25 July 2006

Assessment of Elements of APT's DORC Calculations for RBP

A report for the ACCC

NERA
Economic Consulting

Marsh & McLennan Companies

Project Team

Tom Hird (Ph.D.)

NERA Economic Consulting
Level 16
33 Exhibition Street
Melbourne 3000
Tel: +61 3 9245 5537
Fax: +61 3 9245 5123
www.nera.com

Contents

Summary of Conclusions

APT's proposed DORC valuation contains a number of material deficiencies and errors - all of which tend to result in an over-estimate of the correct DORC value. The identified deficiencies include:

1. Future costs are discounted at an inappropriately high rate.
2. Inadequate account is taken of different service levels between the existing and the hypothetically new pipeline.
3. The proposed averaging of asset lives on the existing pipeline under-estimates the present value of future replacement costs (and leads to an over-estimate of DORC).
4. The cost of tax is incorrectly modelled.

1. Introduction

NERA has been asked by the ACCC to advise on modelling assumptions adopted by APT, and their consultants CRA, in modelling the DORC value for the RBP pipeline. The remainder of this report has the following structure:

- Section 2 examines APT's approach to discounting future costs;
- Section 3 examines the impact on DORC of differences in optimal service levels between new and existing pipeline;
- Section 4 examines APT's approach to averaging of asset lives on the existing pipeline;
- Section 5 examines APT's approach to modelling tax costs; and
- Section 6 provides a summary of our conclusions.

2. Discounting Future Costs

2.1. APT's approach

CRA's modelling for APT discounts all future *costs* using the discount rate that APT proposes is applied to its *profits* (EBIT) in its Access Arrangement for RBP. CRA's only justification for using a *profit* discount rate to discount *costs* is given on page 12 of its report[1]:

> *"We have applied a discount rate in the net present value calculations which is equal to the real pre-tax WACC of 6.90%. The ICB for the MSP that was approved by the Australian Competition Tribunal was also calculated on the basis of a discount rate derived from the pipeline's regulatory WACC."*

From this we understand that CRA is arguing that the Australian Competition Tribunal's MSP decision provides some sort of precedential value that justifies the use of the regulatory WACC in the current circumstance. It is conceivable that this is true in a legal sense, however, it is unusual for economists to rely on legal precedent to settle matters of economic theory and facts.

NERA has been asked to provide an economic assessment of CRA's modeling rather than a legal assessment. As such, we consider that the absence of economic theory or facts to justify this critical assumption to be a serious shortcoming in CRA's report.

Moreover, it is our understanding that the Australian Competition Tribunal did **not** even establish a legal precedent on the appropriate discount rate to be used in the context of estimating economic DORC. CRA also appears to acknowledge this in footnote 22 to Appendix A to their report:

> *"The Tribunal noted in its judgment on the MSP that its decision regarding the HNETmethod in that case did not necessarily establish a precedent for other cases"*

2.2. The correct approach

The pre-tax WACC is the discount rate that is applied to profits. It is wrong to presume that the discount rate applied to profits should also be applied to costs. It is well established in the finance literature, both theoretical and empirical, that the correct discount to be applied to costs will generally be much lower than the discount rate applied to profits.

The intuitive explanation is that the existence of fixed costs makes profits much more volatile than either revenues or costs. For example, imagine a firm expects to have $100 in revenues and $95 of costs - giving it $5 in expected profits. Now, instead imagine that sales revenues were 10% higher than expected and costs were 5% higher than expected (reflecting the fact that some costs are fixed). In this scenario, profits are $10.25 ($110-$99.75) which represents a 105% more than expected (despite revenues and costs being only 10% and 5% higher respectively). This higher volatility of profits than revenues/costs is termed "operating

1 CRA, *Roma - Brisbane pipeline: DORC Asset Valuation*, February 2006.

leverage" in the finance literature. Operating leverage describes the fact that, because many costs are fixed irrespective of sales volumes, costs move less than proportionally with sales with the effect that profits are considerably more volatile than both.

Brealey, Cooper and Habib[2], estimate that the systematic risk exposure of post-tax profits is about twenty times greater than that of costs and that, in general, the discount rate for costs should be little more than the risk-free rate.

> *"Preliminary estimates of these accounting betas for a sample of UK firms suggest that the beta of after-tax profits is about ten times that of revenues and twenty times that of trading expenses. Although these estimates have substantial standard errors, they nevertheless suggest that the average discount rate for costs should be little more than the risk-free rate of interest."*

Luehrman[3] describes discounting future costs at the same discount rate as profits as a 'common mistake' of finance students:

> "*The DCF valuation contains a common mistake. It discounted the discretionary spending in year 3 at the same 12% risk-adjusted rate that had already been applied to the project's cash flows. That rate is almost certainly too high because such expenditures are rarely subject to the same operating and product-market forces that make the project's cash flows risky. Construction costs, for example, may be uncertain, but they are usually much more dependent on engineering factors, weather conditions, and contractors' performance than on customers' tastes, competitive conditions, industry capacity utilization, and such."*

For these reasons, Leurman argues that the correct discount rate to apply to future costs is the risk-free rate that can be earned on Treasury bonds:

> *"To see the magnitude of this effect, discount the year 3 expenditures of $382 million at 5.5% instead of 12% (again, it's as if we were putting investment funds into treasury bonds between now and year 3)."* (Emphasis added.)

Luehrman's 'common mistake' is common because practitioners are generally interested in the value of a future profit stream (revenues less costs) rather than future costs *per se*. An example where this is not the case is the valuation of future costs to insurers. A large proportion of insurer's costs are future insurance claims. Accounting standards for the discounting of these future costs provide relevant precedent for the appropriate discounting of other costs. The relevant Australian accounting standard is AASB 1023 which states:

> *"Outstanding claims liabilities are discounted for the time value of money using risk-free rates that are current observable, objective rates that relate to the nature, structure and term of the outstanding claims liabilities."*

---

2 Brealey, Cooper and Habib, Oxford Review of Economic Policy, p.24

3 Luehrman, Timothy "Investment Opportunities as Real Options: Getting Started on the Numbers", in Harvard Business Review, July-August 1998.

The reasoning behind this standard can be found in the work of the International Accounting Standards Board (IASB) and its predecessor (the IASC) and is entirely consistent with the above discussion. In 2001 the IASC developed a Draft Statement of Principles (DSOP)which took the view that the appropriate discount rate was the risk-free rate. In reaching this conclusion it made a number of relevant statements including in relation to why a firm's future costs **should not be** discounted by the firm's cost of capital (WACC).

> *"This DSOP takes the view that the discount rate for a liability should reflect the characteristics of that liability, not the characteristics of some other instrument with different features. Accordingly, this DSOP does not permit a discount rate for insurance liabilities based on any of the following:*
>
> *(a) an insurer's incremental borrowing rate…*
>
> *(b) an insurer's cost of capital. Some argue that using the cost of capital would help investors by aligning financial reporting with new performance reporting techniques that focus on shareholder value. However, the cost of capital is effectively the weighted-average return that investors require across the current mix of all the insurer's assets, liabilities and operations. It is highly unlikely to reflect the risk profile of any individual liability; and*
>
> *(c) returns on assets held…."*[4]

This statement provides a clear description of the error in APT/CRA's presumption that future costs should be discounted using APT's cost of capital (WACC). It explicitly states that a firm's WACC should not be used to discount its future costs (point b) above. It states that it is "*highly unlikely*" that this will reflect the risks associated with any future costs.

> *"the discount rate for a liability should reflect the characteristics of that liability, not the characteristics of some other instrument with different features*"

2.3. Evidence from Prof. Grundy

For the purpose of the MSP proceedings in front of the Australian Competition Tribunal the ACCC's lawyers sought advice from Bruce Grundy, then the Ian Potter Professor of Financial Studies at the Melbourne Business School. Professor Grundy's full 11 February 2005 statement is provided at Appendix A to this report. However, a relevant quotation from paragraph 5 is provided below:

> *"The only way in which expenditures can be correctly valued is by use of an expenditure specific discount rate. Only by a fluke of circumstances would it be appropriate to discount by the WACC when valuing future expenditures."*

Put simply, Prof. Grundy gave the same advice as expressed in the IASC DSOP above. Specifically, Professor Grundy affirmed that it would in general be incorrect to discount future costs at the same rate as future profits.

---

4 http://www.iasb.org/current/iasb.asp?showPageContent=no&xml=16_173_67_21102005.htm

Professor Grundy went on to note that in the absence of empirical evidence of pipeline costs covariabiltiy with market returns one must consider from first principles what relationship is likely given what we know about pipeline costs.

> *"The discount rate necessary to obtain a correct valuation of the future expenditures must reflect the co-variability of expenditures and share market returns. With limited empirical evidence available on this issue, one must consider the plausibility of conjectured theoretical relations.*
>
> *…*
>
> *"To determine the potential co-variability I first consider the potential links between major capital costs in future decades and the return on the share market during the intervening years.*
>
> *(a) A primary driver of whether the share market outperforms or underperforms current expectations will be whether technological advances and productivity growth turn out to be greater or less than currently predicted. A higher than expected pace of technological advance will lead to a reduction in the capital costs of major projects (such as replacement of the MSP) and a higher than expected return on the market. The discount rate applicable when the amount to be discounted tends to be low when the market return is high is less than the risk-free rate.*
>
> *(b) In the event of a prolonged recession, share market returns will be less than expected and the likelihood of incurring capital costs in replacing or expanding the MSP will be reduced. The discount rate applicable when the amount to be discounted tends to be low when the market return is low is greater than the risk-free rate.*
>
> *(c) In a general context, it is not obvious which of scenarios (a) and (b) is the dominant one. It is not implausible to conclude that in a general context, the appropriate discount rate to use to discount capital costs is equal to the risk-free rate. However, I understand that the NPV cost based DORC is intended to calculate the value of an asset based solely on differences in costs associated with its perpetual replacement. If as a matter of fact the cost of replacing the MSP is largely unaffected by the capacity at which it is replaced, then the weight given to scenario (b) should be commensurately reduced…"*

In summary, Prof Grundy's analysis suggests that it is unclear whether most future capital costs in the economy should be discounted using something more than the risk free rate or something less than the risk free rate. This first principle analysis is consistent with the empirical evidence provided in Brealey, Cooper and Habib which suggests that, on average, something very close to the risk free rate should be used to discount future costs.

However, in the specific case of perpetual replacement of lumpy pipeline assets, then the argument for a discount rate above the risk free rate is considerably weakened. This is because the timing of replacement of lumpy assets is driven by when the assets wear out - and this is largely independent of whether the stock market has performed above or below expectations. Taking this into account, it would be reasonable to consider adopting a discount rate *below* the risk free rate for lumpy future replacement costs.

2.4. Inconsistency with CRA/APT's other assumptions

In order to justify CRA's approach it would be necessary to establish that future costs covary with returns on the market portfolio in the same manner as do future profits. Such evidence would need to establish why this is true for APT when the available evidence[5] is that the average firm's costs have around one twentieth of the covariance profits have with the market.

However, assuming a strong correlation between market returns and costs is inconsistent with the underlying trend relationship modelled by CRA for future pipeline construction costs. CRA assumes that real future pipeline construction costs will fall by 0.48% per year while APT's WACC assumption assumes that average market returns will be over 8% per year. Thus, the implied assumption is that, in trend terms, pipeline costs and market returns are going in opposite directions. However, in terms of deviations from the trend, APT/CRA are assuming that pipeline construction costs and market returns are strongly correlated. Moreover, they are assuming considerably more correlation than exists between market returns and other costs in the economy more generally.

It is strongly counterintuitive to assume in one area of the model that future costs will be falling while the market is rising while simultaneously assuming in a another area that costs and market returns have strong covariance. CRA presents no evidence justifying such a counterintuitive set of assumptions.

2.5. CRA assumes investors like uncertainty about future costs

It is also useful to note that CRA's choice of discount rate implicitly assumes that investors find uncertainty in future costs highly desirable. That is, they prefer those costs to be volatile than to be certain. This can be illustrated with a simple numerical example.

Note that if a cost is certain then it is well accepted that it should be discounted by the risk free rate. If a cost is uncertain then the correct discount rate will be something less than the risk free rate or something more than the risk free rate - depending on whether the uncertainty in future costs is linked to returns on the market. Imagine a pipeline has 30 years of remaining life at which time it must be replaced at an *expected* cost of $1.0bn in constant price terms. If this expected cost is certain then an investor will value this cost at the risk-free rate (say, 3%) in the following manner:

$$\text{Present value of future certain cost} = \$1\text{bn}/(1+0.03)^{30}$$

$$= \$411\text{m}$$

However, if the expected cost was uncertain <u>*and*</u> the investor used a discount rate of 6 per cent (ie, 3 per cent above the risk-free rate) then it would only be valued at:

---

5 Brealey, Cooper and Habib, Oxford Review of Economic Policy, op. cit.

Present value of uncertain cost if discounted at 6% = $\$1bn/(1+0.06)^{30}$

$= \$174m$

By valuing the uncertain cost at a discount rate of 6 per cent the investor has effectively more than halved the value of the future liability relative to a certain cost with the same expected value. This can only be correct if the investor prefers the costs to be uncertain than to be certain. In this case, the investor effectively values the uncertainty associated with the future cost at $237m (ie, $411m - $174m).

Once more this gives a strongly counterintuitive result. For example, it implies that should an investor wish to offload this risk to an insurance company the fair insurance premium would be negative $237m. That is, rather than paying the insurance company to take on the risks associated with variability of those costs, the investor would require the insurance company to *pay it* $237m.

The fact that we do not observe such 'negative premium' insurance transactions in the real world is consistent with the evidence that uncertainty in future costs is **not desirable** (because there is little or no covariance between future costs and returns on the market). This is inconsistent with the implicit assumption in CRA's model that such uncertainty is **highly desirable.**

2.6. Conclusion

On the basis of the above analysis we recommend the adoption of the risk free rate in discounting future pipeline costs. This reflects the best available evidence concerning the discount rate that should be applied to most costs in the economy.

We strongly recommend that the ACCC reject any presumption that the appropriate discount is the regulatory WACC. There has been no economic justification provided for this presumption and it is inconsistent with both empirical evidence and first principles theory.

3. Accounting for Service Differentials

For the purpose of this paper we assume that "DORC" is an economic rather than an accounting valuation and that it represents:

> *The value of the existing asset, given the option exists to replace it with an optimally designed asset. Or, equivalently, the value that would be placed on that asset if there existed a competitive market for 'second-hand' assets.*

So defined, DORC must reflect **both** cost and service differences between the existing and the optimal assets. For example, an existing black and white TV would, in all probability, be optimally replaced by a colour TV (even if it were more costly to produce a colour TV). The market value of second-hand black and white TVs will reflect both the cost of replacing them with colour TVs *and* the higher service potential of colour TVs - with the latter serving to depress the market value of black and white TVs.

Differences in service levels must be included in the definition of economic DORC if economic DORC is intended to capture the value (or hypothetical value) of a second-hand asset. This is a simple reflection of the fact that, other things equal, the market value of existing assets falls when potential replacement assets offer better quality services (consider the TV scenario above or the value of 2G mobile network given the presence of 3G mobile technology).

The Allen Consulting Group (ACG) has defined the 'conceptually correct' definition of DORC in precisely the above manner.[6] ACG states that the 'conceptually correct' value of DORC should be calculated using the following steps:

- *"First, to identify the asset that would be the optimum replacement (providing the optimum level of service) for the asset in place, taking into account all feasible means of providing the service, and to estimate the (full) cost of construction.*
- *Secondly, to identify the differences in the forward-looking service potential and costs associated with the existing asset compared to the new (optimal) asset.*
- *Thirdly, to adjust the estimated cost of the optimal asset to deduct (or add on) the present value of the reduced (or increased) service potential associated with the existing asset, and to deduct (or add on) the present cost of the higher (or lower) forward-looking costs associated with the existing asset compared to the optimal asset."*

This conception of DORC, which we agree is the correct way to estimate the hypothetical value of an asset given the option exists of replacing it, can be expressed in the form of an equation by:

$$\text{DORC} = \text{Net economic value of future services provided by an optimally designed new asset} - \text{Net economic value of future services provided by the existing asset}$$

6 See pages 20 to 23 of ACG's August 2003 Report for the ACCC "Methodology for updating the regulatory value of electricity transmission assets".

Where 'net economic value' is economic value of services less the costs incurred in providing those services.[7] The above definition can be restated equivalently as:

$$\text{DORC} = \begin{array}{c}\text{PV of costs with new asset } \textit{less} \text{ PV of} \\ \text{costs with existing asset}\end{array} - \begin{array}{c}\text{PV of services provided by the new asset } \textit{less} \\ \text{PV of services provided by the existing asset}\end{array}$$

Equation 1

We note that this definition differs from what has come to be defined as "NPV cost based DORC" which is simply the first term on the right hand side of the above equation. NPV cost based DORC will only approximate the true DORC if the new asset would optimally provide the same service potential as the existing asset. If this is not the case then NPV cost based DORC will over-estimate the true DORC value.

Consider our second-hand TV example above. The second-hand value of a black and white TV in Australia today will generally be close to zero. This is not because the cost of replacing that asset is zero but because the value placed on the services it provides is materially lower than the value placed on the services provided by a new colour TV. Estimating its value based solely on the NPV of replacement costs over-estimates its value because it fails to take account of its inferior service potential. This must over-estimate the true value of the existing asset if there is any probability that the existing asset will optimally provide better quality of services.

In the case of the RBP, we consider there are good reasons to believe an optimally designed new asset would provide superior services to the existing RBP. In fact, in developing their design for the optimal replacement asset Venton and Associates (Ventons) spells out many such service benefits of the new pipeline relative to the existing pipeline.

3.1. Additional service value explicitly discussed by Ventons

In a number of places in its report Ventons justifies the design of its alternative replacement pipeline on the basis that it will provide superior service levels. These superior service levels should depress the economic value of the existing asset in the same way that the potential to buy a new colour TV depresses the value of existing black and white TV's. However, no account of these have been taken in APT's estimate of DORC.

For example on page 17 of the Ventons' report it is argued that the hypothetical new route it has designed is superior to the existing route because:

> *A new pipeline constructed along the existing route will:*
>
> - *Introduce increased public safety issues by construction of a high pressure pipeline through existing and future residential areas.*
> - *Not provide for an existing and expected future significant gas loads in the Swanbank area.*

---

[7] Eg, the net economic value of the services provided by the new asset equal "NPV of services optimally supplied by the new asset *less* NPV of optimally incurred forward looking costs in delivering those services".

It will also limit a potential opportunity to deliver gas to the Amberley region

In other words, relative to the existing pipeline the new pipeline offers better public safety and the ability to meet demand that the existing pipeline does not have. The fact that the existing pipeline route will "n*ot provide for an existing and expected future significant gas loads in the Swanbank area" strongly suggests a material difference in service levels between the two assets.* CRA/APT's focus solely on differences in costs between the existing and new pipeline ignores such differences in service levels. These benefits should be, but are not, reflected in APT's estimate of the relative value of the existing pipeline.

On page 38 the Ventons' report states:

> *"The metropolitan section of the pipeline has an additional constraint which is evident from the existing pipeline – future modification to expand the pipeline capacity will be very costly, because of land use change through the life of the pipeline. Consequently it is essential that the metropolitan pipeline is designed with the capacity required to deliver the maximum forecast load in its forecast design life. Capacity expansion by looping is unlikely to be capable of justification on the basis of incremental growth."*

This suggests that serving increased demand on the existing pipeline is 'very' and may be **prohibitively** costly. If serving incremental growth is prohibitively costly then the service levels on the two pipelines are automatically different - voiding a pure NPV cost based DORC valuation. If it is just 'very' costly then this difference should be, but to the best of our knowledge is not, reflected in APT's estimate of the NPV cost based DORC.

In a similar vein, page 14 of the Ventons' report states:

> *"Since the 1980's there has been extensive residential and industrial development along the whole of the route including significant encroachment over the pipeline easement such that in some places, the existing pipeline cannot be maintained without major disturbance to residences*." (Emphasis added.)

The fact that the proposed alternative pipeline avoids "major disturbance to residences" is an advantage that the new pipeline has over the existing pipeline. Just as the advantages of colour TV over black and white TV's depress the economic value of black and whgite TVs so to should advantages of hypothetical new pipelines depress the economic value of existing pipelines.

On page 15 the Ventons' report states

> *"An alternative route is proposed as an optimal route for this study. Between the Redbank area and Tingalpa it is based on a route selected in about 2002 as part of a study associated with an analysis of alternatives that would improve the safety and supply security of the pipeline*." (Emphasis added)

From this statement it would appear that the new route offers large enough safety/security benefits relative to the existing pipeline such that it was seriously considered changing the actual (ie, not just the hypothetical) route of the existing RBP. One could argue that safety benefits primarily accrue to residents in the area and are of little concern to pipeline investors.

Such claims are only true if pipeline owners can not be held legally liable for events that damage residents property or health. In any event, it is far from clear to us that "DORC" is intended to value an asset ignoring the actual and potential costs that asset imposes on third parties. If DORC is intended to truly be an economic rather than an accounting concept then one should expect that all economic costs will be relevant to its valuation. In a more extreme case, one would expect any accurate economic DORC valuation of the Chernobyl nuclear reactor to be negative in the months leading up to its explosion. A DORC valuation of the Chernobyl reactor that excluded costs imposed on local residents would not be an accurate economic valuation of the asset.

Key Finding

Based solely on statements within the Ventons' report, the Ventons' pipeline will provide materially greater service levels than the existing pipeline. Unless the value of these service levels are deducted from APT's estimate of the NPV cost based DORC, that measure will over-estimate the true economic value of the existing pipeline given the hypothetical option to replace it.

Setting the ICB equal to a pure estimate of NPV cost based DORC means customers will be paying for hypothetical benefits that they do not, in reality, receive.

3.2. Optimal volumes unlikely to match RBP volumes

In addition to the advantages of a new pipelineexplicitly noted by Ventons, economic theory suggests that a new pipeline will optimally carry higher volumes than the existing pipeline.

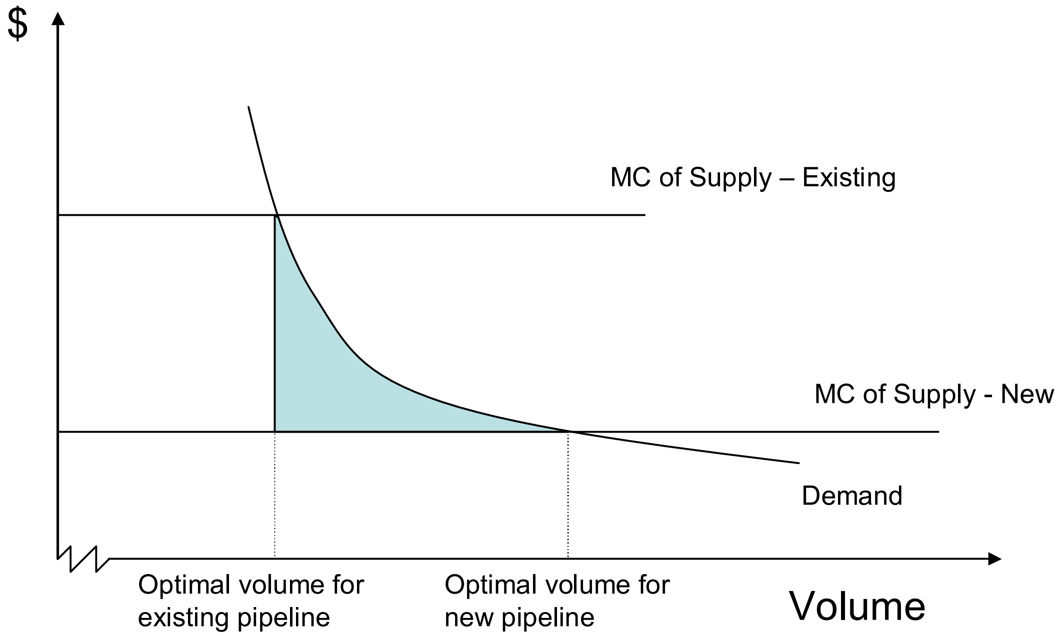
The volume of gas transport sales will, as in all markets, be determined by the interaction of a supply curve and a demand curve. While it may be reasonable to assume that demand for gas transport is the same in both scenarios, the marginal cost of supply will be materially different. This reflects the fact that the new pipeline is designed with a significantly higher diameter and, hence, a significantly lower marginal cost of meeting increased demand. This gives the owner of a new pipeline a much stronger economic incentive to expand supply than the an owner of the existing RBP.

APT's own model indicates that, over the six years to 2011, the marginal expenditure required to meet demand growth:

- on the existing RBP is around $115m; and
- on the new pipeline would is around $38m.

That is, the marginal cost of meeting demand growth is around 1/3rd as high on the new pipeline as on the existing pipeline. Unless the demand for gas is perfectly unresponsive to price then the Ventons' pipeline would rationally supply greater volumes of gas earlier than the existing pipeline. The impact of lower marginal cost on the efficient level of supply is illustrated in the below diagram.

Figure 3.1
Marginal cost and efficient/optimal volumes



The efficient level of gas volumes on a pipeline is given by the point where the marginal cost of an additional unit of gas transported is equal to the marginal value placed on transporting that gas. This is given by the intersection of the marginal cost and demand curves. Assuming a standard downward sloping demand curve, the lower the marginal cost of supply the higher the efficient level of volumes. As drawn, the net value of the additional volumes served on the lower marginal cost pipeline is given by the blue shaded area which is the value consumers place on the additional volumes served less the additional cost of making that volume available).[8]

The fact that, relative to Ventons' pipeline, the existing RBP has around three times the incremental cost of serving the next six years' forecast demand growth suggests that the Ventons' pipeline could efficiently serve materially higher demand at materially earlier times than the existing RBP. This might be, for example, because a potential gas fired generator is able to negotiate more favourable terms with a new (lower marginal cost) pipeline thereby bringing forward its optimal entry time. Alternatively, existing users (generators, industrial and residential users) may be encouraged by lower marginal prices to expand current levels of consumption.

The ability to meet extra demand at a lower marginal cost, and the options this creates, gives rise to material economic advantages for the new pipeline. In a competitive market these economic advantages of a new asset would be reflected in a lower sale price for the existing

---

8 Infrastructure owners use two part tariffs and take or pay arrangements to give shippers marginal incentives that reflect the pipeline's marginal costs.

asset. APT's NPV cost based DORC does not do this, and, as a result, over-estimates the true value of the existing pipeline.

Key Finding

The lower marginal cost of supply on the new pipeline means that the efficient level of supply on that pipeline will be higher than on the RBP. Recognising this has the potential to materially lower the true DORC valuation of the existing pipeline.

There are other reasons why APT's methodology will likely over-estimate the true DORC. In particular, APT's volume forecasts appear to bias the estimated NPV cost based DORC in at least two material ways:

a) It assumes zero demand growth post 2025 - despite assuming that demand grows by 70% over the next 20 years. Absent specific justification, APT should assume the same average demand growth post 2025 as pre 2025 - with concomitantly higher growth related costs for the RBP relative to a new pipeline. Based on pre 2025 figures this would result in 3 times higher growth related expenditure on the RBP.

b) APT assumes that: 1) entry of PNG gas into South West Queensland will be carried on the RBP; but that: 2) this will not result in greater gas transport on the RBP. The first assumption serves to ensure that the value of the RBP is not reduced by virtue of PNG gas stranding this asset. The second assumption avoids the need to model the costs of RBP dealing with increased demand (which is costly for the existing pipeline to meet). This appears an extreme assumption given the normal economic contention that increased supply competition will lower gas prices and lead to greater consumption (and hence greater demand for transport).

4. APT/CRA's Averaging of Asset Lives

The existing RBP is comprised of several different pipeline segments that were built at different times using different materials/technologies. Consequently, APT estimates that each segment has a different remaining useful life.

If these individual segments are truly to be separately replaced at different times, the most accurate estimate the present value of replacement costs is to estimate the cost of replacing each segment and discounting by that segment's number of years of remaining life. Instead of taking this approach CRA has estimated the PV cost of replacement by:

- estimating the 'average' remaining life of all pipeline segments (using pipeline segment volume as a weight). Call this estimate of average remaining life "Z years"; and
- estimating the cost of constructing a new pipeline in its entirety in Z years. Given that pipeline costs are assumed to be falling at "tech" % per annum this is replacement cost is given by ORC*(1-tech)^Z ;
- discounting that cost as if it was incurred in exactly Z years.

This gives the following formula:

CRA's estimate of the NPV cost of replacing the existing pipelines $= \frac{ORC*(1-tech)^z}{(1+r)^z}$.

There are two reasons why this approach will result in a material under-estimate of the present value of replacement costs for the existing pipeline (and, hence, an over-estimate of DORC).

4.1. Total expenditures will be more than ORC*(1-tech)^Z

The numerator will under-estimate the sum of future replacement expenditures because there are, we understand, significant economies of scale/scope in pipeline construction (such that the expenditure on replacing several small pipelines at different times is greater thanthe expenditure on replacing one large pipeline of equivalent aggregate capacity at a single point in time). If there are economies of scale/scope in pipeline construction there will be *higher* future replacement expenditure than ORC*(1-tech)^z - which assumes a single pipeline constructed in a single phase.

We also note that the Venton's report justified the route for the new pipeline on the basis that land use along the existing route meant that it would be 'very costly' to modify.

> *"The metropolitan section of the pipeline has an additional constraint which is evident from the existing pipeline – future modification to expand the pipeline capacity will be very costly, because of land use change through the life of the pipeline." (Page 38)*

This suggests that, even if we ignore economies of scale and scope in pipeline construction, replacing the existing pipeline will be more expensive than building a new pipeline because the route the existing pipeline takes is more densely populated. Thus, using the costs of a new pipeline (ORC) built in a single stage along a *new* route is **not** an appropriate proxy for replacing the existing pipeline in a piecewise fashion along the *existing* route.

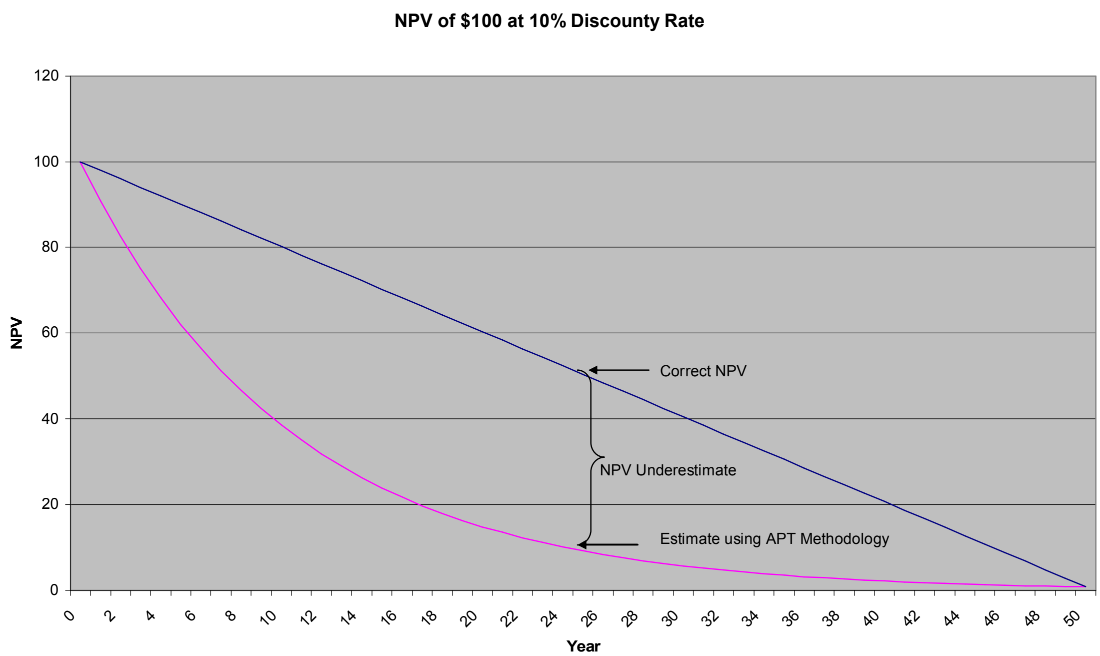
Key Finding

CRA under-estimates the present value of total replacement costs because it ignores the higher cost of piecewise pipeline replacement compared to construction of an entirely new pipeline in a single construction project.

4.2. Discounting by average asset life is incorrect

Even if, contrary to the above finding, $ORC*(1\text{- tech})^{z}$ was an accurate estimate of the sum of total future replacement expenditure, it is not correct to discount this amount by Z years. This reflects the compounding property of continuous discounting as illustrated in the following figure.

Figure 4.1
'Average life' discounting error



The lower curve in the above figure illustrates how the NPV of $100 discounted at 10% varies with the number of years over which it is discounted. This curve is strictly convex to the origin meaning that a straight line between any two points on the curve always lies strictly above the curve.

Now consider an example where there are two assets that need replacing and that both will cost $50 when replaced (ie, total expenditure of $100). Further, imagine that one asset needs to be replaced immediately and the other needs to be replaced in 50 years time. The NPV of the first expenditure will be $50 (because it is immediate) and the NPV of the second expenditure, at a 10% discount rate, will be very close to zero (see above graph). The total NPV will therefore be marginally more than $50 and will be given by the midpoint of the straight line in the above graph (ie, the point on the straight line above the 'average asset life' of 25 years).

However, if we were to surmise that the average life of the assets was 25 years and then attempted to discount the total expenditure ($100) as though it occurred at 25 years we would incorrectly estimate the NPV at around $9. This is an under-estimate of $41 or around 80%. This is effectively the approach adopted by APT.[9] (A general proof of this proposition is provided at appendix B.)

Key Finding

Using a single average asset life to discount multiple replacement costs will under-estimate the true present value of replacement costs.

4.3. Overall conclusion

CRA's approach has two material flaws. To accurately estimate the present value of costs on the existing pipeline the ACCC should attempt to estimate the actual schedule of investment on the existing pipeline and discount it in the year it is actually expected to occur.

---

[9] Not that the compounding nature of the "Tech" factor means that an identical conceptual problem exists in relation to CRA's estimate of the total (undiscounted) future replacement expenditure" ORC*(1-Tech)^Z. That is, the evolution of replacement cost with time is convex to the origin because the Tech factor is compounding as can be seen in the below graph. For the same reasons as discussed above, this convexity means that use of an average asset life will tend to under-estimate the true expenditure. However, because the convexity of the curve when Tech=0.48% is relatively small this source of bias is likely to be relatively small.

5. Treatment of Tax

5.1. Incorrect use of pre-tax discount rate

CRA's discussion of its tax cost modelling is provided on page 12 of its report.

> *In our model we have treated the effect of taxation, including tax deductions for operating costs and tax depreciation concessions on capital, implicitly by adopting a pre-tax WACC discount rate in the formulae outlined in Appendix A. APT calculated the pre-tax WACC using the corporate tax rate of 30%.*
>
> *As a result, the model makes no further allowance for the effect of taxation (that is, separate formulae for tax are not required).*

No further discussion or justification is provided for why CRA believes that adopting a pre-tax WACC means that 'separate formulae for tax are not required'. We show below that such a statement is not correct and that, if one wishes to model tax costs from the perspective of investors:

- the conceptually correct, and more accurate, approach is to discount post-tax costs using a post-tax discount rate; and
- is just as simple to implement as CRA's proposed approach and requires no additional information.

CRA's approach will lead to inaccuracies whenever the cost stream being discounted is not constant through time. This is precisely the current scenario with lumpy expenditures on pipeline replacement. Relative to the conceptually correct approach, CRA's approach over-estimates the present value of early costs and under-estimates the present value of later costs. To see this note that a pre-tax cost of $1 in "n" years time with a tax deduction attached (at a tax rate of "t) has a post-tax present value of:

Post-tax present value (correct) = $\frac{\$1*(1-t)}{(1+r)^n}$, where r = the pre tax discount rate; and

r = the post tax discount rate.

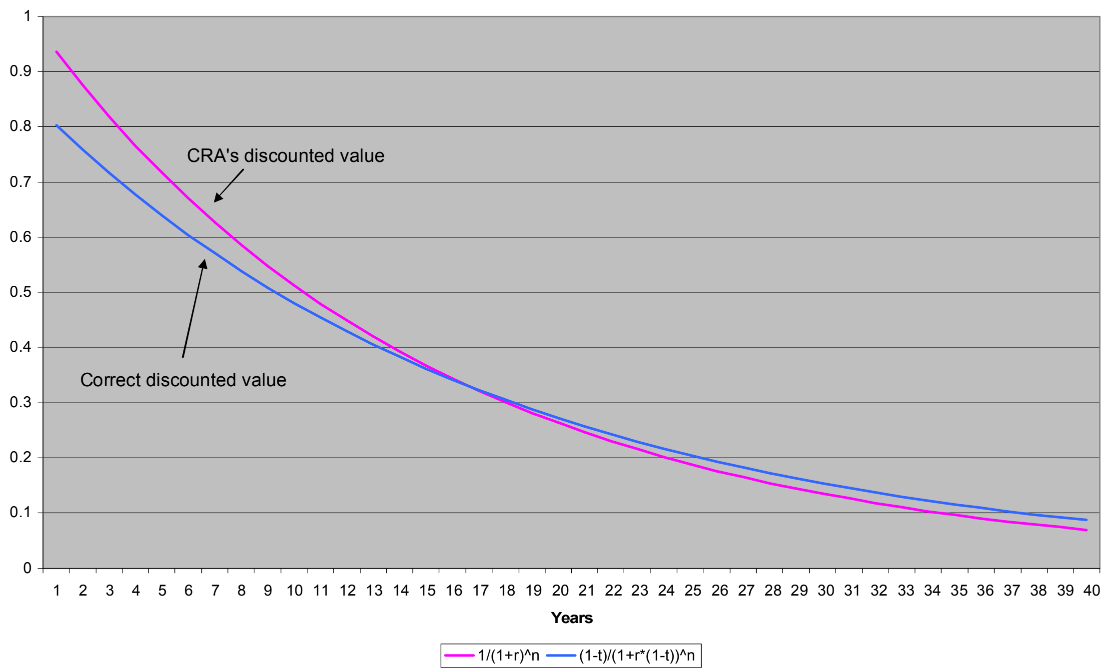
However, CRA's approach values that future pre tax dollar of costs as:

Post-tax present value (CRA) = $\frac{\$1}{(1+\frac{r}{1-t})^n}$; where r/(1-t) = the pre tax discount rate.

Note from the above equations that both approaches require the same information and so, both are equally simple to implement. However, only the first equation gives the correct NPV of a post tax expenditure. That is, only the first equation gives the valuation that is of interest to investors.

As illustrated in the below figure, adopting CRA's approach results in the post-tax cost of expenditure in the first 16 years being over valued while later expenditure is under valued (assuming CRA's 6.9% pre-tax discount rate and t=15% tax rate).

Figure 5.1
CRA vs Correct Discounting



Given that expenditure on the new pipeline is more heavily weighted to early expenditure, CRA's approach introduces an upward bias of the costs of the new pipeline relative to the existing pipeline (ie, tends to over-estimate DORC).

CRA's approach is also problematic in that it does not adequately account for the declining real value of tax depreciation as a result of inflation.

5.2. Cost of tax to whom?

5.2.1. Conceptual issue

The above discussion presumes that tax is a cost that should be taken into account in the calculation of DORC. At a conceptual level it is unclear that this is the case. Consider the valuation of 'tax costs' from three different perspectives:

- pipeline users / society at large;
- the incumbent owner's shareholders; or
- a potential new owner's shareholders.

From society's perspective, tax payments are a transfer not an economic/resource cost. A tax payment goes to provide government services which provide offsetting benefits to society (including taxpayers). That is, tax provides value above and beyond that provided by the pipeline (unlike the cost of steel in the pipeline which has value only in so far as it contributes directly to pipeline services). The DORC valuation of the existing pipeline to society is the value that society places on the existing pipeline given the option exists to replace it with a new pipeline. The DORC value of the pipeline to society will not include tax payments as a cost.

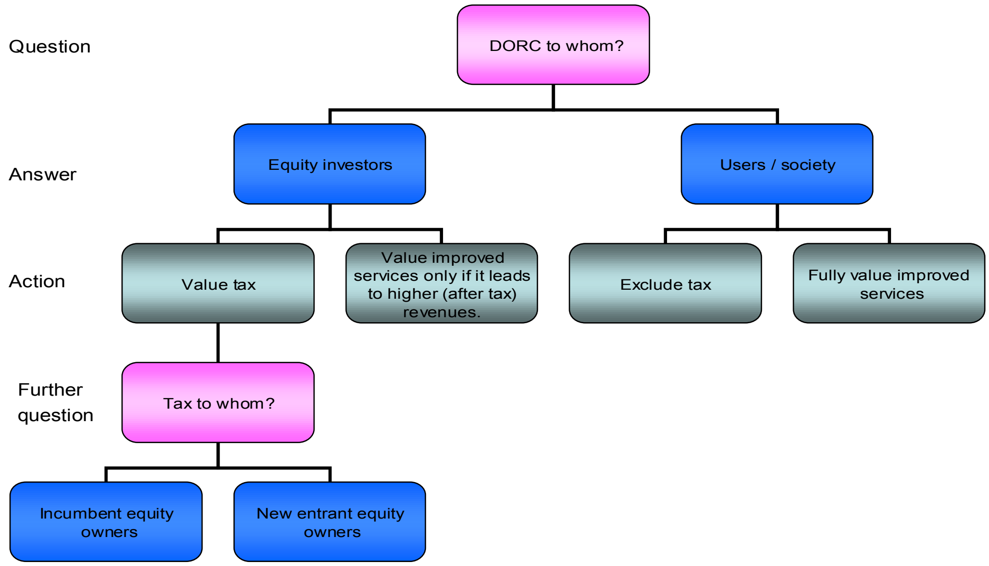
However, from the perspective of an equity investor in the pipeline, she bears the full cost of tax paid but only receives an insignificant fraction of the associated Government services (the latter is spread across all of society while the former is paid only by her). Consequently, equity investors do treat tax liabilities as an economic cost to them and would include these in a DORC valuation.

That said, tax paid by equity investors will depend on whether they are incumbent investors (ie, owners of equity in the firm that currently owns a gas pipeline) or a new investor (ie, owners of equity in a firm that might hypothetically purchase the existing pipeline). An incumbent will tend to have higher tax costs associated with the existing pipeline than a hypothetical alternative owner who recently purchased the existing pipeline (reflecting the fact that a new purchase can be depreciated for tax purposes but that current owners will already tend to have 'used up' available tax depreciation).

Similarly, there will be different valuations of any improved service levels provided by an optimised pipeline of the type discussed in section 3. The true economic value of improved service levels is the value placed on those services by users. However, from an equity investor's perspective this is only 'value' to the extent they can reflect it in higher prices/revenues (and if they can avoid paying tax on these higher revenues).

In summary, before DORC is conceptually defined we need to make an assumption about 'value to whom'? The below figure provides an example of the type of decision tree that must be undertaken (and how different answers to the 'to whom' question can affect the value of DORC).

A 'Value to Whom?' DORC Decision Tree



Key Findings

Users' DORC. If DORC represents the value that users/society place on the existing pipeline given the option to replace it, then tax should be excluded from the DORC calculation.

Incumbent DORC. If DORC is the value of the existing asset to the incumbent owner given the option of replacing it, then only remaining depreciation deductions on the existing asset should be modeled for the existing pipeline.

New entrant DORC. If DORC is the value a new entrant is willing to pay then new depreciation deductions on the existing asset should be modeled.

5.2.2. CRA's approach

CRA does not consistently model tax costs from the perspective of any of the relevant parties. By adopting a pre-tax discount rate it does allow tax to influence its calculation, however, it does not do so in a conceptually meaningful manner. That is, CRA's approach does not model tax in a manner that has a consistent answer to the 'cost to whom' question.

5.2.3. Correct approach

In our view it is not possible to determine a single 'universally' correct approach to treatment of tax when modelling DORC. The correct answer will depend on from who's perspective we are attempting to value the existing pipeline? The important question then becomes from whos' perspective should we model tax given that the resulting DORC value will be considered in the context of setting an ICB for the existing pipeline.

In our view it would be reasonable for the ACCC to ignore tax in this circumstance because tax is simply a transfer and not an economic cost to society. That is, the 'economic value' of the pipeline to the economy does not require modelling of tax.

However, if the perspective of an investor were to be considered relevant then the most important issue is consistency. Specifically, if the ICB is set on the basis of one assumption regarding the level of tax depreciation available to the existing pipeline then the modelling of revenues derived from that ICB should make the same assumption regarding tax depreciation. For example, if the DORC is calculated assuming a given level of tax depreciation on the existing pipeline that same level of tax depreciation should be used in future the revenue modelling.

To do otherwise would be internally inconsistent. For example, calculating DORC as though a new entrant could depreciate its purchase price embeds the value of those hypothetical tax deductions in the ICB. If revenues are then set higher because, in reality, the incumbent has no such tax depreciation the effect would be that users pay for tax advantages in the ICB that do not exist (ie, a windfall gain accrues to the incumbent owner).

Given that standard regulatory practice for the ACCC/AER is to model required revenues on the basis of actual tax depreciation for the incumbent owner then we recommend that the same assumptions be used in modelling DORC. That is, if tax is to be treated as a cost we recommend estimating an 'incumbent DORC'. If, nonetheless, the ACCC had regard to a 'new entrant DORC' in setting the ICB it should, for consistency, model revenues 'as if' the entire ICB can be depreciated for tax purposes.

Appendix A. Prof. Grundy Statement

An Analysis of the

CRA ECONOMIC REPORT: Moomba-Sydney Pipeline asset valuation under the Gas Code (the CRA REPORT)

REPORT BY BRUCE DAVID GRUNDY

Date of this report: 11 February, 2005

1. My full name is Bruce David Grundy. I am the Ian Potter Professor of Financial Studies at the Melbourne Business School.

2. I have been asked by *Deacons* whether CRA's analysis supports the conclusions listed on page 19 of the CRA REPORT and, if not, what errors have caused CRA to come to these conclusions. A list of the documents with which I have been supplied is contained in a Schedule to this Statement.

3. Page 19 of the CRA ECONOMIC REPORT contains four conclusions reproduced and numbered in a Schedule to this Statement.

The validity of the CRA conclusions

4. Based on the documents supplied and my knowledge of finance my opinion concerning the validity of the conclusions in the CRA REPORT is:

   Conclusion i. The statement in the first sentence that the ACCC's approach to separately valuing revenue and expenditure streams is "not without precedent" is misleading. Not only is there precedent for the ACCC's approach but there is no alternative if one wishes to value future expenditure (as one does in the current context). The second sentence of *Conclusion i* is false.

   Conclusion ii. The claim that the plausibility tests provided by the ACCC appear contrary to factual material advanced by the ACCC is false. The claim that the ACCC's views "are not supported empirically, as a claim of this nature must be" is false. As is discussed in relation to Conclusion iii, the empirical evidence supplied by *both* the ACCC and CRA lends greater support to the ACCC's contentions than to CRA's.

Conclusion iii. The first two sentences are false. The third sentence is a conditional statement and as such is correct.

Conclusion iv. This conclusion is false.

Conclusion i - Additivity Principle

5. The implication that the ACCC's approach of using discount rate different from the WACC to value expenditures is a departure from 'standard practice' is false. The only way in which expenditures can be correctly valued is by use of an expenditure specific discount rate. Only by a fluke of circumstances would it be appropriate to discount by the WACC when valuing future expenditures.

6. The common approach of discounting a firm's future profits (revenues less expenditures) at the firm's weighted average cost of capital (WACC) correctly values those profits. If though one wishes to correctly value the future expenditures, one must discount the expenditures at a rate appropriate for their risk.

7. Only when revenues and expenditures have the same risk will the appropriate discount rate be the same for both and equal to the WACC. Only in this case can one correctly value expenditures by discounting at the WACC. (This is the reason why the conditional statement in the final sentence of the CRA REPORT's *Conclusion ii* is correct.)

8. Section 2 of the CRA REPORT argues that there is no reason to depart from the usual practice of discounting future profits at the WACC. But this has no relevance to the determination of the NPV DORC valuation of future expenditures. Calculation of the NPV DORC can only be achieved by discounting at a rate which correctly reflects the risk of those expenditures.

9. Section 2 of the CRA REPORT also claims that the ACCC approach violates the value additivity principle. This is not correct. The confusion underlying the claim arises because the ACCC AMENDED SUBMISSION defines "risk" associated with uncertainty as something that is undesirable to investors – with the corollary that a "negative risk" arises when uncertainty is desirable to investors. This is a

natural way to describe risk from the perspective of an investor

10. CRA misinterprets the ACCC's nomenclature as implying that positive/negative relates to the sign of the covariance with the market return. It is unclear why CRA misinterpreted the ACCC's terminology given that it appears to be well defined even in quotes used by CRA.[10] The effect of this misinterpretation is that the alleged errors CRA ascribes to the ACCC analysis in section 2.2 and 2.3 do not apply.

11. Once one recognizes how the ACCC AMENDED SUBMISSION uses the terms "positive risk" and "negative risk" (i.e., differently for revenues and expenditures) one sees that

    (a) the ACCC AMENDED SUBMISSION is perfectly consistent with the value additivity principal, and that

    (b) the ACCC AMENDED SUBMISSION does not in fact suffer from the common misconception referred to on page 24 of the Brealey, Cooper and Habib article.

[10] See the second sentence in the quote reproduced in paragraph 6 of the CRA report. The potential for the CRA report to have misinterpreted the ACCC's terminology is alluded to in footnote 6 of the CRA report but not in the main body of the report.

Conclusion ii – Expenditure variability and systematic risk

12. The discount rate necessary to obtain a correct valuation of the future expenditures must reflect the co-variability of expenditures and share market returns. With limited empirical evidence available on this issue, one must consider the plausibility of conjectured theoretical relations.

13. Page 11 of the CRA REPORT claims that

> [c]apital costs of future pipeline replacements depart even more dramatically from the "safe" and "nominal" characteristics that must apply if risk free discounting is to be used.

First note that the Capital Asset Pricing Model describes real, as distinct from "nominal", discount rates. Second, "safe" here means zero co-variability of expenditures with share market returns—it does not mean zero variability of those expenditures.

14. To determine the potential co-variability I first consider the potential links between major capital costs in future decades and the return on the share market during the intervening years.

(a) A primary driver of whether the share market outperforms or underperforms current expectations will be whether technological advances and productivity growth turn out to be greater or less than currently predicted. A higher than expected pace of technological advance will lead to a reduction in the capital costs of major projects (such as replacement of the MSP) and a higher than expected return on the market. The discount rate applicable when the amount to be discounted tends to be low when the market return is high is *less* than the risk-free rate.

(b) In the event of a prolonged recession, share market returns will be less than expected and the likelihood of incurring capital costs in replacing or expanding the MSP will be reduced. The discount rate applicable when the amount to be discounted tends to be low when the market return is low is *greater* than the risk-free rate.

(c) In a general context, it is not obvious which of scenarios (a) and (b) is the dominant one. It is not implausible to conclude that in a general context, the appropriate discount rate to use to discount capital costs is *equal* to the risk-free rate. However, I understand that the NPV cost based DORC is intended to calculate the value of an asset based solely on differences in costs associated with its perpetual replacement. If as a matter of fact the cost of replacing the MSP is largely unaffected by the capacity at which it is replaced, then the weight given to scenario (b) should be commensurately reduced. This appears to have been the argument put forward by Australian Pipelines Trust in their 23 May 2003 letter to the ACCC.

15. I now consider the potential links between non capital costs and the return on the share market. Section 4 of the CRA REPORT notes that in each regulatory period, the regulator will establish a revenue requirement based on an assessment of operating and capital costs. Thus expected revenues and costs are likely to exhibit a high degree of co-variability across regulatory cycles. But the measure of co-variability that determines discount rates is *unexpected* co-movement with the share market.

16. Suppose that the economy performs better then expected and share market returns are higher then expected. Pipeline throughput and revenues are likely to be higher than expected. By contrast, according to the *Extract from ACCC Final Decision: Moomba to Sydney Access Arrangement 2 October 2003*, Agility (on behalf of EAPL) has contended that the bulk of the services provided under the Pipeline Management Agreement (PMA) are covered by a fixed charge. The *Extract* notes that:

> despite forecasting a sizable reduction in throughput (and therefore revenue) … , EAPL has not made a downward adjustment to its forecast operational expenditures.

This is strongly suggestive of a lower co-variance of non-capital costs than revenues with the market return (and in turn a lower co-variance of non-capital costs than profits with the market return). At the least this implies the appropriate discount rate for these costs is less than the WACC.

Conclusion iii Empirical evidence

17. The empirical work in Section 4 of the CRA REPORT examines the co-variability of revenues and operating expenditures. The measure of co-variability that determines the discount rate applicable to a cash flow stream is the co-variability of that stream with the return on the share market, and not with some other cash flow stream.

18. Revenues may reflect the health of the economy as well as factors specific to the MSP (such as a break-down of the pipeline). Expenditures may reflect many of the same factors specific to the MSP (for example, the costs of repairing said break-down). Any common movement of revenues and expenditures may reflect only the common factors specific to the operations of the MSP and there may be no relation between stock market returns and the costs of operating the MSP.

19. The question of the source of any co-movement between revenues and costs becomes moot if in fact there is none. Section 4 of the CRA REPORT claims that an analysis of the MSP's revenues and operating expenditures between 1977 and 1994 reveals a significant co-movement. An examination of Figures 4 and 5 reveals that this result is driven by one particularly influential observation. Apparently, the percent changes in revenues and in expenditures between the 1977 and 1978 financial years were 76% and 59% respectively.[11] Changes between other years are relatively small.

20. However, that large percentage increase in revenues and expenditures is driven by the fact that the MSP only operated for 6 months in 1977. This is clearly an "apples and oranges" comparison of revenues and expenditures across the two "years" — the first of the two years lasts only six months. If the regression is undertaken a second time with the first and flawed observation dropped from the data, the estimated relation is quite different. Rather than a 1% increase in

[11] The annual percent changes in revenues (costs) analysed in the CRA REPORT are changes between two years divided by the second year's revenues (costs). Nothing of substance in the CRA REPORT, or in my criticism of it, would be different if one instead measured percentage changes between two years relative to the first year's revenue (cost) level.

revenues being associated with a 0.905% increase in costs, it is only associated with a 0.038% increase in costs and that relation is statistically insignificant. Contrary to *Conclusion iii* of the CRA REPORT, the evidence suggests that there is no co-variation between revenues and operating expenditures for the MSP.

21. What other empirical evidence is available on the discount rate applicable to expenditures? Although not specific to the MSP itself, page 24 of the *Oxford Review of Economic Policy* article by Brealey, Cooper and Habib (referenced in both the ACCC Amended Submission and the CRA REPORT) reports an interesting result for firms in general.

> [F]or a sample of UK firms … the beta of after-tax profits is about ten times that of revenues and twenty times that of trading expenses.

22. The betas referred to in this quotation are "accounting betas." Accounting betas are determined by regressing percent changes in accounting measures of profits, revenues and trading expenses respectively on percent changes in the profits of a share market index portfolio. Accounting betas are used in practice as proxies for betas in the Capital Asset Pricing Model. Since the WACC reflects the beta of profits, the WACC of the typical firm in this UK sample will exceed the risk-free rate by an amount that is *twenty times* the difference between the risk-free rate and the discount rate that should be used to value its trading expenses.

Conclusion iv Discount rates used in regulatory models

23. *Conclusion iv* of the CRA REPORT is a claim that the use of the risk free rate to discount future expenditure streams in order to determine an NPV DORC valuation is inconsistent with the entire regulatory model. This claim is false. Within the context of the current discourse, the regulatory asset base of the MSP is intended to be the present value of the difference between two expenditure streams. The correct present value can only be obtained by discounting at the correct discount rate. When the expenditure stream does not co-vary with share market returns, then the correct discount rate is the risk free rate.

24. The error in the CRA REPORT is due to a mistaken belief (expressed in its footnote 16) that the present values of two future amounts can only be equal if the expected future amounts are themselves equal. The error in this view can be easily demonstrated by analysing the following investment strategy.

25. Suppose you borrow $100 for one year and pledge your home as collateral. Given the collateral, you will be able to borrow at close to the risk free rate, say, 5%. Your repayment cost will then be $105. If the market risk premium is 6%, your expected return on an investment in the market portfolio is 11%. (11% = 6% + 5%). If you invest the $100 in the stock market you expect to be able to sell the shares for $111 in a year's time.

26. The present value of the future repayment cost is $100: the $105 repayment cost discounted at 5%. The present value of the future revenues from the sale of the shares is also $100: the expected sale proceeds of $111 discounted at 11%.

27. Your wealth is initially unaffected by the strategy of borrowing to fund the share investment—your assets and liabilities both increase by $100. But your portfolio is now more risky than it once was. You are now holding a levered position in shares. Your expected profit of $6 is the appropriate reward for bearing this risk. ($6 = $111 – $105.)

28. The present value of the future expected profit of $6 is zero. The value is zero because of the risks involved with this stratagem. For example, if the stock market plummets by 50% during the year, you can only sell your stock for $50 at year-end yet you must still repay $105 on the loan. The possibility of such losses means that you will require a profit of $6 on average simply to compensate you for bearing this risk.

29. The expected future revenues exceed the expected future costs, yet the ***present value*** of those future revenues is equal to the present value of the future costs.

30. Thinking of this stratagem as a small business venture illustrates well the flaw in the CRA REPORT. The discount rate that will correctly value the venture's expected future profit of $6 at its zero value today is infinite! Does this mean that

one can correctly value the venture's future debt repayment costs by discounting at the infinite rate applicable to its profits? As the discount rate increases without bound the discounted value of $105 decreases toward $0.00. How will the lender react to an offer to immediately pay off the loan in full with a cheque in the amount of $0.00?

Schedule of Documents supplied by Deacons
and relied on in forming my opinion

(a) The CRA ECONOMIC REPORT.

(b) The ACCC Amended Submission to the Australian Competition Tribunal dated 20 December, 2004.

(c) An Extract of section 4.4.2 of the EAPL May 1999 AAI (page 49).

(d) An Extract of section 1.1 of the Moomba-Sydney Pipeline Non-capital Costs Final Decision dated December 2003.

(e) Brealey, R.A., I.A. Cooper and M.A.Habib, "Investment appraisal in the public sector," *Oxford Review of Economic Policy*, 13(4), 12—28.

(f) Revenue and expense data necessary to critique the empirical work by CRA.

(g) 23 May 2003 letter from Australian Pipeline Trust to the ACCC.

Schedule of
conclusions contained in the CRA REPORT

i. The ACCC's approach of separately valuing revenue and expenditure streams, while not without precedent, requires great care in implementation in order to avoid results that are inconsistent with the value additivity principle. The ACCC has failed to apply the approach carefully and as a result it has reached untenable conclusions;

ii. The strong claim made by the ACCC on systematic risk of pipeline expenditures is not supported empirically, as a claim of this nature must be. The plausibility tests provided by the ACCC are unconvincing and, in the case of operating and maintenance expenditure appear contrary to factual material advanced by the ACCC itself. Professor Grundy's opinion has no bearing on this issue, as he has simply adopted the conclusion as an assumption;

iii. There are sound theoretical reasons to suppose the MSP's revenues and expenditures have similar levels of systematic risk. What empirical tests can be done with the data that was available to the ACCC at the time of its Final Decision suggest that MSP revenues and expenditures do indeed co-vary, as theory leads us to expect. If it is true that MSP revenues and expenditures exhibit very similar systematic risk profiles, then the correct discount rate to apply in the NPV DORC calculation is satisfactorily approximated by the pipeline's WACC; and

iv. Finally, the ACCC's use of the risk free rate to discount future expenditure streams to arrive at an NPV DORC valuation is inconsistent with the entire regulatory model that the ACCC is obliged to apply under the Gas Code. The regulatory model requires that the discount rate be equal to the pipeline's WACC.

Appendix B. Discounting by Average Asset Life: A General Proof

Assume we have two expenditures "A" and "B" and that they will occur in A years and B years time respectively. What is the value of Z that satisfies the following condition?

$$\frac{A}{(1+r)^a}+\frac{B}{(1+r)^b}=\frac{A+B}{(1+r)^z}$$

That is, if we are to discount the sum of these values by Z years, what is the value of Z that will give the correct value? Moreover, will that value be less than the 'average' asset life Z* where:

$$z^*=\frac{Aa+Bb}{A+B}$$

Multiplying through by $(1+r)^{a+b}$:

$$A(1+r)^b+B(1+r)^a=(A+B)(1+r)^{a+b-z}$$

Taking logs:

$$\ln\left(A(1+r)^b+B(1+r)^a\right)=\ln(A+B)+(a+b-z)\ln(1+r)$$

$$\Rightarrow z=a+b-\frac{\ln\left(A(1+r)^b+B(1+r)^a\right)-\ln(A+B)}{\ln(1+r)}$$

Note that when $a=b$, these formulae return the same result, $z=z^*=a=b$. However, for $a\neq b$, the alternative formulation will always return a higher asset life, when $r,A,B>0$. To see this, note the following:

$$z^*=\frac{Aa+Bb}{A+B}=\frac{Aa+Ba+Ab+Bb}{A+B}-\frac{Ba+Ab}{A+B}$$

$$\Rightarrow z^*=a+b-\frac{Ba+Ab}{A+B}$$

Then:

$$z^*>z\Leftrightarrow a+b-\frac{Ba+Ab}{A+B}>a+b-\frac{\ln\left(A(1+r)^b+B(1+r)^a\right)-\ln(A+B)}{\ln(1+r)}$$

$$\Leftrightarrow\frac{Ba+Ab}{A+B}<\frac{\ln\left(A(1+r)^b+B(1+r)^a\right)-\ln(A+B)}{\ln(1+r)}$$

Bringing the denominator of the right-hand side across preserves the inequality if $r > 0$. Then:

$$\left(\frac{Ba + Ab}{A + B}\right)\ln(1 + r) < \ln\left(A(1 + r)^{b} + B(1 + r)^{a}\right) - \ln(A + B)$$

$$\Leftrightarrow \ln(1 + r)^{\frac{Ba+Ab}{A+B}} < \ln\left(\frac{A(1 + r)^{b} + B(1 + r)^{a}}{A + B}\right)$$

Inverting the natural logs on each side preserves the inequality, as e^{x} is strictly increasing over the reals:

$$(1 + r)^{\frac{Ba+Ab}{A+B}} < \frac{A(1 + r)^{b} + B(1 + r)^{a}}{A + B}$$

If $A, B > 0$, this gives:

$$(A + B)(1 + r)^{\frac{Ba+Ab}{A+B}} < A(1 + r)^{b} + B(1 + r)^{a}$$

$$\Leftrightarrow A + B < A(1 + r)^{b-\frac{Ba+Ab}{A+B}} + B(1 + r)^{a-\frac{Ba+Ab}{A+B}}$$

$$\Leftrightarrow A + B < A(1 + r)^{\frac{B(b-a)}{A+B}} + B(1 + r)^{\frac{A(a-b)}{A+B}}$$

Let $b - a = c$. Then:

$$A + B < A(1 + r)^{\frac{Bc}{A+B}} + B(1 + r)^{-\frac{Ac}{A+B}}$$

The derivative of the left-hand side of the expression with respect to c is zero. For convenience, denote the expression on the right-hand side as $f(c)$. Then:

$$\frac{\partial f}{\partial c} = \left(\frac{B}{A + B}\right)\ln(1 + r)A(1 + r)^{\frac{Bc}{A+B}} - \left(\frac{A}{A + B}\right)\ln(1 + r)B(1 + r)^{-\frac{Ac}{A+B}}$$

$$= \left(\frac{AB}{A + B}\right)\ln(1 + r)(1 + r)^{\frac{Bc}{A+B}} - \left(\frac{AB}{A + B}\right)\ln(1 + r)(1 + r)^{-\frac{Ac}{A+B}}$$

$$= \left(\frac{AB}{A + B}\right)\ln(1 + r)\left[(1 + r)^{\frac{Bc}{A+B}} - (1 + r)^{-\frac{Ac}{A+B}}\right]$$

Notice that:

$$\frac{\partial f}{\partial c} > 0 \Leftrightarrow \left(\frac{AB}{A+B}\right)\ln(1+r)\left[(1+r)^{\frac{Bc}{A+B}} - (1+r)^{-\frac{Ac}{A+B}}\right] > 0$$
$$\Leftrightarrow (1+r)^{\frac{Bc}{A+B}} > (1+r)^{-\frac{Ac}{A+B}}$$
$$\Leftrightarrow (1+r)^{\frac{Bc}{A+B}+\frac{Ac}{A+B}} > 1$$
$$\Leftrightarrow r > 0 \text{, for } c \neq 0$$

This shows that $A(1+r)^{\frac{Bc}{A+B}} + B(1+r)^{-\frac{Ac}{A+B}}$ reaches a local minimum at $c = 0$, when it is equal to $A + B$.

Hence for $c \neq 0$, or $a \neq b$, and $r, A, B > 0$:

$$z < z^*$$

NERA
Economic Consulting

NERA Economic Consulting
Level 16
33 Exhibition Street
Melbourne 3000
Tel: +61 3 9245 5537
Fax: +61 3 9245 5123
www.nera.com