

THE COST OF CAPITAL
FOR THE
DAMPIER TO BUNBURY NATURAL GAS PIPELINE:
APPENDICES
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Epic Energy

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Appendix 1. Derivation of WACC formula

This appendix show how to derive the WACC formula given in the main report. The pre-tax return to shareholders can be defined in two ways: as the “standard return” consisting of capital gains and cash dividends but excluding franking credits (denoted \hat{R}_E), or as the “grossed-up return” return consisting of capital gains, cash dividends *and* franking credits (denoted R_E). In principle the WACC can be calculated correctly using either a formula based on R_E or one based on \hat{R}_E .

The idea behind the derivation we give here is that the after-tax return to shareholders can itself be measured in two ways, corresponding to the two definitions of the pre-investor-level-tax return. The calculated after-tax return should be the same whether it is measured by applying the “effective tax rate on grossed up returns” to R_E , or the “effective tax rate on standard returns” to \hat{R}_E . The derivation uses this fact to transform the standard WACC formula, which gives the WACC in terms of \hat{R}_E , into the one used in the report, which gives the WACC in terms of R_E .

We therefore begin with the “standard formula”:

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

where:

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.

The standard and grossed-up returns are related by:

$$(1 - T_{PE}) \hat{R}_E = (1 - T_{PEG}) R_E \quad (A.2)$$

where T_{PE} and T_{PEG} are the effective tax rates on, respectively, standard and grossed-up equity returns, so that:

$$\hat{R}_E = \frac{(1 - T_{PEG})}{(1 - T_{PE})} R_E \quad (A.3)$$

The new WACC expression is therefore given by substituting (A.3) into (A.1), after first finding an explicit expression for the ratio $(1 - T_{PEG})/(1 - T_{PE})$.

1.1. The effective tax rate on standard equity returns

A \$1 cash dividend with franking ratio k gives rise, for tax-liable investors, to a “grossed-up dividend” of:

$$\frac{k}{1 - T_C} + 1 - k \quad (\text{A.4})$$

and a tax payment, net of credits, of:

$$T_{PED} \left(\frac{k}{1 - T_C} + 1 - k \right) - \frac{kT_C}{1 - T_C} \quad (\text{A.5})$$

where T_{PED} is the tax rate on dividend income. This gives the investor an after-tax cash flow of:

$$(1 - T_{PED}) \left(1 + \frac{kT_C}{1 - T_C} \right) \quad (\text{A.6})$$

Let \mathbf{q} denote the proportion of dividends paid out to tax-liable investors. The average after personal tax cash flow from a \$1 cash dividend is then given by:

$$\begin{aligned} & \mathbf{q} (1 - T_{PED}) \left(1 + \frac{kT_C}{1 - T_C} \right) + (1 - \mathbf{q})(1 - T_{PED}) \\ &= (1 - T_{PED}) \left(1 + \frac{\mathbf{g}T_C}{1 - T_C} \right) \end{aligned} \quad (\text{A.7})$$

where $\mathbf{g} = \mathbf{q}k$.

The effective tax rate on equity T_{PE} is therefore given by:

$$(1 - T_{PE}) = \mathbf{a} (1 - T_{PED}) \frac{(1 - (1 - \mathbf{g})T_C)}{1 - T_C} + (1 - \mathbf{a})(1 - T_{PEC}) \quad (\text{A.8})$$

where T_{PEC} is the tax rate on capital gains.

1.2. The effective tax rate on grossed-up equity returns

A \$1 return (cash dividend plus capital gain) produces \$ a in dividends, \$ $agT_C/(1-T_C)$ in franking credits that will be utilised, and \$(1- a) in capital gains. The first two of these are taxed at rate T_{PED} , the last at rate T_{PEC} . Note that utilised franking credits are in effect taxed at the same rate as dividends. This is because when a taxpayer uses a credit they have to pay personal tax on the grossed up dividend, which is equal to the cash dividend plus the value of the franking credit.

It follows that a proportion:

$$\begin{aligned} & \left(a + \frac{agT_C}{1-T_C} \right) / \left(a + \frac{agT_C}{1-T_C} + 1-a \right) \\ &= a \frac{(1-(1-g)T_C)}{(1-(1-ag)T_C)} \end{aligned} \quad (A.9)$$

of each \$1 of grossed-up return consists of dividends and franking credits, taxable at T_{PED} , while the remainder consists of capital gains, taxable at T_{PEC} . The effective tax rate on grossed-up returns, T_{PEG} , is therefore given by:

$$\begin{aligned} (1-T_{PEG}) &= \left(\frac{a(1-(1-g)T_C)}{1-(1-ag)T_C} \right) (1-T_{PED}) + \left(1 - \frac{a(1-(1-g)T_C)}{1-(1-ag)T_C} \right) (1-T_{PEC}) \\ &= \left(\frac{a(1-(1-g)T_C)}{1-(1-ag)T_C} \right) (1-T_{PED}) + \left(\frac{(1-a)(1-T_C)}{1-(1-ag)T_C} \right) (1-T_{PEC}) \\ &= \frac{(1-T_C)}{(1-(1-ag)T_C)} (1-T_{PE}) \end{aligned} \quad (A.10)$$

1.3. Transforming required return to required grossed-up return

Substituting (A.8) and (A.10) into (A.3) gives:

$$\begin{aligned}
 (1-T_{PEG}) &= \left(\frac{\mathbf{a}(1-(1-\mathbf{g})T_C)}{1-(1-\mathbf{ag})T_C} \right) (1-T_{PED}) + \left(1 - \frac{\mathbf{a}(1-(1-\mathbf{g})T_C)}{1-(1-\mathbf{ag})T_C} \right) (1-T_{PEC}) \\
 &= \left(\frac{\mathbf{a}(1-(1-\mathbf{g})T_C)}{1-(1-\mathbf{ag})T_C} \right) (1-T_{PED}) + \left(\frac{(1-\mathbf{a})(1-T_C)}{1-(1-\mathbf{ag})T_C} \right) (1-T_{PEC}) \quad (\text{A.11}) \\
 &= \frac{(1-T_C)}{(1-(1-\mathbf{ag})T_C)} (1-T_{PE})
 \end{aligned}$$

and substituting into (A.1) we have:

$$WACC = \left(\frac{E}{V_L} \right) \frac{(1-T_C)}{(1-(1-\mathbf{ag})T_C)} R_E + \left(\frac{D}{V_L} \right) R_D (1-T_C) \quad (\text{A.12})$$

1.4. Conclusion

The WACC can be calculated using either of two formulae. The standard formula, which gives the WACC in terms of the “standard” return to equity, is:

$$WACC = \left(\frac{E}{V_L} \right) \hat{R}_E + \left(\frac{D}{V_L} \right) R_D (1-T_C) \quad (\text{A.13})$$

The alternative formula considers the “grossed-up” return, and can be stated as:

$$WACC = \left(\frac{E}{V_L} \right) \frac{(1-T_C)}{(1-(1-\mathbf{ag})T_C)} R_E + \left(\frac{D}{V_L} \right) R_D (1-T_C) \quad (\text{A.14})$$

Appendix 2. US ASX-Weighted Index.

The “US ASX-Weighted Index” is a weighted sum of indices representing diverse sectors of the US economy. The sectors and weights used were chosen so as to mirror as closely as possible the composition of the Australian equity market, as measured by an index created by the Australian Graduate School of Management’s Centre for Research in Finance Risk Measurement Service (RMS). The RMS covers all publicly traded shares in Australia, dividing the market into twenty-nine industry sectors. Weights for these sectors were calculated using year-end market capitalisation data for the years 1993 to 1998.¹

2.1. Mapping Australian to US industry sectors

The first step in the construction of the index was to choose a corresponding US sector for each of the 29 sectors that make up the RMS index. We selected the US sectors from the very large set of US industry sectors for which Standard & Poors (S&P) publishes a sectoral index. In some cases we used more than one US sector index for one Australian sector, because some of the Australian indices are broader categories than the S&P’s. For example, the Diversified Resources sector in Australia is mapped to the Aluminium, Iron & Steel, and Metals Mining sectors in the US. Likewise, some of the American indices encompassed more than one Australian sector. For example the S&P 500 Energy index covers Solid fuels, Oil and gas, and Energy in Australia. The mapping used is shown in column 1 of Table A1 (shown at the end of this appendix). Because the choice of mapping involved some elements of judgement, we also defined alternative mappings, shown in columns 2 to 4 of Table A1, and recalculated our results as a test of the sensitivity of the results to our choice of mapping. Our results turned out to be insensitive to the use of the alternative mappings.

2.2. Calculating the index

Having selected the US indices, we used monthly price data for each such index (obtained from S&P’s Compustat data service)² to calculate monthly return series for each sector.

We then define the “US ASX Weighted Index” return for each time period as the weighted average of the sectoral returns:

¹ Calculated as the product of calendar year close price and the number of fully paid shares.

² S&P’s Compustat data services did not provide data for real estate investment trusts. An index provided by the National Association of Real Estate Investment Trusts was used instead.

$$\sum_{i=1}^{24} R_{t,i} w_{t,i} \quad (\text{A.15})$$

where:

$R_{t,i} = (P_{t,i} - P_{t-1,i}) / P_{t-1,i}$, the period t return on the US market sector(s) corresponding to Australian industry sector i.

$P_{t,i}$ = the period t price on the US market sector(s) corresponding to Australian industry sector i.

$w_{t,i}$ = weight for Australian industry sector i.

The result is a monthly market returns index, using US returns data but re-weighted to reflect approximately the structure of the Australian market.

Equity betas were then calculated for the five US gas pipeline companies in the sample. We ran regressions of the monthly returns on the US ASX Weighted Index, minus the risk free return,³ against the monthly returns of the gas pipeline companies,⁴ again minus the risk free return. The results are shown in table A2. The sensitivity tests described above (using alternative mappings as shown in Table A1) produced no significant changes in the results.

Table A2: Beta Calculations

	Industry Mappings			
	1	2	3	4
Coastal	1.00	1.00	0.98	1.01
El Paso	0.85	0.87	0.85	0.87
Enron	0.93	0.92	0.91	0.91
Sonat	0.59	0.63	0.63	0.62
Williams	0.88	0.87	0.84	0.87
Average	0.85	0.86	0.84	0.86

Notes:

Industry mappings shown in Table A1.

Weighted returns are calculated using weights at the end of the previous year.

³ US 30 day T-Bill total returns as reported by Ibbotson Associates.

⁴ obtained from S&P's Compustat data service.

Table A3: Estimated asset betas of US pipelines

Equity Beta (relative to US-ASX- Company Weighted Index)			
Company	Weighted Index	D/V	Asset Beta
Our cost of capital analysis uses an estimate for the DBNGP asset beta derived from this analysis. We apply the delevering methodology described in the paper to the equity betas shown in Table A2 (column 1), to obtain estimated “ASX-Weighted” asset betas for each of the pipelines, as shown in Table A3 below. We then take the average of these asset betas, 0.58, as our estimate for the asset beta of the DBNGP.			
El Paso	0.85	47%	0.50
Enron	0.93	26%	0.72
Sonata	0.59	28%	0.46
Williams	0.88	35%	0.61
Average	0.85	36%	0.58

Table A1: Mapping of Australian and American Sectors

Australian Sector	American Sectors			
	1	2	3	4
<i>Gold</i>	Gold and precious metal mining - 500	Gold and precious metal mining - 500	Gold and precious metal mining - 500	Gold and precious metal mining - 500
<i>Other metals + Diversified resources</i>	Aluminium - 500	Aluminium - 500	Aluminium - 500	Iron and steel - 500
	Iron and steel - 500	Iron and steel - 500	Metals mining - 500	Metals mining - 500
	Metals mining - 500	Metals mining - 500		
<i>Solid fuels + Oil and gas + Energy</i>	Energy - 500	Energy - 500	Energy - 500	Energy - 500
<i>Developers and contractors</i>	Homebuilding - 500	Aluminium - 500	Aluminium - 500	Iron and steel - 500
		Iron and steel - 500	Metals mining - 500	Metals mining - 500
		Metals mining - 500		
<i>Building materials</i>	Building materials - 500	Building materials - 500	Building materials - 500	Building materials - 500
<i>Alcohol and tobacco</i>	Beverages (alcoholic) - 500	Beverages (alcoholic) - 500	Beverages (alcoholic) - 500	Beverages (alcoholic) - 500
	Tobacco - 500	Tobacco - 500	Tobacco - 500	Tobacco - 500
<i>Food and household goods</i>	Beverages (non-alcoholic) - 500	Beverages (non-alcoholic) - 500	Beverages (non-alcoholic) - 500	Beverages (non-alcoholic) - 500
	Foods - 500	Foods - 500	Foods - 500	Foods - 500
	Household products (non-durable) - 500	Household products (non-durable) - 500	Household products (non-durable) - 500	Household products (non-durable) - 500
	Housewares - 500	Housewares - 500	Housewares - 500	Housewares - 500
<i>Chemicals</i>	Chemicals composite	Chemicals composite	Chemicals composite	Chemicals composite
<i>Engineering</i>	Engineering and construction - 500	Engineering and construction - 500	Engineering and construction - 500	Engineering and construction - 500
<i>Paper and packaging</i>	Containers and package (ppr) - 500	Containers and package (ppr) - 500	Containers and package (ppr) - 500	Containers and package (ppr) - 500
	Paper and forest products - 500	Paper and forest products - 500	Paper and forest products - 500	Paper and forest products - 500
<i>Retail</i>	Retail composite	Retail composite	Retail composite	Retail composite
<i>Transport + BAA plc in 1995</i>	S&P transportation	S&P transportation	S&P transportation	S&P transportation
<i>Media</i>	Publishing (newspaper) - 500	Publishing (newspaper) - 500	Publishing (newspaper) - 500	Publishing (newspaper) - 500
	Broadcasting (tv, radio, cable) - 500	Broadcasting (tv, radio, cable) - 500	Broadcasting (tv, radio, cable) - 500	Broadcasting (tv, radio, cable) - 500
<i>Banks + Banks and finance</i>	Banks composite	Banks composite	Banks composite	Banks composite
<i>Insurance</i>	Insurance composite	Insurance composite	Insurance composite	Insurance composite
<i>Entrepreneurial investors</i>	S&P 500 comp - ltd	S&P 500 comp - ltd	S&P 500 comp - ltd	S&P 500 comp - ltd
<i>Investment and financial services</i>	Financial (diversified) - 500	Financial (diversified) - 500	Financial (diversified) - 500	Financial (diversified) - 500
<i>Property trusts</i>	Real estate investment trusts composite	Real estate investment trusts composite	Real estate investment trusts composite	Real estate investment trusts composite
<i>Miscellaneous services - BAA plc in 1995</i>	Health care (medical products and supplies)	Health care (medical products and supplies)	Health care (medical products and supplies)	Health care (medical products and supplies)
	Natural gas - 500	Natural gas - 500	Natural gas - 500	Natural gas - 500
	Oil and gas (refining and marketing)	Oil and gas (refining and marketing)	Oil and gas (refining and marketing)	Oil and gas (refining and marketing)
	Retail (general merchandise)	Retail (general merchandise)	Retail (general merchandise)	Retail (general merchandise)
	Service (commercial and consumer)	Service (commercial and consumer)	Service (commercial and consumer)	Service (commercial and consumer)
	Telecom (long distance) - 500	Telecom (long distance) - 500	Telecom (long distance) - 500	Telecom (long distance) - 500
	Telephone - 500	Telephone - 500	Telephone - 500	Telephone - 500
	Waste management - 500	Waste management - 500	Waste management - 500	Waste management - 500
<i>Miscellaneous industrials + Diversified industrials</i>	S&P industrials - ltd	S&P industrials - ltd	S&P industrials - ltd	S&P industrials - ltd
<i>Tourism and leisure</i>	Leisure time (products)	Leisure time (products)	Leisure time (products)	Leisure time (products)
	Lodging - hotels - 500	Lodging - hotels - 500	Lodging - hotels - 500	Lodging - hotels - 500
<i>Infrastructure and utilities</i>	S&P utilities	S&P utilities	S&P utilities	S&P utilities
<i>Telecommunications</i>	Telecom (long distance) - 500	Telecom (long distance) - 500	Telecom (long distance) - 500	Telecom (long distance) - 500
	Telephone - 500	Telephone - 500	Telephone - 500	Telephone - 500
<i>Healthcare & biotechnology</i>	Biotechnology - 500	Biotechnology - 500	Biotechnology - 500	Biotechnology - 500
	Healthcare - 500	Healthcare - 500	Healthcare - 500	Healthcare - 500

Note: For each Australian sector the weighting is evenly divided between the identified American sectors, except *Miscellaneous services* where weighting depends upon the nature of the companies in the sector in any given year.

Appendix 3. Estimation of the utilisation factor q .

This appendix explains how the various Australian studies cited in our report (Brown and Clarke (1993), Hathaway and Officer (1999) and McKinsey (1994)) are used to derive estimates of the franking credit “utilisation factor” q . Section 3.1 presents a brief explanation of the “direct” method used by Hathaway and Officer (1999). The remaining sections explain the dividend drop-off methodology, and how we derive estimates from two of the Australian dividend drop-off studies. Section 3.2 derives a standard equilibrium condition relating changes in share price before and after the payment of a dividend to the value of the dividend. The derivation follows Brown and Clarke (1993) except for notation. We then show how this condition can be used in conjunction with a dividend drop-off regression to provide estimates of q (section 3.3), and apply the method to the Brown and Clarke (1993) study (section 3.4) and the Hathaway and Officer study (1999). Finally, section 3.6 explains why we consider the results of the McKinsey (1994) from study to be unreliable.

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 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:⁵

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.

⁵ Officer and Hathaway (1999), p.11.

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”⁶ because it predates recent changes in tax legislation. These changes (which we discuss in the main body of this paper) can be expected to lower the utilisation rate.

3.2. *Equilibrium Condition*

The basis for dividend drop off studies is an equilibrium condition which says that investors should be indifferent between selling a share on the cum-dividend day and on the ex-dividend day. The capital gain from selling cum-dividend rather than ex-dividend should (on an after-tax basis) balance out the value of the dividend.

Using the notation established in Appendix 1, the capital gain from selling cum-dividend rather than ex-dividend, calculated on an after-tax basis, is given by

$$(1 - T_{PEC}) \Delta P \quad (\text{A.16})$$

where ΔP is the difference between the cum-dividend and ex-dividend prices. The value of the dividend, also calculated on an after-tax basis, and taking into account the imputation system, is given by:

$$(1 - T_{PED}) D \left(1 + \frac{qkT_C}{1 - T_C} \right) \quad (\text{A.17})$$

where D is the cash dividend. Equating these two expressions gives the equilibrium condition:

$$(1 - T_{PEC}) \Delta P = (1 - T_{PED}) D \left(1 + \frac{qkT_C}{1 - T_C} \right) \quad (\text{A.18})$$

which multiplies out to give:

$$\frac{\Delta P}{D} = \left(\frac{1 - T_{PED}}{1 - T_{PEC}} \right) + \left(\frac{1 - T_{PED}}{1 - T_{PEC}} \right) \frac{qT_C}{1 - T_C} . k \quad (\text{A.19})$$

⁶ Hathaway and Officer (1999), p.12.

This last expression is the fundamental equation linking the “drop-off ratio” $\Delta P/D$ to the franking ratio k .

3.3. Interpreting Regressions of Drop-off Ratio against Franking Ratio

Because of the linearity of (A.19), it has the form of a simple regression of the drop-off ratio against the franking ratio. Its two coefficient terms can therefore be estimated by such a regression. If we estimate a regression of the form:

$$(\Delta P/D)_i = a + bk_i + e_i \quad (\text{A.20})$$

then the constant term a should provide an estimate of the constant term in (A.19):

$$\frac{(1-T_{PED})}{(1-T_{PEC})} \quad (\text{A.21})$$

while the slope b should estimate the coefficient on k :

$$\frac{(1-T_{PED})}{(1-T_{PEC})} \frac{qT_C}{(1-T_C)} \quad (\text{A.22})$$

We can therefore use the ratio b/a to estimate $qT_C/(1-T_C)$, and so use:

$$\frac{b(1-T_C)}{aT_C} \quad (\text{A.23})$$

to estimate q .⁷

3.4. Officer and Hathaway (1999) Regression Results

Officer and Hathaway (1999) perform the regression in (A.20) above using data from 1985 to 1995.⁸ Table A4 below shows their regression results and our estimates of q , derived by calculating the ratio in (A.23) from their results. The relevant company tax rate is that which applied during the time period covered by the dataset: our analysis therefore uses a 39% rate of company tax, as do Hathaway and Officer.

⁷ Note that, in statistical terminology, this is a “consistent estimator.”

⁸ Their equation (3) is the same as our (A.20), except for notation: they use f for the franking ratio, which we denote k .

Table A4: Estimates of theta derived from Officer & Hathaway (1999)

		[1]	[2]	[3]	[4]
		a	b	N	Estimated θ
Sector	Industrials	0.80	0.31	456	61%
		(-6.23)	(-2.11)		
	Resources	0.72	0.28	183	61%
		(-3.71)	(-1.13)		
	All stocks	0.77	0.31	639	63%
		(-7.23)	(-2.48)		

Notes and sources:

Data set is restricted to stocks with market capitalisation greater than \$500mn.

[1]-[3]: taken from Officer & Hathaway (1999), Table 1 (p.15). Numbers in brackets are (presumably) t-statistics.

[4]: estimate uses the data in columns [1] and [2], together with the formula derived in this appendix: estimated $\theta = (1 - T_c) \times [2] / (T_c \times [1])$. We use a company tax rate T_c of 39% (since the data set covers the period 1/1/85 - 30/6/95).

As well as breaking down their data set by sector (industrials, resources, and all stocks) Officer and Hathaway estimate regressions broken down by company size. The results shown above come from a regression using only data from “Big Stocks,” *i.e.*, those with market capitalisation greater than \$500m. The corresponding results for “Small Stocks,” *i.e.*, those with market capitalisation less than \$500m, seem unreliable, producing wildly different estimates of q for different sectors (20% for industrials, 128% for resources). We agree with Hathaway and Officer that “the results for the Small Stocks appear erratic which in turn affects the results for All Stocks.”⁹ It seems reasonable to discard these as unreliable, and use instead the figures for the Big Stocks only, as shown in Table A4 above, giving an estimated value for q of just over 60%.

Finally, we note that Officer and Hathaway themselves calculate a different ratio. In our notation, they calculate:

$$\frac{b(1 - T_c)}{T_c} \quad (\text{A.24})$$

Examining equation (A.19) above, we see that this latter ratio provides an estimate of:

⁹ Officer and Hathaway (1999), p.15. The regressions using all stocks give estimates of q of 36% for industrials and 100% for resources.

$$\frac{(1-T_{PED})q}{(1-T_{PEC})} \quad (\text{A.25})$$

which represents the relative after-tax value of \$1 of franking credit to \$1 of capital gain. It is a valid estimate of q itself only if one assumes equal *effective* tax rates on dividends and capital gains. Although dividends and capital gains attract the same (top) marginal tax rates, the effective tax rate on capital gains is lower, because the tax is deferred until the capital gain is realised.¹⁰

3.5. Brown and Clarke (1993) Regression Results

Brown and Clarke follow a very similar approach. Starting with equation (A.18) they divide by the (cum-dividend) price P and multiply out the right-hand side to get:

$$\begin{aligned} \frac{\Delta P}{P} &= \left(\frac{1-T_{PED}}{1-T_{PEC}} \right) \cdot \frac{D}{P} + \left(\frac{1-T_{PED}}{1-T_{PEC}} \right) \frac{qT_C}{1-T_C} \cdot \frac{kD}{P} \\ &= \left(\frac{1-T_{PED}}{1-T_{PEC}} \right) \cdot \frac{D}{P} + \left(\frac{1-T_{PED}}{1-T_{PEC}} \right) q \cdot \frac{F}{P} \end{aligned} \quad (\text{A.26})$$

where:

$$F = \frac{kDT_C}{(1-T_C)} \quad (\text{A.27})$$

is the amount of franking credit attached to the declared dividend.¹¹ They therefore estimate a regression of the form:

$$\left(\frac{\Delta P}{P} \right)_i = a_1 + a_2 \left(\frac{D}{P} \right)_i + a_3 \left(\frac{F}{P} \right)_i + e_i \quad (\text{A.28})$$

¹⁰ Brown and Clarke (1993) estimate the effective capital gains tax, assuming that “the buyer contemplates holding the shares for five years and discounts his future capital gains tax at 10% per annum, which includes a 5% allowance for inflation.” (p. 15). If we apply this to the current top income tax rate of 47%, the implied effective tax rate on capital gains is given by $47\% \times (1.05)^5 / (1.10)^5 = 37\%$, significantly lower than the 47%, which applies to dividends.

¹¹ See Brown and Clarke equation (18), and their footnote 17 for the definition of the franking credit.

Specifically, their equation (18) is this regression with some additional explanatory variables: they add dummies for different time periods, and one to control for the effect of the October 1987 Crash.¹² Dividend imputation was first introduced in Australia on July 1, 1987, and its scope extended to superannuation funds from July 1, 1988. Consequently, results from their time periods T3 (defined as 1/7/87-24/5/88), T5 (1/7/88-30/6/89) and T6 (1/7/89-30/6/91) are all potentially of interest.¹³

In principle, estimating a regression like that in (A.28) over any of those time periods, and calculating the ratio a_3/a_2 , ought to provide an estimate of q . However, results from a regression run over the combined period T3/T5 give an implausibly low estimate, and similarly for a regression run over the combined period T5/T6.¹⁴ Moreover, the estimate for a_3 is not statistically significant (at standard significance levels) in those regressions. We take a conservative approach by ignoring the very low estimates from earlier time periods,¹⁵ and instead use only the regression covering period T6.¹⁶ They perform this regression with and without a dummy for outliers. The results are given in Table A5 below.

Table A5: Estimates of theta derived from Brown and Clarke (1993)

Equation estimated	a_2	a_3	Estimated θ (a_3/a_2)
$\Delta P/P = a_1 + a_2(D/P) + a_3(F/P)$	0.8798	0.4584	52%
Above plus dummy for outliers	0.8934	0.4544	51%

Source: Table 7 of Brown and Clarke (1993).

¹² They also use “market-adjusted beginning prices” to control for price changes unrelated to the payment of a dividend.

¹³ The corporate tax rate, and hence the dividend franking rate, changed from 49% to 39% between T5 and T6.

¹⁴ Using the coefficient estimates in their Table 6, we get a range of values for a_3/a_2 from .056 to .081. Both regressions include dummies for the second of the two periods. Brown and Clarke also run a regression pooling the data from T3 and T5, with similar results (a_3 is not statistically significant, and the a_3/a_2 ratio is between .104 and .114).

¹⁵ The weak results may be due to a time-lag in corporate use of imputation credits following their introduction, or in markets’ valuation of the credits.

¹⁶ The last regression given in their Table 7.

Thus, based on Brown and Clarke’s study, a reasonable conservative estimate for q is about 50%.

3.6. McKinsey (1994) Regression Results

McKinsey (1994) performs regression analysis along the same lines as that suggested by expression (A.28) above.¹⁷ However, they obtain unusually large values for the a_3/a_2 ratio. Specifically, almost all of their regressions give an estimated ratio that is greater than 1.¹⁸ In particular, the regression they use for their “final” results (*i.e.*, the results quoted in the main body of the report), which focuses on the later years of their dataset (1/7/90 to 30/6/93), gives a ratio of 68.5/61.8, or 111%.¹⁹ This has the counter-intuitive implication that *taxpayers value credits more highly than cash*.

This implication can be seen very clearly in the example given in their Exhibit 4. In that example, which is based on the regression results, an unfranked \$1 dividend is attributed a market value of \$0.62, *i.e.*, 62% of its “face value.” A franked dividend, whose total face value is \$1.64, has a market value of \$1.06, \$0.44 higher than the unfranked dividend.²⁰ Since the franking adds an extra \$0.64 to the face value of the dividend, and increases the market value by \$0.44, it appears that the franking credit is valued at $44/64 = 68\%$ of face value, more than the 62% valuation placed on the cash dividend. Note that the cash dividend and the franking credit both attract the same levels of personal tax.

Given the implausible implications of the McKinsey study, we do not use it in estimating q .

¹⁷ The regression equation given on p.26 of the McKinsey study is the same, except for notation, as equation (A.28) above, and the note to their Exhibit 4 (p. 12) seems to confirm that they define the “face value of franking credits” in the same way as our expression (A.27).

¹⁸ Exhibit 14 of the McKinsey study reports 16 regressions, of which twelve have a ratio greater than 1.

¹⁹ The regression also applies a series of “filters” to the dataset to remove outliers etc, and adjusts prices for market movement.

²⁰ The franking credit is worth an extra $T_C/(1-T_C)$, and the relevant company tax rate was 39%, giving $.39/.61 = \$0.64$ value.

3.7. Conclusion

Based on both dividend drop-off studies and estimation from ATO data, a reasonable estimate of the utilisation factor q is in the range of 50-60%. We use the mid-point value of this range, 55%.