financial distress costs. A premium toward the upper end of the 0.06 to 0.12 range is broadly consistent with the debt premium we use in this analysis of 1.2 percent.

8. Imputation Credits—Gamma

8.1. Interpretation of gamma

The g parameter measures the ratio of utilised tax credits to corporate tax paid on income paid out on dividends. If all dividends were fully franked, and all franking credits fully utilised, then g would equal one. In general we can write:

$$g = q \times k \tag{13}$$

(as shown in Appendix 1). Here q is the "utilisation factor", the proportion of issued franked credits that are redeemed (and hence measures the average value of $1 of franked credit), and k is the "franking ratio", defined as the ratio of franked dividends to total dividends.[38]

Estimating g therefore involves measuring or estimating both these factors. The franking ratio k can be determined with relative ease from publicly available ATO accounting data. Studies to date have estimated q in two ways: directly, from ATO data giving the ratio of used credits to total franked dividends; and indirectly, from "dividend drop-off studies" that analyse the change in share prices resulting from the payment of a dividend. Both methods are outlined below, while Appendix 3 provides more detail on the use of dividend drop-off studies.

8.2. Estimating the franking ratio

Hathaway and Officer (1999) present ATO data which implies a franking ratio k of around 80%. Specifically, they state that 83% of dividends are franked, and that the

[37] We use the same debt beta of 0.12 for delevering the US equity betas. Our sensitivity test involves simultaneously changing both the US and Australian debt beta figures to 0.06.

[38] Officer (1994, p.4) defines gamma as the ratio of total tax rebate to total corporate tax paid, which is equivalent to this if we assume a payout ratio of 1.

average franking ratio of these franked dividends is 96%.[39] This implies an overall franking ratio of .83 x 96% + .17 x 0% = 80%.

8.3. Estimating theta

Theta can be estimated in at least two ways: directly, from ATO data, and indirectly by evaluating evidence from capital markets via "dividend drop-off studies." Officer and Hathaway (1999) employ both methods, and in addition we are aware of two other dividend drop-off studies Brown and Clarke (1993), and McKinsey (1994). We summarise the results of these studies in Table 7 below, before discussing the two methods in more detail. Based on these results, we believe q to lie in a range of 50-60%, and use a value of 55% for our calculation.

Table 7: Estimates of imputation credit utilisation factor (q)

Source		Estimate of θ
<u>Using ATO data</u>		
Officer & Hathaway (1999)	[1]	60%
Dividend Drop-off Studies		
Officer & Hathaway (1999)	[2]	60%
Brown and Clarke (1993)	[3]	50%
McKinsey (1994)	[4]	-

Notes:
[2]: the figure of 60% is derived from our interpretation of the results in the Officer & Hathaway study.
[3]: the figure of 50% is derived from our interpretation of the results in the Brown and Clarke study.
[4]: we view the McKinsey study as unreliable.

8.3.1. Estimation from ATO data

Based on ATO data, Hathaway and Officer (1999) estimate a utilisation factor q of around 60%. They use the data to calculate two quantities: the aggregate credits issued, and the aggregate credits redeemed (making adjustments in each case to reflect the tax status of the issuing/redeeming entities). The first quantity represents the theoretical maximum value of the credits, the second can be interpreted as their effective value. The

[39] Officer and Hathaway (1999), p.5. They calculate the 96% average franking ratio from underlying data showing that 92% of franked dividends are fully franked, while 8% are only 50% franked, giving an average of 96%.

two would be equal if q were equal to 1. Their ratio can be interpreted as the actual value of q.

Hathaway and Officer (1999) describe their calculation as follows:[40]

> The redemption of franking credits by *taxable investors* is our overall measure of the redemption value of credits. This fraction is the ratio of the aggregate credits redeemed by taxable individuals, taxable finance companies and superfunds to the aggregate credits issued by taxable companies. If we included credits of non-taxable companies we would certainly be double counting. Most dividends received by non-taxable companies are passed through…
>
> The aggregate redemption (*utilisation*) fraction of imputation credits…has fluctuated [over the period 1990-96] around 60%. On the basis of these data and our assumptions, we estimate the redemption value of credits to average 60% per $1 of issued credit.

Hathaway and Officer also note that their data shows a trend towards increasing utilisation, with a 1996 figure of 70%, but that "some caution must be expressed with this most recent utilisation rate"[41] because it predates recent changes in tax legislation. These changes, which we discuss below, can be expected to lower the utilisation rate.

8.3.2. Estimation from dividend drop-off studies

Dividend drop-off studies attempt to estimate the value of franking credits by comparing the market value of a franked dividend to that of an unfranked dividend. The "market value" of a dividend can be calculated by comparing the price of a share "cum-dividend," *i.e.*, immediately before a dividend is paid out, with its price "ex-dividend," *i.e.*, immediately after the dividend is paid out. The difference between these two prices represents the market value of the franking credits. A simple analogy would be to compare two houses, one with a garage one without, but similar in other respects. The difference between the market value of the house with the garage and the market value of the house without the garage represents the market value of the garage itself. That is, a person considering spending money on a garage will consider the value the garage adds to the overall market value of the house in calculating whether the project is worth while. The market value of a $1 dividend will typically not equal $1, because of differences between the effective tax rates on dividends and on capital gains, and other tax-related reasons including imputation tax issues.

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[40] Officer and Hathaway (1999), p.11.

[41] Hathaway and Officer (1999), p.12.

Since share prices are highly volatile, the method outlined above is applied to large data sets, using the techniques of regression analysis to control for extraneous factors. We have cited above the three Australian dividend drop-off studies we are aware of. We have analysed each study in detail. Appendix 3 of this paper explains how the estimates for the utilisation factor q that we presented in Table 7 above are derived from these studies (or in the case of the McKinsey study, why we chose not to use it to derive an estimate).

8.4. Impact on utilisation of new tax legislation

We note that all three studies cited pre-date the government's introduction of measures aimed at preventing the trading of franking credits, including the 45 day minimum holding period, mentioned above. These measures will undoubtedly reduce the utilisation of franking credits in the future. Consequently, studies based on historical data are likely to overestimate the future value of q.

8.5. Estimated gamma

Combining these figures suggests an estimate for γ of 55% x 80% = 44%. Our analysis above suggests that this is likely to be a conservative estimate (*i.e.*, is likely to underestimate the cost of capital).

8.6. Dividend payout ratio

Our formula (2) for the WACC involves not only the traditional gamma parameter, measuring the value of credits, but also a parameter alpha which measures the dividend payout ratio. We have used an estimate of 70% for this figure, based on a recent IPART finding.[42]

9. Cost of Debt

We have followed recent Australian regulatory practice in determining the cost of debt to be the risk free rate plus a corporate debt premium. Previous studies have suggested a debt premium of 100 to 120 basis points (1.0% to 1.2%).[43] Due to the

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[42] "Australian industrial stocks currently show an average dividend payout ratio of approximately 70 percent," IPART, *The Rate of Return for Electricity Distribution Networks*, Discussion Paper, NSW, Nov 1998, p.22.

[43] IPART used a debt premium of 100 basis points in its *Draft Decision: NSW and ACT Transmission Network Revenue Caps 1999/00-2003-04*, 12 May 1999, p.15. The ACCC used a debt premium of 120 basis points in its *Final Decision: Victorian Gas Transmission Access Arrangements*, 6 October 1998, p.53.

relatively high gearing assumption and recent credit spreads, we have used an estimate of 1.2% for the debt premium. As with inflation, it should be noted that credit spreads have continued to increase quite rapidly in recent weeks and a higher value may be appropriate at the time a determination is made by OffGAR. Therefore we recommend that OffGAR obtain more current data at the time of its draft determination.

10. Inflation Rate

We use an estimate of 2.5 percent, which is consistent with current forecasts in Australia and with yield differentials on indexed and non-indexed government debt.[44] This parameter should be updated as necessary by OffGAR at the time a draft determination is to be made. Inflation forecasts have generally been rising over recent months.

[44] Bond yields are taken from the RBA and *The Economist*. Care should be taken when comparing yields on indexed and non-indexed bonds to account for liquidity differences.

11. Overall Results

Table 8 below summarises our calculation of the WACC, showing the inputs and formulae used.

Table 8: Summary of calculation

Parameter			Value	Source/Derivation	Relevant Part of Report
Equity Beta					
Asset beta	[1]		0.58	Derived from US pipeline data	7.1, 7.2 & App 2
Debt beta	[2]		0.12	ORG	7.4
Gearing Ratio	[3]		55%	IPART	4.5
Equity beta	[4]	*See Note*	**1.15**	**Delevering formula:** $\beta_E = \beta_A + (\beta_A - \beta_D) \times (D/E)$	7.2
Cost of Equity					
Risk free rate	[5]		6.4%	Current yield on 10-year bonds	5
Market risk premium	[6]		6.5%	Historical estimates give range 6-8%	6
Cost of Equity	[7]	[5]+[4]x[6]	**13.9%**	**CAPM:** $r_E = r_F + \beta_E \times MRP$	
Cost of Debt					
Risk free rate	[8]		6.4%	Current yield on 10-year bonds	5
Corporate Debt Premium	[9]		1.2%	Recent IPART and ACCC decisions	9
Cost of debt	[10]	[8]+[9]	**7.6%**		
After-tax Nominal WACC					
Company tax rate	[11]		36%	ATO	4.4.3
Payout ratio (α)	[12]		70%	IPART	8.6
Franking ratio (k)	[13]		80%	ATO data	8.2
Utilisation ratio (θ)	[14]		55%	ATO data + dividend drop-off studies	8.3
Value of credits (γ)	[15]	[13]x[14]	44%	$\gamma = k \times \theta$	8.5
After-tax Nominal WACC	[16]	*See Note*	**8.01%**	**"Officer formula": WACC =** $(E/V)R_E(1-T_C)/(1-(1-\alpha\gamma)T_C) + (D/V)R_D(1-T_C)$	4.2 & App 1
Pre-tax Real WACC					
Inflation	[17]		2.5%	yield differentials on indexed & non-indexed bonds	10
Fisher after-tax real WACC	[18]	(1+[16])/(1+[17])-1	5.37%	Fisher formula	4.4
Myers et al after-tax real WACC	[19]	[18]x(1+[17])	5.51%	Adjusts to account for timelag between BOY calculation of real return and EOY realisation	4.4
Pretax real WACC	[20]	[19]/(1-[11])	**8.60%**		4.4

Notes:
[4]: [1]+([1]-[2]) x ([3])/(1-[3])
[16]: (1-[3]) x [7] x (1-[11])/(1-(1-[12] x [15]) x [11]) + [3] x [10] x (1-[11])

Table 9 shows the sensitivity of our estimate to changes in the underlying assumptions, by varying the market risk premium, assumed gearing, value of gamma, and the debt beta.

Table 9: Estimated pre-tax real WACC

Base Case	[1]	**8.60%**
Alternative Scenarios		
Market Risk Premium = 6.0%	[2]	**8.26%**
Market Risk Premium = 7.0%	[3]	**8.95%**
Gearing = 50%	[4]	**8.70%**
Gearing = 60%	[5]	**8.50%**
Gamma = 40%	[6]	**8.71%**
Debt Beta = 0.06	[7]	**8.89%**