FINAL REPORT

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WACC for TPI's Iron Ore Railway

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1. SUMMARY

CRA was retained by the Economic Regulation Authority (the Authority or ERA) to provide recommendations on the WACC methodology and parameter values considered by the consultant to be appropriate for the Authority's 2009 Weighted Average Cost of Capital (WACC) for The Pilbara Infrastructure's (TPI's) iron ore railway in the Pilbara. We provided the Authority with a draft report which the Authority considered in preparation of its Draft Determination.[1,2] The Authority has asked CRA to update its report to take account of submissions on the Draft Determination and to utilise the latest values for the various parameters. We summarise below our analysis of parameters for the WACC and the WACC calculation, and then provide our comments on the issue of compensation for asymmetric risk.

1.1. WACC CALCULATION

Consistent with the Authority's established practice, we calculate the WACC for TPI's iron ore railway using the Officer version of the Capital Asset Pricing Model (CAPM).[3]

1.1.1. Nominal Risk-Free Rate of Return

We use the yield on benchmark 10-year Commonwealth Government Bonds as the nominal risk-free rate of return. Consistent with the approach adopted by the Australian Energy Regulator (AER), the Victorian Essential Services Commission (ESC) and the Authority in the 2008 Freight and Urban Railways Determination,[4] we apply the average rate across the most recent 20 trading days. The average yield on 10-year Commonwealth Government Bonds for the 20 trading days prior to 29 May 2009 was 5.021%.

1.1.2. Debt

Based on available capital market evidence, a benchmark credit rating of BB with a corresponding debt risk premium of 677.07 basis points is recommended.

Gearing ratios currently observed in the capital markets do not show a consistent relationship to credit rating. This is because of the variability of asset riskiness within any given rating band and, at least in part, because of the effects of the recent financial crisis. In particular, the cost of risky debt is substantially higher today than it was before the crisis and firms which took on debt before the crisis will be able to sustain higher levels of debt than firms starting with no debt today.

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1 CRA (2009) *WACC for TPI's Iron Ore Railway*, Draft, 5 January 2009.

2 Economic Regulation Authority (2009) *Weighted Average Cost of Capital for The Pilbara Infrastructure's Railway from the Cloud Break Iron Ore Mine in the Pilbara to Port Hedland*, Draft Determination, 9 January 2009.

3 The Officer version of the CAPM adjusts equity returns for franking or dividend imputation credits.

4 Economic Regulation Authority (2008) *2008 Weighted Average Cost of Capital for the Freight (WestNet Rail) and Urban (Public Transport Authority) Railway Networks*, Final Determination, 23 June 2008.

Having considered the issues raised in submissions on the Draft Determination, we recommend an "affordable" gearing ratio of 16.5% be used in conjunction with the BB credit rating. This is a different approach to that usually employed in regulatory determinations, where the gearing is set from capital market evidence, but without considering whether the firm would genuinely be able to pay both interest and earn an average return on equity (ROE) equal to the required cost of equity. The affordable gearing ratio is the level of gearing that is consistent with the firm being able to pay interest on debt and earn an ROE that is equal to the calculated cost of equity *without any changes in the level of earnings before interest and taxes (EBIT)*. This approach implicitly assumes that a decrease in the credit rating is associated with an increase in the volatility of cash flows rather than a change in the average level. A higher level of gearing would also be possible but this would necessarily require a higher WACC and a higher level of revenue and prices.

The difference in debt premium between a BB credit rating and a BBB credit rating is approximately 287 basis points (bps) (i.e., 2.87%). However, after allowing for changes in the affordable gearing as the credit rating (and hence cost of debt) changes, there is no material impact on the WACC from the choice of credit rating.

1.1.3. Gamma

Gamma can be calculated as the product of (i) theta – the proportion of imputation credits distributed that can be utilised by investors – and (ii) the proportion of credits created that can be distributed.

A detailed study of all the literature relevant to the determination of gamma is beyond the scope of this report. However, our interpretation of the empirical studies is that there is some support for a theta of zero and support for a theta as high as 0.37. The estimate of 0.57 obtained by Beggs and Skeel (2006) has effectively been superseded by Gray (2009) who has extended the dataset to include more recent data (although we note that the AER dismisses this study). [5] The larger dataset produces more accurate estimates of theta, and reduces the estimate to 0.37.

Anecdotal evidence suggests that foreign investors are the marginal investors in the Australian market. If this is true then there is a strong theoretical argument that the value of theta should be zero based on the notion that the marginal investor is a foreign investor who is not able to make use of imputation credits. As noted by Synergies, this view is supported by a number of empirical studies which are not concerned with the specific identity of the marginal investor.

In the absence of evidence to the contrary, it is reasonable to assume that 71% of imputation credits created are distributed in the year that they are created. Imputation credits retained and paid out in future years still have positive value. If retained imputation credits are paid out over a period of one to five years, then it is reasonable to adopt a value of 93% for the effective payout ratio.

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5 Australian Energy Regulator (2009) *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, Final Decision, May, p. 400.

Multiplying together the values for theta and the effective payout ratio suggests a range of 0 to 0.34 for gamma.[6]

If gamma is a weighted average across investors, rather than being set by the marginal investor alone, then it is possible to use foreign investment statistics to derive an upper bound on the likely value of gamma. Recent statistics show that foreign investors own approximately 50%-55% of the Australian equity market. If foreign investors' weight is equal to 50% and they are unable to utilise imputation credits then the effective payout ratio of 93% suggests a maximum value for gamma of 0.465. If the appropriate weight for foreign investors is higher, reflecting a higher share of the equity market and a stronger influence on prices, then the implied value for gamma will reduce. If foreign investors are given a weighting of 60% then the implied value for gamma is 0.372. A gamma of 0.34 is consistent with Australian investors having a weight of 37% and being able to fully utilise imputation credits, or with Australian investors having a higher weighting and being unable to fully utilise imputation credits.

On balance we consider that a gamma of 0.34 is a reasonable value to employ:

- It is consistent with the Gray (2009) estimate of theta;
- It is consistent with an effective payout ratio calculated using a methodology such as that in AER (2009);
- It is consistent with foreign investors having a weight of 60%, which is slightly higher than their actual ownership of Australian equities, with the higher weighting reflecting a superior ability to move capital into and out of Australia;
- It is consistent with Australian domestic investors having a weight of 40% and not being able to fully utilise imputation credits due to factors (but still with a utilisation rate higher than 90% for domestic investors); and
- It is consistent with the broad conclusion from Synergies (2008) that gamma is less than 0.5.

1.1.4. Debt Beta

The Authority requested that CRA prepares an estimate of the debt beta. The literature we have reviewed indicates that the debt beta is a function of the credit rating. The benchmark credit rating of BB corresponds to an average debt beta of 0.08 times the assumed equity beta with a standard deviation of 0.025. Computed against the market portfolio (which has an equity beta of 1) this suggests a beta of 0.08 within a range of 0.055 to 0.105 (one standard deviation on either side of the mean). However, as we demonstrated in our draft report, calculations of the WACC with a debt beta of zero and a debt beta of 0.1 indicate that the debt beta makes no material difference to the WACC. We therefore recommend that the Authority applies a debt beta of zero.

6 The upper bound is calculated as gamma = 0.37 x 0. 93 = 0. 3441.

1.1.5. Asset Beta

As set out in the Issues Paper, our view is that the systematic risk of iron ore mining is relevant to the systematic risk of TPI's railway. We discuss further in this report how an efficient contract is likely to share volume risks between a railway and its customers, and how margin pressures will ultimately also be shared between the two parties. However, we do not agree with FMG's suggestion that the systematic risk of TPI should be the same as the systematic risk of FMG.

The Authority is of the view that it has not been adequately demonstrated that the systematic risk of an infrastructure business depends on the systematic risk of its customers. The Authority has therefore requested that we prepare an estimate of a WACC for an infrastructure business with the characteristics of TPI's railway.

We were unable to find any direct comparators for TPI's railway. This is because single-use railways are generally part of a larger firm, whether as part of a firm that owns and operates multiple railroads or as part of a firm that uses or produces the commodity transported. As a result, we were not able to identify any single-use railways on any stock market. There are also no firms in other industries that provide a direct comparator.

One option is to estimate the beta for an infrastructure firm based on the betas of freight railroads in Canada and the United States. We have selected these firms as comparators because they are focussed on the transportation of freight, primarily by rail (although they may also have intermodal and other operations). However, the large and diversified nature of the firms may mean that their betas are lower than the betas that might apply to a relatively small single-use railroad. Weighting the asset betas by total enterprise value, this suggests an asset beta of 0.71. The asset beta estimate is what might apply to a general freight railroad such as WestNet, and provides a lower bound on the asset beta for TPI.

Another option is to rely on the beta of Genessee & Wyoming Inc. (GWI), which owns leases and operates a total of 48 regional short line railroads. GWI is the sole estimate that we have for short line railroads and the portfolio of railroads owned by GWI mean that it is somewhat representative of the "short line railroad" industry. GWI has an asset beta of 1.23. However, GWI also has considerable diversity across industries served and across regions, so again it might not provide a particularly good comparator for TPI. In addition, the practice of relying on the beta for a single firm is usually discouraged because the high errors inherent in beta estimation mean that a single beta estimate may have significant inaccuracies.

Our view is that there is likely to be some sharing of risk between mines and an independent railway that was serving those mines. As a result, the asset beta for such a railroad would lie somewhere along a continuum between the asset beta for a diversified freight railroad and the asset beta for mining. The beta of Australian mining firms will be biased upwards when estimated against the Australian stock market index because of the relatively high weighting of mining firms in the Australian market.[7] Correcting for that bias, we estimate that the asset beta for iron ores is 1.55. The asset beta for TPI's railway is thus likely to lie between 0.71 and 1.55.

1.1.6. Inflation Forecast

The capital cost component of floor and ceiling costs is an annuity based on the annually-inflated Gross Replacement Value (GRV) of the relevant rail assets. When the underlying asset base is inflated then the annuity must be adjusted for inflation – either by an explicit deduction for the gains from inflation or by using a real WACC in the annuity calculation. The Authority adopts the latter approach.

The NPV of a nominal annuity calculated with the nominal WACC will equal the initial capital cost of the underlying asset. When calculating a real WACC to apply with an annually-inflating asset base the aim is also to obtain an NPV equal to the initial capital cost of the underlying asset. This is most likely to be achieved if the estimate of future inflation applied to calculating the real WACC is the same as the inflation adjustment that will be applied to the GRV. If the GRV is inflated annually by CPI, then a forecast of the same measure should be applied when calculating the real WACC.

The RBA's May 2009 *Statement on Monetary Policy* forecast CPI inflation of 2.5% for the year to 30 June 2010,[8] and the Federal Government's 2009-10 Budget forecast CPI inflation of 1.75% over the same period.[9]

A high inflation forecast increases the chance that actual inflation is less than the forecast. This increases the chance that the calculated floor and ceiling costs are lower than they should be. Conversely, a low inflation forecast increases the chance that actual inflation is greater than the forecast, increasing the chance that the calculated floor and ceiling costs are higher than they should be. Floor and ceiling costs are not fixed prices that must be charged, but simply set bounds on the negotiated prices. There may be many instances where changing the calculated floor and ceiling costs has no impact on actual prices. But there may also be other instances where the ceiling costs are a binding constraint; and more generally the relative level of the floor and ceiling may influence the negotiated price that parties are prepared to agree. If prices are too low then incentives to invest in infrastructure are reduced. Because of this effect on investment incentives, we consider that it is better for the Authority to adopt the lower inflation forecast of 1.75%.

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7 We note that this problem occurs whenever a firm or group of firms forms an abnormally large component of a local market. Betas can be biased upwards giving the aberrant result that an investor would require more to invest in that firm because it is listed on that local market rather than on some other market.

8 Reserve Bank of Australia (2009) *Statement on Monetary Policy*, 8 May, p. 69.

9 Commonwealth of Australia (2009) *Budget Strategy and Outlook 2009-10*, Budget Paper No. 1, 12 May, pp. 2-6.

1.1.7. WACC Estimate

Given the parameter values discussed above, we calculate the nominal vanilla WACC and pre-tax real Officer WACC for TPI as shown in Table 1.

The lower-bound estimate is provided by US and Canadian railroads: using the recommended parameter estimates, the nominal vanilla WACC is 10.40% and the pre-tax real Officer WACC is 10.55%. The upper-bound estimate is provided by iron ore mining: using the recommended parameter estimates, the nominal vanilla WACC is 15.43% and the pre-tax real Officer WACC is 16.71%.

GWI is the only example of a short line railroad. Using the recommended parameter estimates the nominal vanilla WACC is 13.51%-13.54%. The corresponding pre-tax real Officer WACC is 14.36% when gamma is equal to our recommended value of 0.34, or 13.59% when gamma is equal to 0.5.

As a sensitivity analysis, we have also calculated the pre-tax real Officer WACC based on a BBB credit rating and gearing of 35%. With these assumptions the pre-tax real Officer WACC increases by 0.02%-0.07% above the estimates presented in Table 1.

Table 1: Calculation of WACC Estimates

		Floor: US & Canadian Railroads	**Genesee & Wyoming**		**Ceiling: Iron Ore Mining**
			Gamma = 0.34	**Gamma = 0.50**	
Nominal Risk Free RoR	rf	5.021%	5.021%	5.021%	5.021%
Gearing	D	16.5%	16.5%	16.9%	16.5%
Debt Premium (bps)	p	677.07	677.07	677.07	677.07
Debt Issuance Costs (bps)	dic	12.5	12.5	12.5	12.5
Cost of debt	rd	11.92%	11.92%	11.92%	11.92%
Market risk premium	MRP	6.00%	6.00%	6.00%	6.00%
Corporate tax rate	T	30.0%	30.0%	30.0%	30.0%
Gamma	γ	0.34	0.34	0.50	0.34
Asset Beta	Ba	0.71	1.23	1.23	1.55
Debt Beta	Bd	0	0	0	0
	D/E	0.198	0.198	0.203	0.198
	X	0.194	0.194	0.200	0.194
Equity Beta	Be	0.85	1.47	1.48	1.85
Required Return on Equity	re	10.11%	13.83%	13.88%	16.12%
Nominal Vanilla WACC	w_N	10.40%	13.51%	13.54%	15.43%
Pre-tax nominal Officer WACC		12.49%	16.36%	15.58%	18.75%
Inflation		1.75%	1.75%	1.75%	1.75%
Pre-tax real Officer WACC	w_R	**10.55%**	**14.36%**	**13.59%**	**16.71%**

1.2. ASYMMETRIC RISK

In the Issues Paper we reviewed the various measures suggested by TPI as potential ways to provide compensation for asymmetric risk. As we noted in the Issues Paper, a number of the options reviewed by TPI are extremely complex to implement and there is a lack of good data for developing a robust estimate.

We have reviewed the various submissions on asymmetric risk. The North-West Iron Ore Alliance (NWIOA) and the United Minerals Corporation (UMC) argued strongly that there is little risk of a large scale reduction in demand (and hence stranding), while the Australian Rail Track Corporation (ARTC) noted that there has been a drop-off in orders from some suppliers.[10] This latter point has also been reported in the press, although it appears to be localised to certain suppliers.[11] We are somewhat less optimistic about the future than the NWIOA or UMC. However, an economic interpretation of a supply curve produced by FMG (and submitted by NWIOA and UMC) suggests that Fortescue Metals Group's (FMG's) Pilbara operations could be largely insulated in the event of a decline in demand. This suggests that that the stranding risk for the overall TPI railway does not appear to be large.

Although stranding risk in total does not appear to be large, it is still possible that stranding risk could be material for particular parts of the TPI system, particularly in relation to parts of the network that have been constructed specifically at the request of third parties. It is reasonable, therefore, to have some means of providing compensation for, or protection against, asymmetric risk.

Suggestions were made by various parties on alternative means for compensating for asymmetric risk, with Hancock Prospecting (HPPL) and the NWIOA noting that asymmetric risk should not be compensated in the WACC if it is already allowed for elsewhere. TPI's own proposals to utilise accelerated depreciation were noted by NWIOA and UMC, as was the ability for TPI to require up-front capital contributions to help meet the cost of capacity expansions. ARTC suggests the adoption of a "loss capitalisation" approach – whereby losses over the early period of the project are capitalised – in preference to accelerated depreciation. ARTC also suggests that an increment on the WACC or selecting a value from the upper end of a range of values could understate the risks to TPI. The NWIOA noted that the railway should not be treated as a whole when assessing stranding risk – we agree with this and note that individual branch connections and capacity upgrades for a specific user are far more likely to be stranded than the mainline. The NWIOA and UMC propose an approved programme of Major Periodic Maintenance as an alternative to depreciation.

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10 ARTC (2008) *Economic Regulation Authority – Issues Paper: Determination of the Weighted Average Cost of Capital for The Pilbara Infrastructure's Railway from the Cloud Break Iron Ore Mine in The Pilbara to Port Hedland*, ARTC Submission, p.3.

11 On 9 October 2008 Mt Gibson Iron released a statement to the Australian Stock Exchange indicating it had been asked to postpone deliveries. However, BHP Billiton, Rio Tinto and FMG all indicated that they had not had similar problems. See "China Steel Mills Slowing Ore Demand, Mt Gibson Says", Bloomberg, 9 October 2008. Available online at http://www.bloomberg.com/apps/news?pid=20601081&refer=australia&sid=acX0jM7Lgy2I.

We consider the vast majority of all of these points are very valid, but it is unclear whether NWIOA's suggested treatment of Major Periodic Maintenance would provide full compensation to TPI. TPI's original submission suggested ways to increase the WACC to compensate for asymmetric risk. Our view is that the various measures suggested above provide a more robust means of dealing with asymmetric risk than the TPI proposals. The suggestions by submitters also benefit from not relying on contentious estimates of what an appropriate risk premium might be. Up-front capital contributions would eliminate stranding risk for the portion of any capacity expansion that is covered by the contribution, and accelerated depreciation would significantly reduce stranding risk for the residual.

Nevertheless, it is reasonable for TPI to require some protection against asymmetric risk. There are a range of mechanisms available for this that do not rely on contentious estimates of an additional premium, including accelerated depreciation, up-front capital contributions, alternative treatment of major periodic maintenance, etc. We recommend that the Authority uses those mechanisms to minimise asymmetric risk rather than increasing the WACC.

2. INTRODUCTION

2.1. PROJECT SCOPE

CRA was retained by the Economic Regulation Authority (Authority or ERA) to provide recommendations on the parameters to be applied in the calculation of the WACC for TPI's iron ore railway in the Pilbara. The WACC model applied should be the Officer model, as applied by the Authority in the 2008 Freight and Urban Railways Determination. The market risk premium should also be the 6% value applied in the Authority's other determinations. CRA's advice on the WACC is therefore primarily focussed on:

- Selecting appropriate comparator companies;
- Estimating the cost of debt;
- Systematic risk and calculating the cost of equity (using the assumed market risk premium); and
- Conversion of the nominal post-tax WACC to a real pre-tax WACC.

The Authority also requested CRA to provide advice on the treatment of asymmetric risk.

2.2. REPORT STRUCTURE

This report is structured as follows:

- Section 3 estimates the nominal risk-free rate of return and the cost of debt;
- Section 4 discusses issues of taxation and dividend imputation;
- Section 5 discusses systematic risk and presents estimates of the debt beta, asset beta, and equity beta;
- Section 6 provides some brief comments on the Market Risk Premium;
- Section 7 presents the calculation of the WACC; and
- Section 8 considers the magnitude and appropriate treatment of asymmetric risk.

3. THE RISK-FREE RATE OF RETURN AND THE COST OF DEBT

The cost of debt is calculated as the sum of the risk-free rate of return, the estimated debt premium and the estimated debt issuance costs. FMG has questioned the validity of this standard methodology, arguing instead that actual debt costs should be used; we address this objection in section 3.1. We then estimate the nominal risk-free rate in section 3.2. In section 3.3 we establish the benchmark credit rating and estimate the associated debt premium in section 3.3. We discuss debt issuance costs in section 3.4 and estimate the appropriate level of gearing for each credit rating in section 3.5.

3.1. APPROPRIATENESS OF STANDARD METHOD

The "standard method" for calculating the cost of debt in regulatory determinations is to estimate the market cost of debt as the sum of the risk-free rate of return, a debt premium corresponding to a benchmark credit rating and debt issuance costs. FMG argues that instead, TPI's cost of debt should be set equal to FMG's cost of debt, which FMG calculates to be equal to 11.87%. This is the weighted average of (a) long-dated fixed interest bonds with an interest rate of 10.22% at issue and (b) the effective interest rate on a complex debt and equity purchase by Leucadia.

Before dealing with the specific objections raised by FMG, we note that it is always correct to use the market rate of interest rather than a historical rate. As market interest rates rise above the coupon rate for a bond, the price (value) of that bond declines, thus increasing the effective interest rate until it is equal to the market interest rate. Similarly, if market interest rates fall below the coupon rate for a bond, the price (value) of that bond rises, reducing the effective interest rate until it is equal to the market interest rate. Just as market values are used for calculating the cost of equity, market values should also be used for calculating the cost of debt. If FMG "marked to market" the book value of its debt, then it would observe that its true cost of debt varied as market interest rates varied. The historical weighted average of 11.87% is therefore not a meaningful number for inclusion in the calculation of the WACC and would instead at the very least have to be adjusted to reflect changes in market interest rates.

Specific objections raised by FMG are:

> *the ERA has then made ... three flawed steps, each of which acts to prejudice the interests of TPI:*
>
> - *Firstly, it has chosen to apply a benchmark gearing ratio which is not appropriate given the risk characteristics of TPI.*
> - *Secondly, it has chosen to calculate the nominal risk free rate of return at a time when the Global Financial Crisis ("GFC") has seen a 'flight to quality' that has compressed the apparent real risk free rate of return to a historical low, and yet no adjustment has been made to compensate for what is undoubtedly an unusual and relatively short term phenomenon.*

- *And finally, it has calculated a debt margin based on a BBB credit rating, when TPI obtains its debt from Fortescue, and Fortescue has a B+ credit rating which therefore should have been adopted.*[12]

> *The cost of debt in a WACC calculation should be based on the benchmark gearing and benchmark credit rating applicable to TPI. As argued ..., actual gearing and credit rating are appropriate proxies for benchmark measures.*[13]

The precise value of the risk-free rate is irrelevant for two reasons:

- First the *observed* cost of benchmark corporate debt is decomposed into the risk-free rate plus a premium. That premium is then added to an updated estimate of the risk-free rate to obtain a close estimate of the market cost of corporate debt. If the risk-free rate drops but the cost of corporate debt does not, then there is an increase in the debt premium but the estimated cost of debt remains unchanged.
- Second, even if the cost of corporate debt did decrease due to the Global Financial Crisis, it would be appropriate to use that lower value because it reflects the market cost of debt, which is the true economic cost of debt to the firm.

Our view is that FMG's credit rating is not an appropriate proxy. We address this point in detail in section 3.3.1 below. With a materially different credit rating, FMG's cost of debt could not be the appropriate cost of debt for TPI.

We therefore conclude that FMG's objections to the method used for calculating the cost of debt are neither correct nor relevant. They do, however, raise some valid points about the benchmark credit rating: this issue is addressed in section 3.3.1 below.

3.2. NOMINAL RISK-FREE RATE OF RETURN

We use the yield on benchmark 10-year Commonwealth Government Bonds as the nominal risk-free rate of return. Consistent with the approach adopted by the AER, the Victorian Essential Services Commission and the Authority in the 2008 Freight and Urban Railways Determination, we apply the average rate across the most recent 20 trading days.

FMG and Synergies suggested that the risk-free rate should be adjusted upwards, by using a 12-month average and by making an adjustment for the convenience yield.[14,15]

12 FMG (2009) "Submission in Response to Draft Determination of WACC for TPI Railway", letter to Mr Russell Dumas, Director – Gas and Rail Access, Economic Regulation Authority, 27 February 2009, p. 2.

13 FMG (2009), p. 8.

14 FMG (2009), p. 6.

15 Synergies (2009) The Pilbara Infrastructure Ltd: WACC Draft Determination Response, February 2009, pp. 14-16.

There is no valid reason to use a 12-month average for the risk-free rate of return. MRP and betas are measured using many years of data because there is no robust indicator of expected values for these parameters. This is not the case with interest rates and, in an ideal world, an instantaneous observation should be preferred. That is, ideally no averaging should be undertaken at all. However, some averaging may be relevant where price volatility is a function of low liquidity. In this case 20 days appears to be adequate.

The main point is that at the outset of a tariff period the regulated firm can lock in the cost of debt for the entire tariff period and therefore it does not matter whether the yield curve is actually a good estimate of what will happen over that period or not. This is also true where the risk-free rate is underpinning the cost of equity. The investor can hedge their return using government stock and by so doing "lock in" the expected margin even if interest rates change.

The second argument raised is that there should be an adjustment for the convenience yield. Contrary to Synergies' argument, table 1 in Synergies report (p. 16) does not appear to show an increase in the convenience yield as suggested. It shows an 80 bps increase in the credit default swap (CDS) cost but a decrease in the bias. If the driver of this bias is supply of Commonwealth Government Securities (CGS) relative to GDP (as per Hird and Grundy (2007),[16] cited by Synergies) then given supply is now increasing the bias should be falling.[17] We further note that historically relevant risks which have been overlooked and/or under-estimated are: the under-pricing of default risk (e.g. by AIG); and counterparty risk (e.g. Lehman Bros and AIG). We would expect that these risks would be priced more accurately following the financial crisis, and as such the cost of CDS will increase without having any implication for the risk-free rate.

In order to calculate the hypothetical cost of debt of a marginal investor, it is important to match the maturities of the benchmark risk-free rate with the suggested spread above the risk-free rate. Therefore, we rely on 10-year spreads over the benchmark rate to match the Authority's choice of the risk-free rate.

The average yield on 10-year Commonwealth Government Bonds for the 20 trading days ending 29 May 2009 was 5.021%.

3.3. DEBT PREMIUM

We calculate the debt premium as the average premium for 10-year corporate bonds at a benchmark credit rating over the yield on 10-year Commonwealth Government bonds. The premium would ideally be based on observed premia.

16 Hird, T. And B. Grundy (2007) *Bias in Indexed CGS Yields as a Proxy for the CAPM Risk Free Rate*, A report for the ENA, NERA, March.

17 We note that the Reserve Bank of Australia's Table E05 indicates that bond tenders have increased from $5.6bn - $5.9bn per annum over 2006-2008 to $7.2bn in the period 1 January 2009 – 11 March 2009. In addition, the announcement of major infrastructure investments like broadband will mean that markets will be pricing in the expectation that supply will increase further.

3.3.1. Benchmark Credit Rating

In our draft report we utilised a benchmark credit rating of BBB, which was the average credit rating across the identified sample of potentially comparable firms.

In its submission on the Draft Determination, HPPL argued that a "BBB rating is appropriate and the rating should reflect that for an infrastructure provider and not have any regard to the credit rating of the major infrastructure customers".[18] Conversely, FMG and Synergies argued that the benchmark of BBB was too high and that the appropriate credit rating is that of FMG, which is B+.[19,20]

Our view is that FMG and Synergies raise some important and valid issues, although we disagree with their conclusion. We see two key issues arising from the various comments made by FMG and Synergies:

- The extent to which large relatively diversified US Class 1 railroads provide an appropriate benchmark for TPI; and
- The extent to which customer credit ratings affect the firm.

On the question of whether a diversified business affects the credit rating, it is worth quoting at length from Standard & Poor's:[21]

> *Standard & Poor's has no minimum size criterion for any given rating level. However, size turns out to be significantly correlated to ratings. The reason: size often provides a measure of diversification, and/or affects competitive position.*
>
> *...*
>
> *Small companies are, almost by definition, more concentrated in terms of product, number of customers, or geography. In effect, they lack some elements of diversification that can benefit larger companies. To the extent that markets and regional economies change, a broader scope of business affords protection. This consideration is balanced against the performance and prospects of a given business.*
>
> *...*
>
> *Large companies have substantial staying power, even if their businesses are troubled. Their constituencies—including large numbers of employees—can influence their fates. Banks' exposure to these companies may be quite extensive, creating a reluctance to abandon them. Moreover, such companies often have accumulated a lot of peripheral assets that can be sold. In contrast, the promise of small companies can fade very quickly...*

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18 HPPL (2009) "Draft Determination on Weighted Average Cost of Capital for the Pilbara Infrastructure Railway", letter to Mr Russell Dumas, Director – Gas and Rail Access, Economic Regulation Authority, 19 February 2009, p. 2.

19 FMG (2009), p. 8.

20 Synergies (2009), p. 19.

21 Standard & Poor's, *Corporate Ratings Criteria 2006*, p. 22.

These comments by Standard & Poor's offer strong support for Synergies' argument that the large diversified Class 1 US railroads provide a poor benchmark for TPI's credit rating.

Synergies also raises the argument that the credit rating for TPI could not be higher than the credit rating for its major customer, FMG.[22] Conceptually, a key determinant of credit ratings must be the implied security of revenue streams. This is the very reason why a large diversified company has a higher credit rating – its diverse revenue streams have lower risk than revenue streams that are concentrated on just a few customers. An independent company in the same position as TPI would only ever have very few customers: either a small number of moderate sized mines, or a large customer with the potential of several smaller customers. We therefore agree with the premise that the customer credit ratings are relevant to the credit rating of TPI. However, we do not agree that the ratings should be the same.

If TPI provided a non-essential service to the mines then the security of the revenue stream would be less than FMG's credit rating. In that case, we would assume that the revenue stream is unsecured and thus would have a lower rating than the secured debt (which is rated B+). This is the situation that corresponds to Synergies claim that "Unless some form of credit enhancement is provided, from a lender's perspective, the credit risk of a loan to the railway can be no better than the credit risk of the major customer".[23]

However, our view is that TPI clearly provides an essential service. A mine owner could default on debt and have its assets liquidated, but the new owner (possibly the bond-holders) could continue to operate the mine and require rail transportation (unless revenues are unable to match avoidable costs excluding financing costs). This suggests that TPI's revenue stream could be *more secure* than any debt issued by TPI's customers. We therefore conclude that the appropriate benchmark credit rating for TPI could be higher than the credit rating of debt issued by its customers.

This leads to the follow-on question of what is a reasonable estimate of the credit rating of TPI's customers. Very few mining companies have credit ratings, so it is not possible to draw from a wide sample. FMG has a credit rating of B+ and is probably representative of miners with undiversified operations focussed on iron ore, although we note that FMG's relatively high debt level may result in a credit rating that is lower than it otherwise would be.[24] We therefore increase the customer credit rating by one notch to BB- and use this rating as the bottom end of the likely range.

Considering all these factors, it seems likely that a benchmark rating would lie somewhere in the range from BB- to BBB. This is a very wide range (in terms of the differences in credit spread). Synergies suggest the Panama Canal Railway (PCR) as a comparator, which has a credit rating of BB. This is just below the mid-point of the BB- to BBB range. The Panama Canal Railway may be a reasonable comparator from the

22 Synergies (2009), p. 19.

23 Ibid.

24 CapitalIQ reports that as of 29 May 2009, FMG's market capitalisation was $6,665.9m and total debt was $3,607.7m, giving a gearing ratio (debt to debt plus market capitalisation) of 35%.

perspective that it is a single line railway. However, we note that there are some significant differences between PCR and TPI:

- PCR has a more diverse source of traffic than TPI (PCR is lower risk);
- Traffic for PCR is likely to be on an opportunistic basis whereas traffic for TPI is more likely to be under contract and, as we have noted, is an essential service for the mines serviced (TPI is lower risk);[25] and
- PCR will not be facing the large level of capital expenditure currently required for establishing TPI's railway (PCR is lower risk).[26]

Finally, we note that the benchmark credit rating is ultimately used for setting regulated floor and ceiling costs for third party access rather than for FMG. If there are extra risks associated with FMG's mine operations then those risks are in the first instance relevant to the pricing agreed between TPI and FMG rather than to third party access prices. We also note the estimated mine life of 20 years for the Cloud Break and Christmas Creek developments.[27] The appropriate way to manage that risk is through accelerated depreciation (i.e., use asset lives that reflect the impact of the expected mine life) rather than through ad hoc adjustments to the credit rating.

On balance, our view is that a BB credit rating is likely to be appropriate for the TPI railway.

3.3.2. Methodology for Calculating the Premium

There are so few 10-year corporate bonds issued in Australia that it is necessary to either rely on a prediction model or to apply the premium for the closest benchmark reported by a source such as Bloomberg.

For the 2008 Freight and Urban Railways Determination the Allen Consulting Group (ACG) utilised the predictions generated by Bloomberg and by CBA Spectrum and adjusted those predictions to reflect average differences compared with actual data.[28]

An alternative approach used by the Victorian Essential Services Commission is to apply the premium for benchmark Australian corporate 8-year bonds. More specifically, the spread between 8-year BBB rated and A rated corporate bonds is added to the spread between 10-year A rated and government bonds. In this approach the spread between 8-year BBB rated and A rated corporate bonds is used as a proxy for the spread on 10-year bonds. This approach was deemed necessary because there was no 10-year benchmark index for BBB rated Australian corporate bonds but there is an 8-year benchmark.

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25 Container traffic is the primary source of income for the railway, but this is diversified across commodities and industries. There is also a tourist train for passengers.

26 In 2000 and 2001 the Panama Canal Railway was upgraded to handle large shipping containers for ships that are too large to pass through the Panama Canal. PCR has therefore passed its large capital expenditure phase.

27 Synergies (2009), p. 5.

28 ACG (2007) *Railways (Access) Code 2000: Weighted Average Cost of Capital, 2008 WACC Determinations*, Report to the Economic Regulation Authority, October, pp. 20-21.

The Authority has requested estimates of the debt premium for credit ratings of BBB+, BBB, BBB-, BB+, BB, and BB-. There are insufficient Australian corporate bond issues at most of these ratings to have a benchmark index developed or published. For example, there are only four BB rated Australian companies. We therefore use the spreads on US corporate bonds as a proxy for the spreads on Australian corporate bonds. More specifically, we develop a proxy for the return on a 10-year BB rated corporate bond by adding (a) the spread between 10-year BB and A rated US corporate bonds to (b) the spread between 10-year A rated Australian corporate bonds and 10-year Australian government bonds. This can be expressed as the following formula:

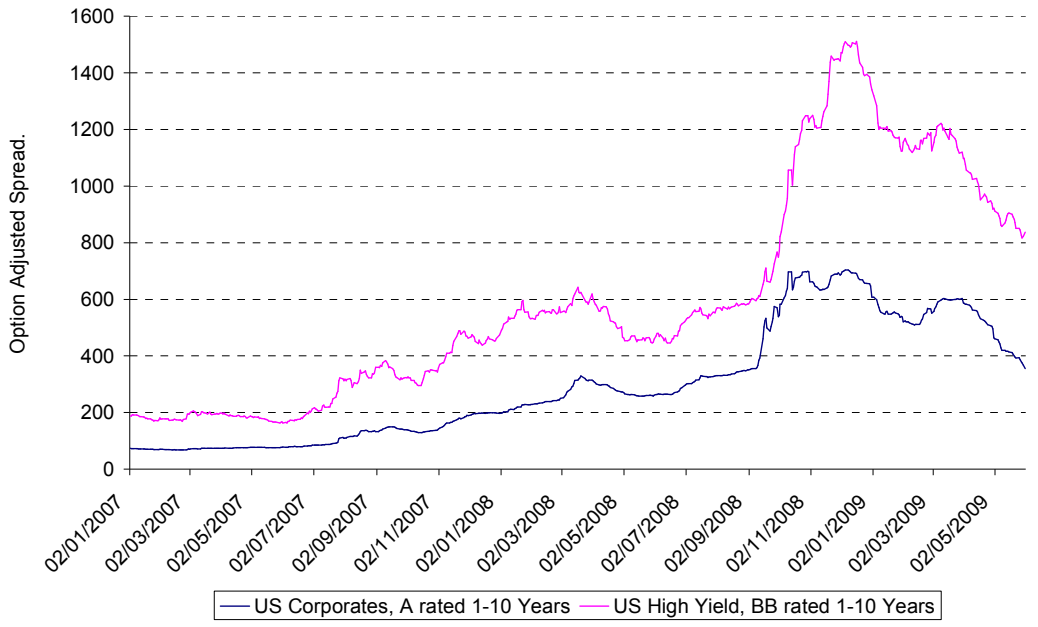
Spread = (10-year BB US Corporate –10-year A US corporate)
+ (10-year A AU Corporate –10-year AU Government benchmark)

The same approach is adopted for each other credit rating of interest.

3.3.3. Spreads of BB rated Australian and US firms over benchmark government rates

As Figure 1 below shows, spreads on A and BB rated US bonds have widened substantially since the beginning of the credit crunch in mid-2007. At the end of May 2009, the spread on BB rated US corporate bonds maturing in between 1 and 10 years was approximately 800 basis points. This is a 600-basis point change since before the crisis when spreads were closer to 200 basis points, although significantly lower than the 1,500-basis point spread at the end of 2008.

Figure 1: Spreads for A and BB rated corporate US bonds with maturities of 1-10 years (spread over benchmark risk-free rate, basis points)

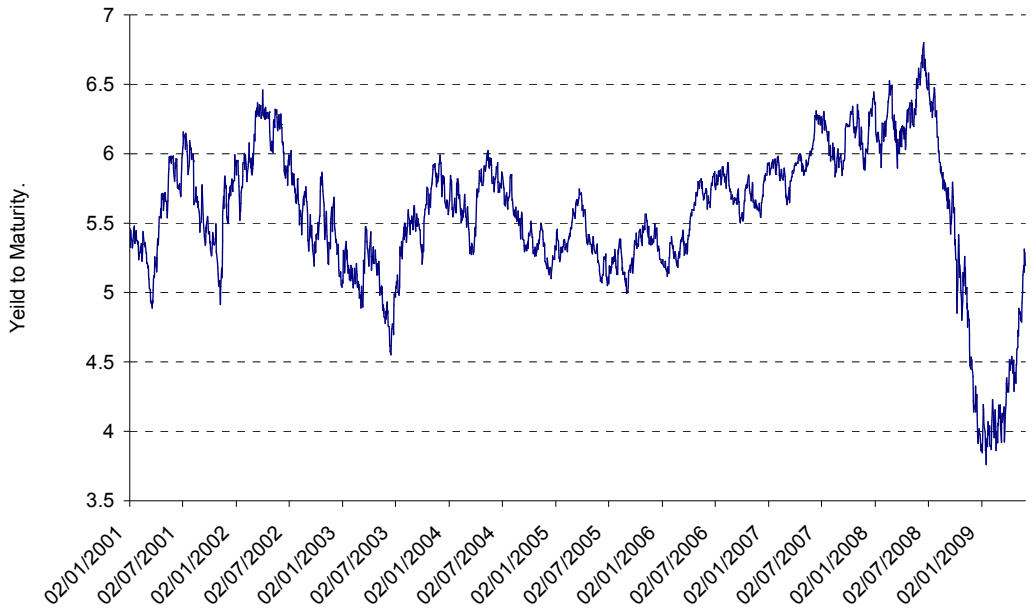


Source: Bloomberg, ML C4A3 and C4A4 indices.

Unfortunately there is not comparable data available on Australian Corporate bonds. Specifically, there is no index for high yield Australian BB rated bonds. Indeed, a company screen on Capital IQ returned only four companies listed on the Australian Stock Exchange with an S&P BB bond rating.[29] With such a thin and presumably unstable constituent base it is understandable that such an index does not exist.

Some of the recent widening of the spread is driven by the "flight to safety" by capital investors. This has resulted in a decrease in yields of government issued bonds in both Australia (Figure 2) and the US.

Figure 2: 7-10-year Australian Treasury benchmark (yield, %)



Source: Bloomberg.

3.3.4. Spreads on Benchmark Bonds

As described above, we have used the following formula to estimate the spread for each credit rating:

Spread (BB)= (10-year BB US Corporate –10-year A US corporate)
+ (10-year A AU Corporate –10-year AU Government benchmark)

The calculation has been performed for each credit rating from BB- to BBB+. The calculation of these premia are shown in Table 2.

29 As of 15 April 2009.

Table 2: Calculation of Debt Premium on Australian Corporate Bonds for Selected Credit Ratings

	Bond Rating						
	BB-	BB	BB+	BBB-	BBB	BBB+	A
US Spread to A Corporate (%)	4.2768	4.2524	4.1266	2.2721	1.3873	1.2917	
Spread between AUS A Corporate and Govt Bond (%)	2.5182	2.5182	2.5182	2.5182	2.5182	2.5182	2.5182
Total Spread (%)	6.7950	6.7707	6.6448	4.7904	3.9056	3.8100	2.5182
Debt Premium (bps)	679.50	677.07	664.48	479.04	390.56	381.00	251.82

Note: All figures are averages calculated over 20 trading days to 29 May 2009.

3.3.5. Explanation of the Large Increase in Premium from BBB to BB

The debt premium for BBB rated debt ranges from 381 bps for BBB+ rated debt to 479 bps for BBB- debt. There is then a large increase in premium when moving to the BB ratings: BB+ rated debt has a premium of 664 bps.

The reason for the large increase in debt premium is the large increase in default risk that occurs when moving from investment grade (BBB- and above) ratings to speculative grade (BB+ and below) ratings. Table 3 shows the latest cumulative average default rates for all major rating grades, as published by Standard & Poor's. For example, the ten-year default rates show that by the end of ten years, 5.16% of BBB rated issuers and 16.02% of BB rated issuers will have defaulted. Over ten years the default risk is thus 3.1 times higher for BB rated debt than for BBB rated debt.

Market interest rates reflect a premium for the increased default risk of lower-grade debt and also reflect the effect of higher demand for investment-grade securities due to restrictions on the type of securities that some institutions (such as US banks and pension funds) are able to invest in.

Table 3: Global Cumulative Average Default Rates (1981-2008) (%)

	Time horizon (years)									
Rating	1	2	3	4	5	6	7	8	9	10
AAA	0.00	0.00	0.09	0.18	0.27	0.37	0.40	0.47	0.51	0.55
AA	0.03	0.08	0.14	0.25	0.34	0.45	0.56	0.65	0.73	0.83
A	0.08	0.20	0.34	0.52	0.72	0.95	1.21	1.45	1.69	1.94
BBB	0.24	0.68	1.17	1.79	2.43	3.06	3.59	4.12	4.63	5.16
BB	0.99	2.88	5.07	7.18	9.07	10.90	12.41	13.74	15.00	16.02
B	4.51	9.87	14.43	17.97	20.58	22.67	24.46	25.93	27.17	28.41
CCC/C	25.67	34.10	39.25	42.29	44.93	46.24	47.45	48.09	49.53	50.33

Source: Standard & Poor's (2009) "Default, Transition, and Recovery: 2008 Annual Global Corporate Default Study and Rating Transitions", Global Fixed Income Research, 2 April.

3.3.6. Adjustment for Default Risk

In the Issues Paper we raised the question of whether any adjustments should be made for credit or default risk. Synergies commented that:[30]

> *the CAPM is a long-term forward-looking model used to estimate returns required to compensate debt and equity holders for investing in the business. As such, it is only ex-ante returns that are of interest to investors. It is inconsistent with generally accepted modern financial theory to discount such forward looking estimates on the basis of historic realised returns.*

Our view is that expected returns should be discounted using the expected rate of return, and promised returns should be discounted using the promised rate of return. We also note that the estimated cost of equity uses historical calculations of realised returns to calculate an estimate of the expected (i.e. forward looking) cost of equity,[31] and such an approach is also adopted by Synergies.[32]

There is a question whether it is inconsistent to adopt an average of an expected equity return and a promised debt return when calculating a WACC used for regulatory purposes. To the extent that the WACC is used to set maximum revenues or returns, then it may even be appropriate to adjust the cost of equity upwards so that expected revenues – which will be less than the maximum – provide the expected return. Alternatively, if the WACC is used to set what genuinely is an "expected" earnings path, with opportunities to earn both above and below that level then an expected WACC is appropriate, which implies both an expected cost of debt and an expected cost of equity.

Nevertheless, we note that the use of an expected equity return and a promised debt return is the commonly adopted approach and is accepted by both the Authority and submitters. The cost of debt calculated on this basis reflects the cost paid by the benchmark firm if it was issuing debt at the date of the determination, rather than the expected return to holders of that debt. This is consistent with the view that the purpose of the regulatory WACC is to compensate the *firm* for its capital costs.

3.4. Debt Issuance Costs

Debt issuance costs including a variety of fees involved in raising debt finance, such as underwriting fees, legal fees and the costs associated with obtaining a credit rating. These costs are not reflected in the price of traded debt but they are a cost that is borne by the company. Ultimately, a benchmark firm operating in a competitive market (where all firms bear these costs) would have higher prices in order to recover these costs. It is therefore appropriate to make an allowance for debt issuance costs.

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30 Synergies (2008) *The Pilbara Infrastructure Pty Ltd, Review of the Weighted Average Cost of Capital*, October, p. 32.

31 We note in particular that the MRP is an estimate of the historic realised returns on the market portfolio, expressed as a premium over the risk-free rate of return.

32 Synergies (2008) p. 39 states "While acknowledging the conceptual correctness of a forward-looking method to estimate MRP, we are not of the view that survey results should be used to derive estimates of MRP. We have therefore focussed on estimates produced using historical averaging".

For the 2008 Freight and Urban Railways Determination, ACG recommended that the Authority adopt an allowance for debt issuance costs of 12.5 bps. The Authority also adopted this value in its final determination.[33]

HPPL supports the use of 12.5 bps as a benchmark measure of cost of debt raising costs (as used in standard practice by regulators in Australia). ARTC "considers an assumption of 12.5 is appropriate" (due to this allowance being consistently applied in regulatory decisions). Synergies also considers that 12.5 bps is appropriate as an estimate of the ongoing costs of debt funding.

Synergies notes that Dalrymple Bay Coal Terminal (DBCT) was granted an additional premium by the QCA in recognition of additional up-front debt-raising costs, and also notes ACG's September 2004 finding that in addition to up-front financing fees there is typically a commitment fee payable of between 30% and 40% of the debt margin.[34] Synergies translates this fee to an additional allowance of 1% but does not include that 1% in their estimate of the WACC.

Our view is that it is appropriate to include an allowance for initial debt raising costs for the TPI railway. These could be included either as a mark-up on the cost of debt, as a cash-flow item or capitalised into the asset base. In our view there is a reasonable argument to be made for capitalising the initial debt raising costs, as these are: (a) costs that had to be incurred to be able to construct the railway; and (b) are costs incurred for the provision of the railway over a long time horizon.

It is therefore appropriate to include an allowance of 12.5 bps for debt raising costs as part of the cost of debt.

3.5. BENCHMARK GEARING

3.5.1. Draft Report and Submissions

Our draft report considered a number of potential comparator firms. On a debt-weighted basis, on average those firms had BBB (or equivalent) credit ratings, and the average ratio of debt to total enterprise value was 28% for the freight railroads, 34% for the mining related firms and 32% across all firms. We therefore recommended that for a WACC based solely on the freight railroad estimates it would be appropriate to use a ratio of 28% and for a WACC based on both rail and mining firms it would be appropriate to use a ratio of 32%.

However, as discussed in the section on the debt premium, it is likely that the only railway with a credit rating approximately equal to a benchmark credit rating of BB is the Panama Canal Railway. That firm does not belong to our initial sample, so the gearing estimates in our draft report are also potentially no longer relevant. Furthermore, Panama Canal Railway is a privately-held company, so there is no data available on either the level of debt or the market value of the company.

33 ERA (2008), p. 36.

34 ACG (2004) *Dalrymple Bay Coal Terminal: Financing Costs*, Report to Queensland Competition Authority, September p. 15.

The Authority applied a gearing of 35% in the Draft Determination.

HPPL argues that the appropriate gearing is 50%, whereas FMG argues that a number of comparators are inappropriate and that a more suitable range is 10%-15%.

3.5.2. Credit Rating and Gearing

A firm's credit rating reflects the riskiness of its debt and this is clearly a function of the riskiness of the firm's assets and its level of indebtedness. Furthermore, the riskiness of a firm's assets is the product of a number of factors including: industry; exposure to particular customers; firm size; and diversification.[35] Accordingly it is not surprising that rating and gearing are not highly correlated when we look at the data (e.g., see Table 4) in spite of the fact that, all else being equal, higher indebtedness will lead to lower gearing. As a result, it is not possible to set out a deterministic relationship between rating and gearing.

In the case of TPI we have argued that its assets are no more risky (and possibly less risky) than its principal customer FMG. However, its exposure to FMG as one of its major clients, as well as other mining companies, suggests that a more appropriate rating for determining TPI's cost of debt is BB rather than BBB. Unfortunately, as discussed above, this does not lead us directly to an appropriate level of gearing for TPI.

Taking average figures for firms in a particular credit rating band is not only an approximation, but may in fact lead to a significant bias for a hypothetical benchmark firm constructing and owning a railway similar to TPI's. This is because, for riskier investments, the cost of capital contracted today is higher than it was over the last four to five years. As such, other firms in the BB rating may have agreed interest terms which allow them to sustain a substantially higher gearing than a firm today could arrange or afford.

Observed Gearing Across Credit Ratings

Consistent with the discussion above, there is no clear observed relationship between credit rating and gearing (Table 4). There is no clear pattern either within a particular credit rating grade (i.e. from BBB+ to BBB to BBB-) or between grades (i.e. between the BB and BBB grades).

35 See, for example, the discussion of risk factors in Standard & Poor's (2006) "Rating Methodology: Industrials and Utilities", *Corporate Ratings Criteria 2006*.

Table 4: Observed Relationship between Gearing and Credit Rating

	Australian Securities Exchange (ASX)		New York Stock Exchange (NYSE)	
	Total Debt / (Total Debt + Equity)	Net Debt / (Net Debt + Equity)	Total Debt / (Total Debt + Equity)	Net Debt / (Net Debt + Equity)
BB-	-	-	0.63	0.61
BB	-	-	0.33	0.26
BB+	0.65	0.64	0.39	0.30
BBB-	0.64	0.50	0.44	0.27
BBB	0.41	0.22	0.28	0.24
BBB+	0.33	0.31	0.41	0.37

Source: CapitalIQ, Industrial Firms

As stated above, in our view, the lack of a clear relationship between credit ratings and gearing arises partly from the differing circumstances of individual firms.

Affordable Gearing

Given the absence of capital market observations to demonstrate how the gearing of a firm newly issuing debt would vary with the credit rating, it is necessary to develop an alternative approach. Our approach is based on assuming that TPI's EBIT is sufficient to achieve the Standard and Poor's reported median EBIT interest cover ratio of 4.7x at a BBB credit rating.[36] While this methodology does not provide a deterministic relationship between all the gearing, rating and other variables included in the analysis, it does allow us to capture the idea that the affordability of their payments is an important factor in determining a firm's rating.

We compute the gearing levels that produce a return on equity that is equal to the pre-tax nominal equity return required by the Officer formula, given a constant pre-interest earnings across all credit ratings. These gearing levels are the levels at which the firm just earns sufficient cash flows to be able to meet the calculated WACC – it is able to meet its interest payments and provide the required return to equity holders. As such, this can be thought of as the "affordable" gearing level.

We assume a constant level of EBIT across credit ratings. This also implicitly assumes that although EBIT is constant across credit ratings, the "quality" of the earnings stream must decline at lower credit ratings. This would mean, for example, that there would be higher variability in EBIT at lower credit ratings even though the average EBIT might remain unchanged. Variability could arise through exposure to commodity price cycles. More variable EBIT raises the chance that in any given year earnings will be too low to meet repayments, and hence also raises the chance that default will occur.

36 Standard & Poor's (2006) *Corporate Ratings Criteria 2006*.

Under the Officer formula the pre-tax equity return is given by:

Pre-tax required return on equity = $re\frac{1}{1-T(1-\gamma)}$

where $re = \text{the cost of equity} = rf + \beta e \cdot MRP$

$rd = \text{the (pre - tax) cost of debt}$

$T = \text{the statutory corporate tax rate}$

$V = \text{D} + \text{E}$

We assume that EBIT is constant across credit ratings, and is sufficient to achieve the Standard & Poor's reported median EBIT interest cover ratio of 4.7x at a BBB credit rating.[37] The affordable gearing level at each credit rating is shown in the first row of Table 5. There is a reduction in the affordable gearing level with each reduction in credit rating, with a large step down as the credit rating drops from the BBB range to the BB range.

Table 5: Affordable Gearing Levels

	BB-	BB	BB+	BBB-	BBB	BBB+
D/(D+E)	**16.4%**	**16.5%**	**16.9%**	**26.0%**	**34.9%**	**36.2%**
Debt	164.35	165.08	168.99	259.56	348.69	362.13
Equity	835.65	834.92	831.01	740.44	651.31	637.87
EBIT (*)	146.29	146.29	146.29	146.29	146.29	146.29
rd	11.82%	11.79%	11.67%	9.81%	8.93%	8.83%
Interest	19.42	19.47	19.71	25.47	31.13	31.98
Equity Return	15.18%	15.19%	15.23%	16.32%	17.68%	17.92%
X	0.19255	0.19359	0.19915	0.34434	0.52668	0.55859
Be	1.19	1.19	1.20	1.34	1.53	1.56
re	12.18%	12.18%	12.22%	13.09%	14.18%	14.37%
Pre-tax nominal re	15.18%	15.19%	15.23%	16.32%	17.68%	17.92%

Notes (*) Calculated to achieve median interest cover ratio at BBB credit rating. Assumptions: Debt + Equity = 1,000; asset beta = 1; gamma = 0.34; rd = nominal interest rate; X is calculated as per formula in section 5.3.2.

The sensitivity of the affordable gearing level to the asset beta and the choice of gamma is shown in Table 6. There are minor changes to the affordable level of gearing as parameters change, but the overall effect is relatively minor. We recommend that the gearing levels in the shaded rows are applied, as appropriate for the assumed value of gamma.

37 Standard & Poor's, *Corporate Ratings Criteria 2006*.

Table 6: Sensitivity of Affordable Gearing to Asset Beta and Gamma

Ba	gamma	BB-	BB	BB+	BBB-	BBB	BBB+
0.9	0.34	15.6%	15.6%	16.0%	24.6%	33.0%	34.2%
1	0.34	16.4%	16.5%	16.9%	26.0%	34.9%	36.2%
1.1	0.34	17.3%	17.4%	17.8%	27.3%	36.8%	38.2%
0.9	0.5	15.9%	16.0%	16.3%	24.2%	31.4%	32.5%
1	0.5	16.8%	16.9%	17.3%	25.6%	33.2%	34.3%
1.1	0.5	17.7%	17.8%	18.2%	27.0%	35.0%	36.2%

Source: CRA calculations. The gamma of 0.34 is calculated in section 4.2.6.

3.5.3. Conclusion on Gearing

Capital market evidence provides limited guidance on the appropriate benchmark gearing for TPI's WACC. Observed ratios do not show a clear trend. This is because of the variability of asset riskiness within any given credit rating band and, at least in part, likely to be because observed gearing ratios reflect ratios that were applicable before credit rating downgrades, or before reductions in equity valuations, or other such events. TPI is in an entirely different position, where it has the deemed BB credit rating and is seeking to raise debt finance. In this situation the gearing ratio is likely to be lower.

We have therefore computed affordable gearing levels, which are consistent with the firm on average being able to meet its cost of capital. As credit rating decreases and interest costs increase, there is a clear reduction in the affordable gearing.

Our estimates of the affordable gearing at a BB credit rating are broadly consistent with the top end of the 10%-15% range suggested by FMG. The 50% gearing suggested by HPPL is consistent with an A rated utility that has highly stable cash flows and minimal risk to bondholders. In our view TPI does not have the characteristics of a highly stable utility. We also note that even if a BBB+ credit rating is applied with 50% gearing the outcome is a higher post-tax nominal WACC and a higher pre-tax real WACC than we calculate in this report.

3.6. Conclusions on Cost of Debt

Based on the discussion above, CRA recommends the parameters in Table 7 for calculating the cost of debt.

Table 7: Calculation of the Cost of Debt

Parameter		Value
Risk free RoR	*rf*	5.021%
Credit Rating		BB
Debt Premium (bps)	*p*	677.07
Debt Issuance Costs (bps)	*dic*	12.5
Cost of debt	*rd*	11.92%

4. TAXATION AND DIVIDEND IMPUTATION

4.1. TAX RATE

The Monkhouse formula requires the use of an effective tax rate for levering and de-levering betas, and the Officer formula for the post-tax nominal WACC requires the use of a tax rate for calculating the post-tax cost of debt.

The appropriate tax rate for calculating the post-tax cost of debt is the statutory corporate tax rate, which is 30%.

As we show in Section 5.3.3 below, the precise value of the tax rate used for levering and de-levering the beta does not have a material impact. We therefore also apply the statutory corporate tax for calculating the equity beta.

4.2. GAMMA

The parameter gamma captures the value of dividend imputation credits (or franking credits) to investors. Gamma has a significant impact on the cost of equity in the Officer formulation of the WACC and as such has proved to be a very contentious parameter.

Submitters to the current review are strongly divided on the appropriate value for gamma. In submissions on the Issues Paper, potential users of the TPI railway argued for a value of at least 0.5, while ARTC and TPI argued for a value of zero based on studies of the ability for foreign investors to utilise dividend imputation credits. The Authority adopted a value of 0.5 in the Draft Determination. In its submission on the Draft Determination HPPL again argues for a value of at least 0.5 and makes the unsupported assertion that the debate is moving in the direction of the value being higher. FMG argues for a gamma of zero on the basis that the marginal investor is a foreign investor and is unable to utilise imputation credits, and on the basis that suitable empirical studies support this assumption. FMG also argues that the ACCC decision rejecting the use of a gamma of 0.3 was highly specific to ARTC and that nothing justifies the use of a gamma above 0.37.

Gamma can be defined as the product of (i) the value of imputation credits distributed as a proportion of their face value – also known as the utilisation rate or theta (θ) – and (ii) the proportion of credits created that can be distributed.

4.2.1. The Victorian Gas Access Arrangement Review

ACG's October 2007 report briefly surveyed some of the arguments around gamma, focussing on the (then draft) Victorian ESC's Gas Access Arrangement Review.[38] The ESC's review contained a very detailed review of gamma, considering a range of expert reports including several by the Strategic Finance Group (SFG) submitted by the distributors,[39,40] and a report by Lally submitted by the Energy Users Association of

38 ESC (2007) *Gas Access Arrangement Review 2008-2012*, Draft Decision, 28 August.

39 SFG (2007a) *The impact of franking credits in the corporate cost of capital: Empirical evidence*, Report prepared for Envestra, 22 March

Australia.[41] The ESC's draft report criticised certain assumptions and studies relied on by SFG. SFG responded to these criticisms and also identified a number of flaws in analysis relied on by the ESC.[42] In its final decision the ESC again criticised SFG analysis and demonstrated a clear preference for Lally's analysis, without subjecting Lally's analysis to the same level of scrutiny.[43]

We do not believe that the ESC's criticisms were warranted and have strong sympathies for some of the arguments advanced by SFG.

4.2.2. The Value of θ

Taxation Regime Changes and the Value of θ

An issue of considerable importance in the ESC's draft decision was the July 2000 tax change, which allowed Australian residents who previously could not fully utilise imputation credits received to receive a cash rebate. The ESC claimed that key studies relied on by SFG predated the change and hence should be disregarded. In its report submitted to the current review, Synergies has countered this criticism by clearly identifying studies that post-date the July 2000 change.

We do not intend to review the relevant studies in detail, as that has been performed adequately by Synergies. Results of the studies are summarised in Synergies' Table 9.[44] We also note that Synergies' review (and table) includes the studies preferred by the ESC.

In our view the studies indicate the following:

- When the regulatory precedent of gamma = 0.5 was first established the only available study suggested that a value of 0.5 was reasonable for gamma (and theta);[45]
- After the introduction of the 45-day rule in 1997 the evidence for theta was mixed, with some studies suggesting a value for theta of zero and others suggesting a value of around 0.5; and
- After the July 2000 imputation rebate change the studies remain ambiguous with Beggs and Skeels (2005) suggesting a value of 0.57, and Feuerhadt, Gray and Hall (2007) suggesting a value of zero.

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40 SFG (2007b) *Internal consistency in regulatory estimates of the value of franking credits*, Report prepared for Envestra, 22 March.

41 Lally, M. (2007) "Review of parameters in the national electricity rules", Victoria University Wellington, 11 September.

42 SFG (2008) "Essential Services Commission Final Decision – Gas Access Arrangement review 2008-12, Issues in relation to estimation of gamma", 28 March.

43 ESC (2008) *Gas Access Arrangement Review 2008-2012*, Final Decision – Public Version, 7 March. For the discussion of gamma see pp. 492-509.

44 Synergies (2008), pp. 60-61.

45 See Strategic Finance Group (2007) *The impact of franking credits on the corporate cost of capital*, Report Prepared for Envestra, 22 March, p. 6.

- We further note that Beggs and Skeels (2005) has recently been extended by Gray (2009).[46] Beggs and Skeels used data covering the period 1 July 2000 to 10 May 2004. Gray extends the dataset to cover the period 1 July 2000 to 30 September 2006. The inclusion of a greater number of observations (all post-July 2000) reduces the estimate of theta to 0.37. Gray also demonstrates that the estimates of theta are significantly influenced by just 1 percent of the observations: excluding that 1 percent of observations from the extended dataset further reduces theta from 0.37 to 0.24 while simultaneously increasing the adjusted R-squared statistic (which measures the "goodness of fit" from 3.5% to 31.0%). The AER dismisses the analysis of Gray (2009) on the grounds that the reliability of the results could not be verified on the information presented by the authors and continues to prefer Beggs and Skeels.[47]

The above studies are all dividend drop-off studies. An alternative approach is to use Australian Tax Office statistics to provide an estimate of the value for theta. Synergies notes Australian Tax Office statistics that only 32% of distributed franking credits were redeemed in the 2002-03 tax year. The AER refers to the study of Handley and Maheswaran (2008), covering the period from 1988 to 2004, which gives "a point estimate for theta from tax statistics of 0.74".[48] The Handley and Maheswaran study computes a simple average and is not necessarily representative of either the "representative" or marginal investor.

Our preference is to rely on dividend drop-off studies rather than tax office statistics. Dividend drop-off studies infer the value that the market places on the combined dividend and franking credit by observing the reduction in share price that occurs after a dividend is paid. In our view this is the only way to determine with any accuracy the impact that the combined dividend and franking credit is valued by the market.

Handley (2008) notes that the reduction in share price would always be less than the combined value of the dividend and franking credit because of the impact of differential personal tax rates on dividends as compared to capital gains and because of risk.[49] He does not quantify the size of this impact.

The body of empirical work does not provide any clear consensus on the value of theta, with significant positive values seeming to be reported as often as zero values. However, the dividend drop-off studies, which we prefer on the grounds that they are attempting to measure the market value of dividends and franking credits, generally suggest a value less than 0.5 even after the 2000 tax changes.

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46 Gray, Stephen (2009) *The value of imputation credits as implied by the methodology of Beggs and Skeels (2006)*, Report prepared for ENA, APIA, and Grid Australia, SFG Consulting, 1 February.

47 Australian Energy Regulator (2009) *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, Final Decision, May, p. 400.

48 Op. cit., p. 448.

49 Handley, John C. (2008) *A Note on the Valuation of Imputation Credits*, Report prepared for the Australian Energy Regulator, Final, 12 November, pp. 9-11.

The Marginal Investor Sets the Price

In section 4.2.5 we review the implications of the argument that prices are set as some sort of weighted average across investors. We generally disagree with that proposition. Prices are always set by the marginal participant. In financial markets that participant is the marginal investor. While it may be true that the demand of all investors affects the prices for all assets, it is the marginal investor that ultimately sets the price. If the market return was somehow set as an average across the return required by all investors, then the market return would be too low for some investors. Those investors would reduce the price that they were willing to pay for the asset and the market price of the asset would fall until the market return was equal to the return required by the marginal investor.

It could be argued, however, that there are clientele effects which mean that different investors (or different groups of investors) are the marginal investor for different sectors of the market. Foreign investors may, for example, be the marginal investor for industrial and utility stocks, while domestic investors may be the marginal investor for retailers. If this was true then gamma would be different for different sectors of the market. Even in this scenario, gamma for the market as a whole would not be a weighted average across all investors, but would be the weighted average across the different groups of marginal investors.

The sharp fall in the Australian share market as foreign investors have repatriated their capital provides a very stark illustration that foreign investors are the marginal investors in the Australian stock market. Economic theory tells us that it is the marginal participant who sets the price in a market, including when the market is in equilibrium, which quite clearly suggests that theta should be set to reflect the ability of foreign investors to utilise imputation credits (i.e. theta should be set to zero). This is consistent with a number of studies.

Foreign Investors Should be Included in the Calculation of θ

Identifying foreign investors as the marginal investor sometimes raises the objection that the CAPM being estimated is a domestic CAPM and as such there should be no foreign investors (and hence theta should be set to 1). We do not agree with this objection.[50] The Australian stock market is part of a partially-integrated international financial system in which both domestic and foreign investors participate. The estimates for the risk-free rate and the debt premium are both derived from actual data observed from that partially-integrated system. The estimate for the market risk premium is also intended to be an estimate of the appropriate premium for the Australian market within that partially-integrated system. There is no argument that any of those parameters should be estimated as if the Australian market were completely segregated from the rest of the world. Estimation of gamma should proceed on a consistent basis with the estimation of

50 We also note that this argument is rejected by Handley (2008), who argues for a "representative" investor based on a complex weighted average of all investors in the market, including foreign investors.

the other parameters, i.e. it should be derived from actual data.[51] This means that any argument that theta should equal 1 should be dismissed.

A Possible Approach to Setting θ

We favour the lower estimates of theta because they are more consistent with economic concepts of the marginal investor. On this basis the 32% of distributed franking credits redeemed in the 2002-03 tax year is a reasonable estimate of theta, as is the estimate of 0.37 from Gray (2009). These values would provide a ceiling on the value of gamma that would apply if it is correct to treat gamma as a weighted average across all investors rather than as the value that applies to the marginal (price-setting investor). These values are also consistent with foreign investors having a significant impact on market prices, in excess of their ownership stake of approximately 50%-55%, but not being the sole price setters in the Australian equity market.

An alternative approach that could be adopted by the Authority is to leave the value of theta equal to 0.5. Regardless of the theoretical arguments, there is no clear empirical consensus as to the value of theta. In its submission to the AER, the NSW Treasury stated:

> *In order to satisfy the 'persuasive evidence' test, NSW Treasury contends that there should be greater consensus for change between academic experts. Given the ongoing debate in the academic literature regarding the appropriate recognition of the value of imputation credits and resultant wide range of expert views, NSW Treasury remains unconvinced that the AER's proposed gamma of 0.65 has been determined with any greater certainty relative to the previous value of 0.50.*

4.2.3. Proportion of Credits that are Distributed (F)

The second parameter used in the calculation of gamma is the proportion of imputation credits that are distributed. As noted by the Victorian ESC, Hathaway and Officer (2004) found that 71% of the imputation credits created over the period between 1988 and 2002 were distributed to shareholders.[52] The Victorian ESC considered that this proportion is too low for energy utilities, instead considering that 100% of the imputation credits created would be distributed because of their high dividend payout rate. The AER, on the other hand, considers that the 71% is a reasonable estimate of the proportion of imputation credits generated in a year that are paid out in that year (i.e., the annual payout ratio).[53]

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51 We note that the Victorian ESC also considered that the value of gamma should be estimated on a basis consistent with the degree of market integration assumed in the estimation of other parameters. See ESC (2007), p.424.

52 Hathaway, N. and R. Officer (2004) *The Value of Imputation Tax Credits*, Capital Research Pty Ltd, 2 November.

53 AER (2009), p. 415.

Without detailed financial modelling it is difficult to establish the level of imputation credits that would be paid out by a stand-alone railway in the position of TPI. Our view is that in the absence of contrary evidence there is no reason to believe that an independent railway would have a high dividend payout rate. Further, FMG submits that debt covenants prevent a high dividend payout rate. It seems likely, therefore, that the market average of 71% of imputation credits created being distributed to shareholders would be a ceiling on the annual payout ratio for TPI.

The AER noted that retained imputation credits would eventually be paid out to investors and considered a range of evidence on how the credits paid out in future years should be valued. The AER considered that these credits would be paid out in a period ranging from 1 to 5 years, and that the appropriate discount rate for calculating the value of that deferred payout lay somewhere between the risk-free rate and the cost of equity. Our view is that the imputation credits are clearly part of the return on equity, and therefore the appropriate discount rate is the cost of equity.

Given this more comprehensive view of the payout of imputation credits, the value of F would be calculated as:

$$F = R + (1 - R)\psi$$

where R is the annual payout ratio and ψ (psi) is the per dollar value of a retained imputation credit. The value of ψ is obtained by discounting one dollar at the appropriate discount rate for the appropriate number of years into the future. Given R = 0.71 and a discount rate equal to the cost of equity for the market as a whole, the value of F ranges from 0.97 for one years' retention to 0.89 for 5 years' retention.[54] The average value for F across the one to five year period is 0.93.

4.2.4. Synergies' Behavioural Test of Gamma

In their submission on the Issues Paper Synergies described a test that they have performed on the behaviour of price movements for unfranked and fully-franked dividends.[55] Specifically, they tested whether the market responds differently to franked and unfranked dividends by comparing the relative price change of pairs of observations. Subject to the caveat that we have not reviewed their data or calculations, and nor has the study been published in a peer-reviewed journal, we are of the view that the study does support the proposition that the market values franking credits at some value less than 0.5. As Synergies reports its study, the analysis rejects the hypothesis that gamma is 1 or 0.5, but is unable to reject the hypothesis that gamma is zero.

54 These values are calculated by the AER (op. cit.), but we have also independently confirmed the calculation of F using an independent estimate of the cost of equity for the market as a whole.

55 Synergies (2008), pp. 61-64.

Synergies results do not mean that the only supportable value for gamma is zero. Instead, it is likely that there are positive values of gamma between 0 and 0.5 that would not be rejected by Synergies' test. As we noted in our draft report, we would like to see the study repeated at gamma values of 0.1, 0.2, 0.3, and 0.4, and then further refined to obtain the upper bound for gamma. We would also like to see the study repeated (a) with the unfranked dividends compared with different random sets of franked dividends,[56] and (b) between random pairs of franked dividends.[57] These two extensions would help to confirm the robustness of the results obtained by Synergies. Unfortunately Synergies did not provide an update of this study in their response to the Draft Determination.

4.2.5. What if Gamma is a Weighted Average Across Investors?

It is sometimes claimed that the value of gamma should be set by taking a weighted average across investors. This argument claims that because investors are collectively setting the price of the portfolio of all assets then it is the weighted average value of gamma across all investors that is relevant. For example, Handley (2008) suggests that "this interpretation of gamma is consistent with the interpretation of the aggregate tax factor T in the Brennan CAPM", "which represents a complex weighted average of personal tax rates and levels of risk aversion across all investors in the market".[58] The weights are based on individual levels of wealth and include foreign investors, "but only to the extent that they invest domestically".[59]

As a broad and approximate indicator, a little over half of the Australian equity market is held by foreign investors.[60] In relatively small markets such as Australia, the wealth of global investors can have a very significant impact on prices. The ability to move significant levels of capital either into or out of Australia at very short notice means that impact of these investors can extend well beyond the level suggested by their Australian investments at any one moment in time. In our view the weighting of foreign investors in terms of their impact on prices would be significantly greater than 50%-55%.

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56 As far as we are aware, Synergies has performed the analysis with a single set of randomly selected franked dividends matched with the set of unfranked dividends. The study could be repeated with different sets of randomly selected franked dividends. If the results are robust then there would be no significant difference in results obtained with the different sets of franked dividends.

57 Pairing one randomly selected set of franked dividends with a second randomly selected set should always produce the result that the market does not treat the two sets differently.

58 Op. cit., p. 7.

59 Ibid.

60 The ASX reports domestic equity market capitalisation of $969,046m at the end of December 2008,and $1,187,429m at the end of September 2008. The Australian Bureau of Statistics (ABS) reports foreign investment in Australian equity capital as $536,056m at the end of the December 2008 quarter, and $599,189m at the beginning of that quarter. Foreign equity investment was therefore approximately 55%of market capitalisation in December 2008 and 50% in September 2008. It is unclear, however, whether all ABS data is marked to current market prices, or whether a portion reflects historical prices. For foreign investment data see ABS (2009) *Balance of Payments and International Investment Position December Quarter 2008*, 5302.0, 3 March.

If we assume that Australian domestic investors are able to fully utilise imputation credits (i.e. θ = 1) and foreign investors are unable to utilise imputation credits (i.e. θ = 0), and that the average value for F is 0.93 (as calculated in section 4.2.3), then the maximum value for gamma is 0.465 based on foreign investors having a 50% share of the domestic equity market and there being no other factors that increase their influence above that of Australian domestic investors. If the appropriate weighting for foreign investors was 60% (assuming that their influence on prices is slightly greater than Australian domestic investors because of their ability to rapidly move capital) then the maximum value for gamma would be 0.372.

4.2.6. Conclusion

Gamma can be calculated as the product of (i) theta – the proportion of imputation credits distributed that can be utilised by investors – and (ii) the proportion of credits created that can be distributed.

A detailed study of all the literature relevant to the determination of gamma is beyond the scope of this report. However, our interpretation of the empirical studies is that there is some support for a theta of zero and support for a theta as high as 0.37. The estimate of 0.57 obtained by Beggs and Skeel (2006) has effectively been superseded by Gray (2009) who has extended the dataset to include more recent data (although we note that the AER dismisses this study). The larger dataset produces more accurate estimates of theta, and reduces the estimate to 0.37.

Anecdotal evidence suggests that foreign investors are the marginal investors in the Australian market. If this is true then there is a strong theoretical argument that the value of theta should be zero based on the notion that the marginal investor is a foreign investor who is not able to make use of imputation credits. As noted by Synergies, this view is supported by a number of empirical studies which are not concerned with the specific identity of the marginal investor.

In the absence of evidence to the contrary, it is reasonable to assume that 71% of imputation credits created are distributed in the year that they are created. Imputation credits retained and paid out in future years still have positive value. If retained imputation credits are paid out over a period of one to five years, then it is reasonable to adopt a value of 93% for the effective payout ratio.

Multiplying together the values for theta and the effective payout ratio suggests a range of 0 to 0.34 for gamma.[61]

If gamma is a weighted average across investors, rather than being set by the marginal investor alone, then it is possible to use foreign investment statistics to derive an upper bound on the likely value of gamma. Recent statistics show that foreign investors own approximately 50%-55% of the Australian equity market. If foreign investors' weight is equal to 50% and they are unable to utilise imputation credits then the effective payout ratio of 93% suggests a maximum value for gamma of 0.465. If the appropriate weight for foreign investors is higher, reflecting a higher share of the equity market and a stronger

61 The upper bound is calculated as gamma = 0.37 x 0. 93 = 0.3441.

influence on prices, then the implied value for gamma will reduce. If foreign investors are given a weighting of 60% then the implied value for gamma is 0.372. A gamma of 0.34 is consistent with Australian investors having a weight of 37% and being able to fully utilise imputation credits, or with Australian investors having a higher weighting and being unable to fully utilise imputation credits.

Synergies' behavioural test of gamma supports the proposition that gamma is less than 0.5, but it does not necessarily imply that the value of gamma should be zero.

On balance we consider that a gamma of 0.34 is a reasonable value to employ:

- It is consistent with the Gray (2009) estimate of theta;
- It is consistent with an effective payout ratio calculated using a methodology such as that in AER (2009);
- It is consistent with foreign investors having a weight of 60%, which is slightly higher than their actual ownership of Australian equities, with the higher weighting reflecting a superior ability to move capital into, and out of, Australia;
- It is consistent with Australian domestic investors having a weight of 40% and not being able to fully utilise imputation credits due to factors (but still with a utilisation rate higher than 90% for domestic investors); and
- It is consistent with the broad conclusion from Synergies (2008) that gamma is less than 0.5.

5. SYSTEMATIC RISK

Calculating the cost of equity requires an estimate of the asset beta For a listed company a beta can be calculated directly from share market data, although even then it may be preferable to employ an industry estimate to reduce the influence of non-systematic risk. For a non-listed company such as TPI, there are no market observations and therefore we must rely on the data available for a set of comparable companies when calculating the asset beta. We develop our set of comparator companies in section 5.1.

The asset beta can be decomposed into an equity beta and a debt beta. This means that the value of the asset betas calculated from a set of equity betas will depend on the assumed debt beta. With consistent application of a debt beta in de-levering (calculating the asset beta from an equity beta) and re-levering (calculating the equity beta from an assumed asset beta) the debt beta has no material effect on the equity beta, the cost of equity or the WACC. This is discussed further in section 5.2.

Having established a value for the debt beta, in section 5.3 we propose a range for the asset beta for TPI. We first summarise and comment on submissions made in response to the Draft Determination, then identify a set of comparators and finally calculate the asset beta estimates.

5.1. COMPARATOR COMPANIES

Comparator companies ideally should have the same characteristics as the regulated firm, i.e., the same exposure to systematic risk, asset stranding and other asset-related risks.

The ideal comparator companies would be other railroads dedicated to carrying a single commodity, preferably a mineral that is exported. There are few companies that fit this description, so it is necessary to consider a wider set of comparators. Suitable comparators might include:

- other railroads specialising in freight services;
- other infrastructure companies, such as electricity networks, gas networks, roads, airports, and ports; and
- mining companies specialising in iron ore.

The key arguments for or against each of these types of companies centre on the exposure of each to systematic risk.

5.1.1. Conceptual Analysis

The Nature of Contracts

TPI's exposure to systematic risk will depend on the type of contracts that it has entered. While it is possible that TPI *could* enter fixed price contracts that would largely (but not entirely) eliminate systematic risk, it is not obvious that such contracts would be commercially possible for an independent railroad nor that such contracts would be efficient.

An efficient contract allocates risk to the party best able to manage that risk. Where neither party can manage the risk, it is generally efficient to share the risk. Placing the entire quantum of an unmanageable risk on to one party increases the chance of that party judging that the risks outweigh the rewards, and hence increases the chance that an otherwise mutually beneficial (and welfare-enhancing) arrangement does not go ahead.

In its submission in response to the Draft Determination, FMG states:

> *Most damaging to TPI's interests is the unwarranted assumption of a contractual relationship between FMG Chichester. Without that assumption TPI's risk profile becomes Fortescue's risk profile and an asset beta of 2.14 becomes clearly warranted.*

In our view it is inappropriate to estimate the asset beta for TPI as if it is an integral part of FMG. Just as the costs included in any calculation of floor and ceiling prices should only be the costs pertaining to the TPI railway, so the asset beta should be the asset beta pertaining to the TPI railway. We acknowledge that there is not an arms-length relationship between FMG and TPI, so it is possible for contractual arrangements – whether express or implied – to be whatever FMG wants them to be. Again this is an entirely inappropriate basis for setting regulated prices and it is therefore necessary to assess what arms-length contractual arrangements might be like.

We also note that while we consider that the systematic risk of FMG will have a significant impact on the systematic risk of TPI, the systematic risk of the two entities need not be the same. As we explained further below, there are a range of factors that mean that TPI's asset beta is unlikely to be exactly the same as FMG's asset beta, although FMG's asset beta will influence TPI's asset beta.

An Independent Railroad's Likely Risks

To consider the risks that TPI might be exposed to it is necessary to consider the value chain from the mine to the steel mill, consider the total risks faced by both an independent railroad owner and operator and the mine operator, and consider the likely allocation of those risks.

Key risks would seem to be:

- Reduction in demand from steel mills, thereby reducing demand for iron ore from the mine and reducing the quantity of ore transported over the railroad;
- Reduction in the price of ore, thereby reducing the attractiveness of continuing to mine for ore;
- An increase in the cost of mining;
- An increase in the cost of operating the railroad; and
- An increase in the cost of shipping, whether due to fuel prices, shortage of ships, or increased insurance premiums.

We would expect that there would be a volume component to the charge structure negotiated by an independent railroad. This would have the effect of sharing the demand risk that cannot be controlled by either party. The costs of the mine operator are likely to be more responsive to volume than are the costs of maintaining and operating a track network, so we would expect that the mine operator would bear the greater portion of the demand risk.

In the first instance an increase in the cost of mining would be borne by the mine operator and an increase in the cost of operating the railroad would be borne by the railroad operator. However, the railroad operator is likely to be able to pass on at least a portion of increased costs when rates are renegotiated.

We also note that many of these items impact on the profitability of the mine operator and could ultimately squeeze margins to the point where operator has to consider whether to continue mining. Such decisions may have seemed unlikely given the extremely buoyant market for iron ore in recent years, but now appear more likely given the recent downturn in the iron ore market. When adverse conditions do occur we would expect downwards pressure to be placed on the rates charged by an independent railroad, i.e. the railroad operator ultimately shares part of the costs faced by the mining operator. This would be accentuated where the independent railroad was parallel to a potentially competing railroad.

In summary, it seems likely that an independent railroad operator would be exposed to both volume risk and price risk, with both of those risks reflecting the demand and profit risks faced by the mine operator. This implies that mining companies may provide an appropriate comparator for the independent single-commodity railroad hauling minerals.

5.1.2. Other Infrastructure Companies

The range of potentially relevant infrastructure companies includes railroads specialising in freight services, as well as electricity networks, gas networks, roads, airports, and ports. A common feature of all of these types of companies is that they have a diversified customer base and hence risks will also be more diversified. To the extent that mining companies have a higher systematic risk than the general economy this means that infrastructure companies will have a lower systematic risk than mining companies. Diversified infrastructure companies, therefore, are not good comparators for TPI.

Some infrastructure companies would not be suitable comparators because of the way that they are regulated. Any firm with a regulated revenue cap and an overs-and-unders account is likely to have lower levels of systematic risk than we would expect from an independent single-commodity railroad. We therefore consider that electricity and gas networks are likely to provide relatively poor comparators for railway infrastructure.

On the other hand, companies that specialise in freight transportation, and particularly freight transportation by rail, are more likely to be subject to similar systematic risks as TPI. As discussed above, firms specialised in mining of iron ore or mining services are also likely to be faced with similar systematic risks. We therefore include these firms as comparators for TPI in our analysis of the applicable debt and equity betas and the determination of an applicable credit rating for TPI.

Other potential comparators include airports, ports, and roads. We consider that airports and roads would be poor comparators: in particular, they have a significant component of passenger transportation, so are unlikely to reflect the risks associated with freight transportation. [62] In addition, both airports and marine ports are more of a "hub" through which traffic passes rather than actually being involved in the transportation of freight.

5.1.3. Comparators

Based on the factors discussed above, the companies that we have selected as comparators are set out in Table 8 below. Short descriptions for each of these companies are provided in Appendix B.

Table 8: Comparator Companies

Industry	Country	Company
Freight Railroads	United States	Kansas City Southern
	United States	Genesee & Wyoming Inc.
	United States	CSX Corp.
	United States	Union Pacific Corp.
	United States	Norfolk Southern Corp.
	United States	Burlington Northern Santa Fe Corp.
	Canada	Canadian Pacific Railway Limited
	Canada	Canadian National Railway Company
Mining Services	Australia	Orica Ltd
Diversified Minerals	Australia	BHP Billiton Ltd
	Australia	Rio Tinto Ltd
	Australia	Oxiana Ltd
Iron Ores	United States	United States Steel Corp.
	United States	Cliffs Natural Resources Inc.
	Australia	Fortescue Metals Group Ltd.
	Australia	Mount Gibson Iron Ltd.
	Australia	Ferrowest Limited
	Australia	Territory Resources Limited
	Australia	OneSteel Ltd

62 We note that ACG (2007) used toll roads as a comparator for the passenger network, but not for the freight network.

5.2. DEBT BETA

In a departure from the approach adopted in the 2008 general rail determination, the Authority requested that CRA determine the likely range for the debt beta. In our draft report we reviewed some of the evidence for the debt beta.[63] We also demonstrated that even if the debt beta is non-zero, it does not have any significant effect on the WACC. The Authority adopted a debt beta of zero in the Draft Determination.

In its submission on the Draft Determination HPPL agreed that the best estimate for the debt beta is zero and that this is a "pragmatic response" by the Authority until better estimates can be developed. Our view is that it is more than a pragmatic response to a lack of precision: even a significant large positive debt beta will have no material effect on either the equity beta or the WACC if the debt beta is consistently applied in the de-levering and re-levering calculations. It is for this reason that the debt beta is routinely assumed to be zero by regulatory authorities around the world.

We also note (see section 5.3) that it is materially incorrect to adopt an asset beta that was calculated with a debt beta of zero, and then re-lever that asset beta using a positive debt beta. This approach will artificially depress the equity beta and hence also artificially depress the cost of equity and the WACC.

5.3. ASSET BETA

Estimates of the asset beta are dependent on the debt beta assumption utilised. We therefore provide two estimates: one with the low debt beta assumption and one with the high debt beta assumption. It is not correct to use estimates of the asset beta that have been calculated with a debt beta of zero and then re-lever those estimates using a positive debt beta – doing so will artificially lower the calculated equity beta and cost of equity.

5.3.1. Submissions

Submissions on the Issues Paper

In submissions on the Issues Paper there was generally little comment on the beta that should be employed for the TPI railway. HPPL supported the use of QR's coal network as a suitable comparator as the nature of the traffic means that QR's network embodies similar systematic risk characteristics to TPI's railway. ARTC submitted that TPI's systematic risk is strongly linked to the iron-ore mining industry rather than general rail, and the beta should reflect this. ARTC also suggested that an appropriate asset beta would be in the range of 0.5-0.6, which is slightly lower than the asset beta of 0.65 applied by the ACCC for ARTC's interstate network. NWIOA endorse the approach adopted by the Authority in the 2008 Freight and Urban Railways Determination, but as we noted in our draft report, it is unclear precisely what this means. One interpretation is that the NWIOA endorses the Authority's original approach to estimating an asset beta, which adopted different asset betas for broad categories of traffic. This was, however, superseded by the approach in the Authority's final determination, which suggests that

63 This review is reproduced in Appendix C.

the NWIOA endorses the Authority's use of an equity beta of 1.00 with gearing of 35%, which implies an asset beta of approximately 0.655.[64] UMC provided no comment on systematic risk / beta.

CRA's Draft Report

Our view is that the submissions in response to the Issues Paper provided some support for the proposition that the appropriate beta is the beta for mining in general, and iron ore mining in particular, rather than a beta that is generally related to infrastructure or to railways. We estimated the asset beta for US and Canadian railroads, marine ports, and the iron ore, diversified minerals, and mining services industries.

The US and Canadian railroads provide a beta for large a diversified freight railway: such a railway is likely to have lower systematic risk than a single commodity railway because of the diversification across the number of customers and number of different industries served. The US and Canadian railroads in general can therefore be thought of as providing an absolute floor on the likely beta. In our draft report we estimated this beta to be 0.69 (with a debt beta of zero).

The set of US and Canadian railroads included Genesee & Wyoming, which is a holding company for regional short line railroads. The asset beta for this firm was estimated as 1.07 (with a debt beta of zero).

CRA's view was also that the systematic risk of the single-commodity railroad is likely to be related to the systematic risk of the industry that it serves. The reason for this is that change in demand for the commodity will affect both the miner and the shipper/railway. Differences in systematic risk will arise from differences in cost structure and the pricing mechanisms included in the contract between the railway and miner(s).[65]

We also noted that measuring the beta for Australian iron ore miners against the Australian Securities Exchange (ASX) overstates systematic risk for those firms because they are over-represented on the ASX. If there was only one firm in the stock market then the market would reflect both the systematic and non-systematic risks of that firm. As more firms are added to the market index, the non-systematic risks are increasingly diversified away. Compared to the rest of the world, mining firms comprise a relatively large proportion of the ASX. If mining betas are estimated against the ASX then their betas will include an element of non-systematic risk and hence be overstated.[66] We therefore estimated the betas for relevant mining companies against a world index. The asset beta for iron ore mining was 1.37 (with a debt beta of zero).

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64 The figure of 0.655 is calculated using the full version of the Monkhouse formula, using the values for the cost of debt, the corporate tax rate, and gamma applied by the Authority in the 2008 Freight and Urban Railways Final Determination.

65 Systematic risk for the firm is related to the systematic risk of the difference between revenue and costs. If two firms have an identical revenue stream with an indentical level of systematic risk, the firm with the greater proportion of fixed costs will have a higher level of systematic risk. Conversely, a firm with entirely variable costs, that is able to scale costs with revenues, will have a lower level of systematic risk. We do not have the data to make the judgement on the relative level of systematic risk between iron ore mining and the TPI railway.

66 See Appendix E.

Collectively these estimates provide a range of 0.69 to 1.37 for TPI's asset beta. One approach to selecting a point estimate would be to take the midpoint, or perhaps the weighted average across all the comparators. Another approach would be to use the asset beta of Genesee & Wyoming Inc (GWI), which provides the only example of a beta for short line railroads.

The Draft Determination

The Authority considered a range of factors when setting the asset beta. In particular, the Authority considered that the asset beta for TPI was likely to be higher than the average for the Class 1 US railroads and higher than the Australian regulated freight railways. The Authority proposed a range of 0.7 to one, with the upper bound approximately reflecting the asset beta for GWI. The Authority settled on an asset beta of 1.0:

> *Given the particular circumstances of the TPI railway (remote railway with a single mining commodity), the Authority considers that an asset beta at the higher end of this range would be more appropriate. On balance, the Authority considers that an asset beta of one is appropriate for the TPI WACC determination.*

Submissions on the Draft Report

Submissions on the draft report do not differ significantly from the submissions on the Issues Paper. HPPL again argues that the asset beta for the TPI railway should be set in the range 0.44 to 0.50 reflecting the regulated betas for the Hunter Valley and QR rail networks. NWIOA also argues that the asset beta should be similar to that employed for the Hunter Valley and QR rail networks. Conversely, FMG and Synergies again argue that the asset beta for TPI should equal the asset beta for FMG, and that an appropriate value for this is 1.85 to 2.14 (FMG) or 1.07 to 2.14 (Synergies). We disagree with most of the arguments raised by respondents and set out our responses to a number of the arguments below:

The NWIOA argues that the WACC should be set at the 75th percentile of "the range":

> *The NWIOA ... asks the Authority to review its setting of the beta at the high end of the range (ie at 1.0). In reviewing the Allen Consulting Reports on proxy betas (commissioned by the Queensland Competition Authority), Professor R. G. Bowman noted extreme inaccuracy in estimating asset betas. He recommended that the comparisons be done over a long time frame, that the forward view be over a lengthy time horizon and that regulators choose a WACC value from the 75th percentile of the range (as a lower percentile may lead to underinvestment).*[67]

67 NWIOA (2009) "Draft Determination on Weighted Average Cost of Capital for The Pilbara Infrastructure Pty Ltd's Railway from the Cloud Break Iron Ore Mine in the Pilbara to Port Hedland", letter to Mr Russell Dumas, Director – Gas and Rail Access, Economic Regulation Authority, 19 February 2009, p. 2.

CRA response: we agree that adopting a WACC value equal to the 75th percentile is generally appropriate for setting a regulated WACC and this is an argument that we ourselves have advanced in other forums. However, that approach is only suitable when there is a reasonable point estimate of the appropriate WACC and there is a reasonable estimate of the distribution of values around that estimate. In the present situation we do not have a point estimate. Instead, there is a lower bound estimate and an upper bound estimate, and there is a significant difference between the two estimates. The Authority must choose an appropriate value from within that range. As suggested by NWOIA, it is appropriate that the Authority selects a value from the upper end of the range because a lower value may lead to underinvestment.

NWIOA's comments refer to a report by Professor Bowman. In addition to noting extreme inaccuracy in estimating asset betas, Professor Bowman also reports that:

> *For over 85% of the beta estimates, it was not possible to reject the hypothesis that the true beta was equal to one at the 95% confidence level. And of those that were statistically different from one, more were greater than one than were less than one.*[68]
>
> *…the report by Gray et al. (2005) goes further in testing the usefulness of beta estimates for the purpose of forecasting a forward-looking beta. The result is that even when forecasting an OLS estimate of beta, a simple prediction that the beta equals one outperforms an OLS estimate.*[69]

Bowman goes on to conclude:

> *Because of the severe problem of estimation error and the evidence that a forward-looking estimate of equity beta equal to one is effective, I believe it should be best practice to begin from the premise that equity beta equals one. From this point, empirical, first principles and other evidence can be evaluated to determine whether an alternative estimate can be defended in preference to the benchmark value.*[70]

Given this statement, our view is that Bowman would support rather than oppose the asset beta that the Authority has proposed for TPI in the Draft Determination.

> *HPPL comments further on the Authority's choice of asset beta for TPI:[HPPL] could accept that TPI may be seen as being at the high end of the Australian examples, but would find it difficult to see that it should be at the high end of the US/Canada examples. Then to add in a large premium for the "particular circumstances" by going from an equity beta of 0.7 to 1.0 even more difficult to understand.*[71]

68 Bowman, R.G. (2005) *Queensland Rail – Determination Of Regulated WACC, Response To Reports Prepared By The Allen Consulting Group*, August, p. 5.

69 Bowman (2005), p. 6.

70 Bowman (2005), p. 10.

71 HPPL (2009), p. 2.

CRA response: we have addressed this issue earlier in this report. TPI lacks diversification across customers and across commodities and this lack of diversification increases the sensitivity of returns to movements in the economy, thus increasing systematic risk. The US and Canadian Class 1 railroads provide a lower limit on the likely asset beta.

The NWIOA argues that the beta selected for TPI should reflect the beta for coal:

> *The NWIOA believes that from an economic demand viewpoint, both coal and iron ore are similarly linked to the demand for steel. Hence, they have similar systematic risks. The current economic crisis highlights the relationship between domestic economic growth and the demand for steel. As a consequence, the NWIOA requests the Authority review the beta range Determination.*[72]

CRA response: we agree that coal and iron ore are both important inputs into steel, and that fluctuations in the demand for steel will translate into fluctuations in demand for both coal and iron ore. This does not mean, however, that both will have the same level of systematic risk. Coal is also a major fuel for electric power generation, so demand for coal will be significantly affected by power generation both in Australia and in the Asia-Pacific region. Our view is that the demand for coal is likely to be more stable that the demand for iron ore, both from the perspective of total demand and from the perspective of systematic risk.

In a similar vein to the above two comments, HPPL states that:

> *... there is no case for an equity beta of 1.0 and that the Authority should be satisfied that lower end of its range i.e. an equity beta of 0.7 is appropriate to TPI railway. This is above the highest equity beta of the regulated railways in Australia and well above the equity beta HPPL believes is appropriate.*[73]

CRA response: As discussed above, we consider that it is appropriate for the asset beta to fall within the range bounded by the asset beta for a general freight railway and the asset beta for iron ore mining. HPPL's position on the asset beta, gearing and equity beta is inconsistent. An asset beta of 0.44 to 0.50 with gearing of 50% translates into an equity beta of 0.87 to 0.90, which is well above HPPL's recommended equity beta of 0.70. In our view it is not appropriate to focus on achieving any particular equity beta, as this is significantly influenced by gearing, while the overall WACC will change relatively little with large changes in gearing. Instead, it is important to consider the appropriate range for the asset beta.

Synergies and FMG put the case for a higher asset beta than that proposed by the Authority:

72 NWIOA (2009), p. 2.

73 HPPL (2009), p. 3.

> *To the extent that it is equity in Fortescue that supports the capital investment in the infrastructure that asset seekers will require access to, the cost of equity to TPI is the cost of equity to Fortescue. With TPI effectively exposed to the same risk as Fortescue, TPI should be considered to have the same asset beta as Fortescue, namely 2.14.*[74]

CRA response: FMG's logic is not correct. It is the systematic risk of the activity that determines the appropriate asset beta, not the systematic risk of the equity investor's other investment(s). It is also our view that measuring the beta of mining stocks against the ASX will overstate those betas by including an element of idiosyncratic (non-systematic) risk in the estimated beta.[75]

Synergies argues that GWI's asset beta should provide the lower bound on TPI's asset beta, while the beta for iron ore mining should provide the upper bound. We agree that iron ore mining should be the upper bound, although as noted above we consider that measuring the beta against the ASX will bias the beta upwards. We disagree that GWI's asset beta should necessarily be considered to be the floor for TPI's asset beta. Conceptually, GWI can be thought of as a portfolio of the component railways and thus GWI's observed beta is the weighted average of the beta for each of those railways. Being a weighted average, this suggests that some of the component railroads will have a higher beta and some will have a lower beta. Differences in industries served, number of customers and profitability / cost structure will all be factors affecting the beta of the individual railroads. We do not know the range in which the betas for the individual railroads will fall but we do know that it will stretch from somewhere below the observed beta for GWI to somewhere above the observed beta. Even if we did know that range, we do not know where in that range the beta for TPI's railroad would fall. Although still imprecise, the beta for GWI thus provides the best available estimate of TPI's beta within the range bounded by the beta for the Class 1 freight railroads and iron ore mining.

> *HPPL argues that third party access to the TPI railway entails no risk and should therefore not have a high beta:[The] TPI railway ... was built and economically justified to carry iron ore from the FMG mines to the FMG port facilities at Port Hedland. If there was never to be any third party traffic the rail would still have been built. On this basis the third party use is extra revenue that is above that required to justify the building of the rail and entails no risk as it is all clear profit. On this argument alone it is hard to see why TPI should be somehow rewarded for building the railway by having a beta that is higher than other heavy haul railways in Australia and therefore be able to gain more revenue from third parties use of the rail.*[76]

CRA response: this argument confuses profitability and incremental revenues with risk. Incremental revenues might not be required to justify the project but they are neither risk-free in an absolute sense (i.e., are not guaranteed constant revenues) nor risk-free in the sense that they have no systematic risk (i.e., they will have some correlation with overall market returns). As noted by FMG:

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74 FMG (2009), p. 14.

75 See Appendix E for further elaboration of this point.

76 HPPL (2009), p. 2.

> *…iron ore is the only product likely to be transported so there is no ability to diversify risk through transporting a variety of different products (with different demand cycles). Moreover, whilst there are assertions made by third parties about the large amount of Mineral Resources that represent latent demand for transport services – it is important to distinguish between Mineral Resources, which merely attest to the existence of iron molecules in the ground and Ore Reserves which attest to the commercial viability of extracting the ore from the ground and selling it.*[77]

Commercial viability and the quantity of ore mined is likely to vary in line with commodity price cycles, giving rise to positive systematic risk.

5.3.2. Formulae

To calculate asset betas (de-levering) and equity betas (re-levering) we use the Monkhouse formula. The Monkhouse formula is:[78]

$$\beta e = \beta a + (\beta a - \beta d)\left[1 - \left(\frac{rd}{1+rd}\right)(1-\gamma)Te\right]\frac{D}{E}$$

where βa = the asset beta

βe = the equity beta

rd = the cost of debt

Te = the effective corporate tax rate

D = the market value of debt

E = the market value of equity

To calculate asset betas we rearrange the Monkhouse formula to give:

$$\beta a = \frac{\beta e + \beta d \cdot X}{1+X}$$

where

$$X = \left[1 - \left(\frac{rd}{1+rd}\right)(1-\gamma)Te\right]\frac{D}{E}$$

5.3.3. Assumptions

This formulation means that it is necessary to have an estimate of gamma, the tax rate and the cost of debt for each comparator. We note, however, that the precise value of these parameters is not critical.[79]

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77 FMG (2009), p. 14.

78 ACCC, *Statement of principles for the regulation of electricity transmission revenues – background paper*, 8 December 2004, p. 103.

79 See Appendix C for an analysis of the sensitivity of the Monkhouse formula to the parameter estimates.

For the purpose of our de-levering calculations, we have assumed:

- The D/E ratio is calculated as the ratio of total debt to market capitalisation and is calculated as the average ratio over the period that the beta is calculated. This means that a significant recent change in the D/E ratio does not have a disproportionate impact on the asset beta;
- The cost of debt is equal to reported interest expense divided by the reported total debt;
- The value of gamma is 0.5, except for US-based firms for whom gamma is assumed to be zero (the US does not have a system of dividend imputation); and
- The tax rate is the reported effective tax rate. For those firms that do not have a reported effective tax rate we assume a tax rate of 30%. As noted above, this assumption does not result in any material error in the de-levering calculations.

5.3.4. Asset Beta Estimates for Comparators

Tables 9-12 below show our estimates of the asset betas for each comparator firm and the average for each industry. Table 9 shows the asset betas for US and Canadian freight railroads. In all cases the betas are calculated based on weekly data available for these firms on Datastream and measured against the appropriate US and Canadian market indices.

Table 9: Asset Beta Estimates for US and Canadian Freight Railroads

Company Name	D/E	X	Be	Asset Beta, Ba
Kansas City Southern	0.75	0.74	1.54	0.89
Genesee & Wyoming Inc.	0.30	0.29	1.60	1.23
CSX Corp.	0.68	0.66	1.29	0.78
Union Pacific Corp.	0.39	0.38	1.06	0.76
Norfolk Southern Corp.	0.52	0.50	1.15	0.77
Burlington Northern Santa Fe Corp.	0.39	0.38	0.91	0.66
Canadian Pacific Railway Limited	0.50	0.49	0.98	0.66
Canadian National Railway Company	0.27	0.27	0.73	0.58
Total	0.44			0.71

Source: Calculated from data downloaded from CapitalIQ and Datastream, 29 May 2009.

The estimation of betas for firms in the “Iron Ores” and “Diversified Minerals” industries presents additional challenges because of the large contribution that firms in these industries make to the Australian market. If a firm or industry comprises a relatively large proportion of the market index then the equity betas for that firm or industry will be biased upwards (in other words, their equity betas no longer contain just the systematic risk component). To correct for the bias that exists from measuring such betas against the Australian all ordinary shares index, we estimate betas for firms such as BHP Billiton and Rio Tinto against the world market (see Appendix E).

Table 10: Asset Beta Estimates for Iron Ores

Company Name	D/E	X	Be	Asset Beta, Ba
United States Steel Corp.	0.45	0.45	2.12	1.47
Cliffs Natural Resources Inc.	0.10	0.10	2.53	2.30
Fortescue Metals Group Ltd.	0.27	0.27	1.70	1.34
Mount Gibson Iron Ltd.	0.18	0.18	1.59	1.35
Territory Resources Limited	0.29	0.29	1.31	1.02
Total	0.30			1.55

Source: Calculated from data downloaded from CapitalIQ and Datastream, 29 May 2009.

We present the betas for diversified minerals in Table 11 but note that the diversified nature of those firms means that they probably do not provide a good estimate of the upper bound on the beta of an iron ore railway.

Table 11: Asset Beta Estimates for Diversified Minerals

Company Name	D/E	X	Be	Asset Beta, Ba
BHP Billiton Ltd.	0.10	0.09	1.12	1.02
Rio Tinto Ltd.	0.23	0.23	1.01	0.82
Total	0.15			0.95

Source: Calculated from data downloaded from CapitalIQ and Datastream, 29 May 2009.

Table 12: Asset Beta Estimates for Mining Services

Company Name	D/E	X	Be	Asset Beta, Ba
Orica	0.26	0.26	0.96	0.76

Source: Calculated from data downloaded from CapitalIQ and Datastream, 29 May 2009.

5.3.5. Conclusions on Asset Beta

The Canadian and US freight railroads provide a good estimate of the beta for a large diversified railway. However, the diversified nature of those railways means that they are not particularly good comparators to TPI. Weighting the asset betas by total enterprise value suggests an asset beta of 0.71.

Within the set of Canadian and US railroads, Genesee & Wyoming Inc (GWI) provides the only example of regional short-line railroads. The number of such railroads owned means that GWI will have considerable diversity across the various lines, so it could in some ways be considered to be a proxy for the “short-line railroad” industry. Short line railroads would be a better approximation to TPI than the large trans-national railroads, providing an asset beta of 1.23 (with a debt beta of zero). However, the large statistical errors inherent in beta estimation mean that reliance on a single comparator is always subject to considerable error. Since the estimation of GWI’s beta for our draft report, the estimate of the equity beta has increased from 1.37 to 1.60 and the estimate of the asset beta has increased from 1.07 to 1.23.

Finally, as we have previously discussed, we expect that there would be some sharing of risk between mines and an independent ore-carrying railway. As a result, we would expect that the asset beta for such a railroad would lie somewhere between the beta for a diversified freight railway and the beta for iron ore mining. The average asset beta for iron ore mining is 1.55, when measured against a world index to remove bias from over-representation in the ASX. This also has increased significantly from our draft report (where the average asset beta was 1.37), reflecting continuing uncertainty in equity markets.

6. THE MARKET RISK PREMIUM

The appropriate value for the Market Risk Premium (MRP) lies outside the scope of this project. However, we do have some comments on the issues raised in submissions.

Some submitters argue for a different MRP than the MRP used by the Authority in its various WACC determinations. In responses to the Issues Paper, some submitters argued for a higher MRP based on recent studies, while others argued for a lower MRP either to reflect the MRP used in a foreign market or for other project-specific factors (e.g. NWIOA). In our draft report we noted that the appropriate MRP is the MRP for the Australian market as a whole, that estimates for foreign markets are therefore not particularly relevant, and that there is no case for altering the MRP on a project-specific basis. There is, however, a case that recent studies should be considered by the Authority, but we recommend that this occurs as a separate consultative exercise involving all the industries regulated by the Authority, as the same value should be applied across all industries.

Further arguments have been raised in submissions on the Draft Determination. HPPL supported the use of a 6% MRP but "would not discourage the Authority from finding that a downward adjustment of some type would be required to reflect the weakness evident in world markets". FMG, on the other hand, referred to a recent study by Officer and Bishop (2009) which concludes that the MRP should be increased to "7% if imputation tax benefits were valued at greater than 0.3 when distributed…" (p. 5).

There is no justification for lowering the MRP in response to a decline in equity prices other than to recognise that the historical average over a 100-year period "with the decline" will be lower than it would be had the decline never occurred. That is, a 40% decline will reduce the observed 100-year rolling arithmetic average MRP by 0.47% (assuming it had been 7%).

The more interesting point is that such a substantial decline can actually help resolve some of the conflict between historical MRP and the MRP that was implied by high equity prices. That is, high equity prices implied a low discount rate but increased the observed MRP. A substantial fall could imply a substantial increase in the implied discount rate and a slightly lower historical average MRP. Thus reducing or even eliminating the apparent contradiction.

Another thread in the argument for a lower MRP was the belief that, since central banks had formed a consensus in regard to controlling inflation, economic growth was likely to be less volatile in the future than it was in the past. Clearly, the current turmoil suggests that was an overly sanguine attitude.

FMG's argument that the MRP should be increased is consistent with the AER's recent decision, although there is some disagreement over the level of the MRP with and without adjustment for imputation credits. The AER also noted that cash flow measures of the MRP, which in recent years had been below the MRP calculated as the average of historical excess returns, have now increased significantly, providing "some evidence ... that the MRP (perhaps even the medium term MRP) is above the long run historical MRP".[80]

The ERA has previously determined that 6.0% is the appropriate level. Since this is lower than the historical observed MRP relative to bills, there is, on balance, no firm argument to suggest that current events should lead to this being lowered.

Consistent with other WACC determinations by the Authority, we have applied a Market Risk Premium of 6%.

80 AER (2009), p. 220.

7. THE WEIGHTED AVERAGE COST OF CAPITAL

Section 7.1 summarises our parameter estimates and presents our calculation of the nominal vanilla WACC. Section 7.2 presents our calculation of the pre-tax real Officer WACC, including our estimate of inflation over the 10-year period corresponding with the tenor of the risk-free instrument. As a sensitivity analysis, we present estimates for our recommended parameters, being a BB credit rating with affordable gearing, as well as for a BBB credit rating with gearing of 35%.

We calculate the following estimates of WACC:

- The lower-bound estimate set by the US and Canadian freight railroads, with a gamma of 0.23;
- The WACC based on GWI's asset beta of 1.23, with the gamma of 0.5 that the Authority adopted in the Draft Determination;
- The WACC based on GWI's asset beta of 1.23, with a gamma of 0.34; and
- The upper-bound estimate set by the asset beta for iron ore mining.

In all cases the debt beta is set to zero.

7.1. NOMINAL VANILLA WACC

The nominal vanilla WACC is calculated using the formula:

$$WACC = re \cdot \frac{E}{V} + rd \cdot \frac{D}{V}$$

Given the other parameter values recommended earlier in this report, including a credit rating of BB and affordable gearing, we calculate the nominal vanilla WACC for TPI as shown in Table 13. Our lower-bound estimate of the nominal vanilla WACC is 10.40%, and the upper-bound estimate is 15.43%. The nominal vanilla WACC based on GWI's asset beta is 13.51%-13.54%, depending on the assumption for gamma.

Table 13: Calculation of Nominal Vanilla WACC, BB Credit Rating with Affordable Gearing

		Floor: US & Canadian Railroads	Genesee & Wyoming		Ceiling: Iron Ore Mining
			Gamma = 0.34	Gamma = 0.50	
Nominal Risk Free RoR	rf	5.021%	5.021%	5.021%	5.021%
Gearing	D	16.5%	16.5%	16.9%	16.5%
Debt Premium (bps)	p	677.07	677.07	677.07	677.07
Debt Issuance Costs (bps)	dic	12.5	12.5	12.5	12.5
Cost of debt	rd	11.92%	11.92%	11.92%	11.92%
Market risk premium	MRP	6.00%	6.00%	6.00%	6.00%
Corporate tax rate	T	30.0%	30.0%	30.0%	30.0%
Gamma	γ	0.34	0.34	0.50	0.34
Asset Beta	Ba	0.71	1.23	1.23	1.55
Debt Beta	Bd	0	0	0	0
	D/E	0.198	0.198	0.203	0.198
	X	0.194	0.194	0.200	0.194
Equity Beta	Be	0.85	1.47	1.48	1.85
Required Return on Equity	re	10.11%	13.83%	13.88%	16.12%
Nominal Vanilla WACC	w_N	**10.40%**	**13.51%**	**13.54%**	**15.43%**

7.2. PRE-TAX REAL WACC

We would generally recommend the use of a post-tax nominal WACC applied within a model that explicitly calculates benchmark tax payments by the regulated firm. Our preference for this approach is because in theory it more accurately models the cash flows faced by investors in the benchmark firm and the post-tax WACC is consistent with the post-tax returns required by providers of capital.

We note, however, that the Authority's practice is to apply a real pre-tax WACC without modelling tax payments. Consistency with the 2008 Freight and Urban Railways Determination is one reason to adopt a pre-tax real Officer WACC in the present determination but consistency with previous decisions should not be treated as an over-riding consideration,.

We also note that the pre-tax real approach appears to be accepted by submitters. The pre-tax method loses some accuracy but if it is accepted by stakeholders, it avoids contentious arguments over how to calculate the benchmark tax allowance and the items that should be included in, or excluded from, that allowance. In New Zealand, for example, an inconsistency between the treatment of taxation and the valuation of the regulatory asset base means that allowed revenues decrease if a firm pays above the regulatory value for assets.[81]

7.2.1. Inflation Estimate

The capital cost component of floor and ceiling costs is an annuity based on the annually-inflated GRV of the relevant rail assets. When the underlying asset base is inflated then the annuity must be adjusted for inflation – either by an explicit deduction for the gains from inflation or by using a real WACC in the annuity calculation. The Authority adopts the latter approach.

The NPV of a nominal annuity calculated with the nominal WACC will equal the initial capital cost of the underlying asset. When calculating a real WACC to apply with an annually-inflating asset base the aim is also to obtain an NPV equal to the initial capital cost of the underlying asset. This is most likely to be achieved if the estimate of future inflation applied to calculating the real WACC is the same as the inflation adjustment that will be applied to the GRV. If the GRV is inflated annually by CPI, then a forecast of the same measure should be applied when calculating the real WACC.

It has recently been recognised by regulators that estimates of future inflation derived using inflation-indexed bonds are biased upwards. This is because there is a limited supply of inflation-indexed bonds, which tends to result in bond prices being "too high" and hence returns on inflation-indexed bonds being too low. When compared with nominal bonds, the effect is to overstate future inflation.

One approach to forecasting inflation is to adopt the midpoint of the Reserve Bank of Australia's (RBA's) inflation target band, i.e., 2.5%. We consider that this is generally likely to provide reasonable outcomes, although there will be periods when inflation is significantly above or below this target.

A better approach, particularly when inflation is expected to depart significantly from the target, is to derive an estimate of inflation based on forecasts. This is essentially the approach adopted by the Authority in the 2008 Freight and Urban Railways Determination. To the extent that the forecasts represent the market's best estimate of future inflation this method is likely to provide the most appropriate outcomes.

81 See, for example, the discussion in CRA (2005) *Review of the Commerce Commission's Intention to Declare Control of Unison*, Final Report, 28 October, pp. 32-42.

For the current determination the relevant period for inflation is the year ended 30 June 2010. In February 2009 the Australian Federal Government's *Updated Economic Forecast and Outlook* forecast CPI inflation of 2.0% for the period. The RBA's May 2009 *Statement on Monetary Policy* forecast CPI inflation of 2.5%.[82] The Federal Government's 2009-10 Budget forecast CPI inflation of 1.75%.[83]

With differing inflation forecasts there is a question over which forecast is "better". We have no comment to make on the relative accuracy of RBA and Treasury forecasts. Rather, we note that the Authority is essentially faced with the choice of whether to "choose high" (2.5%) or to "choose low" (1.75%). In general terms the "best" choice can be informed by a "least regrets" approach to decision making. If the Authority consistently chooses the higher inflation estimate then there would be a greater chance that the inflation estimate used for calculating the real WACC would be too high – in the sense that it is higher than the actual inflation outcome – leading to a real WACC that is too low, and as a consequence lower floor and ceiling costs. Conversely, if the Authority consistently chooses the lower inflation estimate then there would be a greater chance that the inflation estimate would be too low – in the sense that it is lower than the actual inflation outcome – leading to a real WACC that is too high, and as a consequence higher floor and ceiling costs. While the floor and ceiling costs may not be binding constraints in many price negotiations, they may nevertheless influence the negotiated prices that parties are prepared to agree to. There is a risk, therefore that a high inflation forecast and low floor and ceiling costs will reduce the incentive for investment in infrastructure. If the floor and ceiling are slightly high then it is likely that the two parties will still be able to negotiate appropriate access prices. For this reason we consider that it is better for the Authority to adopt the lower inflation forecast of 1.75%.

7.2.2. Estimate of the Pre-Tax Real WACC

The pre-tax nominal Officer WACC is calculated using the Officer formula:

$$WACC = re\frac{1}{1-T(1-\gamma)}\cdot\frac{E}{V}+rd\cdot\frac{D}{V}$$

where $re = \text{the cost of equity} = rf + \beta e \cdot MRP$

$rd = \text{the (pre - tax) cost of debt}$

$T = \text{the statutory corporate tax rate}$

$V = \text{D} + \text{E}$

The pre-tax nominal Officer WACC is then adjusted for inflation to obtain a pre-tax real Officer WACC.

82 Reserve Bank of Australia (2009) *Statement on Monetary Policy*, 8 May, p. 69.

83 Commonwealth of Australia (2009) *Budget Strategy and Outlook 2009-10*, Budget Paper No. 1, 12 May, pp. 2-6.

Table 14 shows our calculation of the pre-tax real Officer WACC values corresponding to the nominal vanilla WACC values on Table 13 (BB credit rating, affordable gearing). Based on our recommended approach and parameter values, the pre-tax real Officer WACC for TPI lies between a lower bound of 10.55% and an upper bound of 16.71%. GWI's pre-tax real Officer WACC is 13.59% when calculated with a gamma of 0.5 or 14.36% when calculated with a gamma of 0.34.

Table 14: Calculation of Pre-Tax Real WACC, BB Credit Rating, Affordable Gearing

		Floor: US & Canadian Railroads	Genesee & Wyoming		Ceiling: Iron Ore Mining
			Gamma = 0.34	Gamma = 0.50	
Nominal Vanilla WACC	w_N	10.40%	13.51%	13.54%	15.43%
Pre-tax nominal Officer WACC		12.49%	16.36%	15.58%	18.75%
Inflation		1.75%	1.75%	1.75%	1.75%
Pre-tax real Officer WACC	w_R	**10.55%**	**14.36%**	**13.59%**	**16.71%**

7.2.3. Sensitivity to Credit Rating and Gearing Assumptions

Moving from a BBB benchmark credit rating to a BB benchmark credit rating significantly increases the debt premium. In our draft report a premium of 295 bps was used for a benchmark credit rating of BBB. The debt premium for BBB rated debt is now approximately 100 bps higher. However, in this report we utilise a premium of 677 bps for a benchmark credit rating of BB. Although this increases the cost of debt by approximately 3.8%, the impact on the pre-tax real Officer WACC is much less.

Table 15 shows the calculation of the nominal vanilla WACC with a BBB credit rating and gearing of 35%. The lower-bound estimate increases from 10.40% to 10.67%; the upper-bound estimate increases from 15.43% to 15.68%, and the nominal vanilla WACC based on GWI's asset beta increases from 13.51%-13.54% to 13.77%-13.78%.

Table 15: Calculation of Nominal Vanilla WACC, BBB Credit Rating with 35% Gearing

		Floor: US & Canadian Railroads	Genesee & Wyoming		Ceiling: Iron Ore Mining
			Gamma = 0.34	Gamma = 0.50	
Nominal Risk Free RoR	rf	5.021%	5.021%	5.021%	5.021%
Gearing	D	35.0%	35.0%	35.0%	35.0%
Debt Premium (bps)	p	390.56	390.56	390.56	390.56
Debt Issuance Costs (bps)	dic	12.5	12.5	12.5	12.5
Cost of debt	rd	9.05%	9.05%	9.05%	9.05%
Market risk premium	MRP	6.00%	6.00%	6.00%	6.00%
Corporate tax rate	T	30.0%	30.0%	30.0%	30.0%
Gamma	γ	0.34	0.34	0.50	0.34
Asset Beta	Ba	0.71	1.23	1.23	1.55
Debt Beta	Bd	0	0	0	0
	D/E	0.538	0.538	0.538	0.538
	X	0.530	0.530	0.532	0.530
Equity Beta	Be	1.09	1.88	1.88	2.37
Required Return on Equity	re	11.54%	16.31%	16.32%	19.25%
Nominal Vanilla WACC	w_N	**10.67%**	**13.77%**	**13.78%**	**15.68%**

Table 16 shows the pre-tax real Officer WACC values corresponding to the nominal vanilla WACC values in Table 15. Adopting a BBB credit rating and 35% gearing raises the upper- and lower-bound of the pre-tax WACC by just 0.02%-0.03%, while the pre-tax real Officer WACC based on GWI's asset beta increases by between 0.02% and 0.07%.

Table 16: Calculation of Pre-Tax Real WACC, BBB Credit Rating with 35% Gearing

		Floor: US & Canadian Railroads	Genesee & Wyoming		Ceiling: Iron Ore Mining
			Gamma = 0.34	Gamma = 0.50	
Nominal Vanilla WACC	w_N	10.67%	13.77%	13.78%	15.68%
Pre-tax nominal Officer WACC		12.52%	16.39%	15.65%	18.77%
Inflation		1.75%	1.75%	1.75%	1.75%
Pre-tax real Officer WACC	w_R	**10.58%**	**14.38%**	**13.66%**	**16.72%**

This sensitivity analysis indicates that the pre-tax real Officer WACC is robust to consistent assumptions about the credit rating and gearing. Our affordable gearing analysis indicates that a credit rating of BBB would be associated with an affordable gearing of between approximately 33.2% (gamma = 0.50) and 34.9% (gamma = 0.34); and that a credit rating of BB would be associated with an affordable gearing of between approximately 16.5% (gamma = 0.34) and 16.9% (gamma = 0.50). Comparing the calculations in Table 16 with those in Table 14 indicates that the two combinations of credit rating and gearing have no material impact on the magnitude of the pre-tax real Officer WACC.

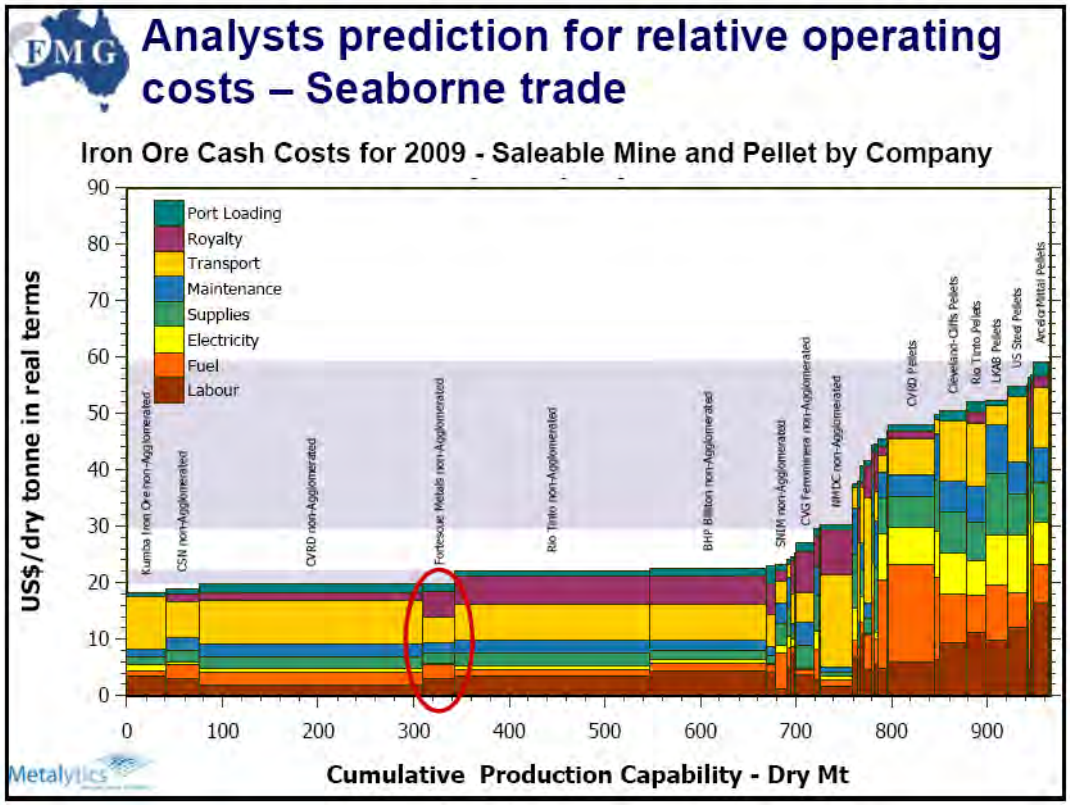
8. ASYMMETRIC RISK

TPI's original application to the ERA argued strongly for compensation for asymmetric risk. All parties other than TPI commented on the treatment of asymmetric risk in their submissions in response to the Issues Paper.

NWIOA, and UMC presented material arguing that there is considerable demand for iron ore, particularly from the growing economies of India and China. The suggestion is made that this growth would continue for the foreseeable future, thus making it unlikely that there was any material stranding risk. We are less convinced about the potential for such trends to continue unabated, with the prospect of sustained global downturn being a genuine concern at the moment. Such a downturn could significantly reduce industrial production in China and India for an extended period, better enabling them to rely on domestic iron ore and steel production. It is therefore appropriate to consider the risk of FMG needing to cut production if there was a sustained global recession.

One of the more powerful arguments against stranding risk was provided in a chart that NWIOA and UMC reproduce from one of FMG's own presentations (see Figure 3 below). This chart provides FMG's estimate of a supply curve for iron ore, and indicates that FMG's operations in the Pilbara will be relatively low cost.

Figure 3: FMG's Estimate of the Supply Curve for Iron Ore



Source: Fortescue Metals Group, The New Force in Iron Ore, JP Morgan Asia Pacific & Emerging Markets Equity Conference, September 3-5, 2008. A similar chart was released as part of the slides for FMG's Annual General Meeting 2008.

One implication from this chart is that if world iron ore demand does contract, there are other high cost producers who would be forced to shut down well before FMG's Pilbara operations (i.e., those at the right hand side of the chart).

We also note from the chart that FMG's Pilbara operations produce a relatively small quantity of iron ore relative to CVRD, Rio Tinto, and BHP Billiton. The significance of this from an economic perspective is that FMG's production volumes are unlikely to influence market price, but production volumes from the three large producers could have an influence on price. If demand for iron ore falls and market prices also drop, then the three large producers may have an incentive to reduce production volumes in order to support market prices. While the likelihood of this depends on the price elasticity of demand in the international market for iron ore, it further indicates that other mining operations are likely to reduce production before FMG.

Consistent with this assessment, FMG recently had a temporary shutdown of the port in order to *expand* loading capacity, allowing it to achieve its target of 55 million tonnes per annum.[84]

We agree, therefore, that on the balance of available evidence the stranding risk for the overall TPI railway does not appear to be large.

Although stranding risk in total does not appear to be large, it is still possible that stranding risk could be material for particular parts of the TPI system, particularly in relation to parts of the network that have been constructed specifically at the request of third parties.[85] It is reasonable, therefore, to have some means of providing compensation for, or protection against, asymmetric risk.

Suggestions were made by various parties on alternative means for compensating for asymmetric risk, with HPPL and the NWIOA noting that asymmetric risk should not be compensated in the WACC if it is already allowed for elsewhere. TPI's own proposals to utilise accelerated depreciation were noted by NWIOA and UMC, as was the ability for TPI to require up-front capital contributions to help meet the cost of capacity expansions. ARTC suggests the adoption of a "loss capitalisation" approach – whereby losses over the early period of the project are capitalised – in preference to accelerated depreciation. ARTC also suggests that an increment on the WACC or selecting a value from the upper end of a range of values could understate the risks to TPI. The NWIOA noted that the railway should not be treated as a whole when assessing stranding risk – we agree with this and note that individual branch connections and capacity upgrades for a specific user are far more likely to be stranded than the mainline. The NWIOA and UMC propose an approved programme of Major Periodic Maintenance as an alternative to depreciation.

84 See FMG press release "Loading Recommences after Expansion Shut Down, Mining to finish Calendar Year Strongly, Shipping to put in a Solid Performance Despite the Shut", 26 November 2008.

85 This is the corollary of NWIOA's concerns that the railway should not be treated as a whole when assessing stranding risk, and that stranding risk would likely to be minor on the main line.

We consider the vast majority of all of these points are very valid, but it is unclear whether NWIOA's suggested treatment of Major Periodic Maintenance would provide full compensation to TPI. TPI's original submission suggested ways to increase the WACC to compensate for asymmetric risk. As we noted in the Issues Paper, a number of the options reviewed by TPI are extremely complex to implement and there is a lack of good data for developing a robust estimate. Our view is that the various measures suggested above provide a more robust means of dealing with asymmetric risk and benefit from not relying on contentious estimates of what an appropriate risk premium might be. Up-front capital contributions will eliminate stranding risk for the portion of any capacity expansion that is covered by the contribution, and accelerated depreciation would significantly reduce stranding risk for the residual. We also note that employing upfront capital contributions in the manner suggested would also respond to NWIOA's concerns that the railway not be treated as a whole because capacity additions for a junior miner, and hence the attendant stranding risks, are likely to be relatively minor on the mainline.

In summary, NWIOA and UMC argued strongly that there is little risk of a large scale reduction in demand (and hence stranding), while ARTC noted that there has been a drop-off in orders from some suppliers. We are somewhat less optimistic about the future than the NWIOA or UMC, but we also note that a supply curve produced by FMG suggests that FMG's Pilbara operations could be largely insulated in the event of a decline in demand. Nevertheless, it is reasonable for TPI to require some protection against asymmetric risk. There are a range of mechanisms available for this that do not rely on contentious estimates of an additional premium, including accelerated depreciation, up-front capital contributions, alternative treatment of major periodic maintenance, etc. We recommend that the Authority uses those mechanisms to minimise asymmetric risk rather than increasing the WACC.

APPENDIX A: THE AFFORDABLE GEARING

This appendix sets out the formula and approach used for calculating the affordable gearing.

We start by noting that the pre-tax return on equity (ROE) can be calculated from the financial statements as:

$$ROE = \frac{EBIT - I}{E}$$

At the same time the required average return on equity is given by the Officer version of the CAPM as:

$$E(ROE) = \frac{rf + \beta e \cdot MRP}{1 - T(1-\gamma)}$$

Where E(ROE) is used to denote the expected (or average) value of the ROE.

In principle the ROE is equal to the expected return on equity:

$$\frac{EBIT - I}{E} = \frac{rf + \beta e \cdot MRP}{1 - T(1-\gamma)}$$

Noting that

$$I = rd \cdot D$$

$$\beta e = \beta a\left(1 + x\frac{D}{E}\right) \quad \text{for} \quad \beta d = 0, x = 1 - \left(\frac{rd}{1+rd}\right)(1-\gamma)Te$$

We have:

$$\frac{EBIT - rd \cdot D}{E} = \frac{rf + \beta a\left(1 + x\frac{D}{E}\right) \cdot MRP}{1 - T(1-\gamma)}$$

Multiplying through we have:

$$\frac{EBIT - rd \cdot D}{E} = \frac{rf + \beta a\left(1 + x\frac{D}{E}\right) \cdot MRP}{1 - T(1-\gamma)}$$

$$\begin{aligned}
[1 - T(1-\gamma)][EBIT - rd \cdot D] &= \left[rf + \beta a\left(1 + x\frac{D}{E}\right) \cdot MRP\right]E \\
&= (rf + \beta a \cdot MRP)E + \beta a \cdot MRP \cdot xD \\
&= (rf + \beta a \cdot MRP)(1 - D) + \beta a \cdot MRP \cdot xD \\
&= (rf + \beta a \cdot MRP) + (\beta a \cdot MRP \cdot x - rf - \beta a \cdot MRP)D
\end{aligned}$$

$$[1 - T(1-\gamma)]EBIT - (rf + \beta a \cdot MRP) = ((1 - T(1-\gamma))rd - (1-x)\beta a \cdot MRP - rf)D$$

And hence we have the affordable level of debt:

$$D = \frac{\left[1 - T(1-\gamma)\right]EBIT - (rf + \beta a \cdot MRP)}{(1 - T(1-\gamma))rd - (1-x)\beta a \cdot MRP - rf}$$

To solve for the equilibrium level of debt we therefore require:

- The tax rate;
- Gamma;
- The risk-free rate of return;
- The asset beta;
- The market risk premium;
- The cost of debt (for the selected credit rating); and
- EBIT.

We start by calculating a level of debt that is consistent with a BBB credit rating. At a BBB credit rating the Standard & Poor's median EBIT interest cover ratio is 4.7. Given a target EBIT interest cover ratio *c*, the equilibrium condition becomes:

$$\left[1 - T(1-\gamma)\right]c \cdot rd \cdot D - (rf + \beta a \cdot MRP) = ((1 - T(1-\gamma))rd - (1-x)\beta a \cdot MRP - rf)D$$

And hence the affordable level of debt is given by:

$$D = (rf + \beta a \cdot MRP)/\left[(1 - T(1-\gamma))c \cdot rd - (1 - T(1-\gamma))rd + (1-x)\beta a \cdot MRP + rf\right]$$

Having calculated equilibrium debt, interest expense is simply the product of the cost of debt and the level of debt, and EBIT is the product of interest expense and the target EBIT interest cover ratio.

We then assume that the same level of EBIT applies at each credit rating. We are implicitly assuming that while the expected level of EBIT remains unchanged, the variability of that EBIT increases as credit rating declines. This variability increases the chance of default and hence reduces the credit rating.

APPENDIX B: COMPARATOR COMPANIES

Business descriptions provided by CapitalIQ.

Company Name	Business Description
US and Canadian Freight Railroads	
Kansas City Southern (NYSE:KSU)	Kansas City Southern, through its subsidiaries, provides domestic and international rail transportation services in the United States and Mexico. It operates north/south rail between Kansas City, Missouri, and various ports along the Gulf of Mexico in Alabama, Louisiana, Mississippi, and Texas in the midwest and southeast regions of the United States. The company also operates direct rail passageway between Mexico City and Laredo in Texas, serving various Mexico's industrial cities and 3 of its shipping ports; operates a 157-mile rail line extending from Laredo to the port city of Corpus Christi, Texas; and owns the northern half of the rail bridge at Laredo, Texas. In addition, it holds a concession to operate a 47-mile railroad located adjacent to the Panama Canal, as well as operates and promotes commuter and tourist passenger services. Further, the company operates a bulk materials handling facility with deep-water access to the Gulf of Mexico at Port Arthur, Texas that stores and transfers petroleum coke from rail cars to ships primarily for export; and a railroad wood tie treatment facility. Kansas City Southern serves customers conducting business in various industries, including electric-generating utilities, chemical and petroleum products, forest products and metals, agriculture and mineral products, automotive products, and intermodal transportation. The company was founded in 1962 as Kansas City Southern Industries, Inc. and changed its name to Kansas City Southern in 2002. Kansas City Southern is based in Kansas City, Missouri.
Genesee & Wyoming Inc. (NYSE:GWR)	Genesee & Wyoming, Inc., through its subsidiaries, owns and operates short line and regional freight railroads in the United States, Australia, and Canada. The company's railroads transport various commodities, such as pulp and paper; coal, coke, and ores; metals; minerals and stone; lumber and forest products; farm and food products; chemicals and plastics; petroleum products; and autos and auto parts. As of December 31, 2007, Genesee & Wyoming, Inc. owned, leased, or operated 48 short line and regional freight railroads with approximately 5,800 miles of owned and leased track; and approximately 3,000 additional miles under track access arrangements. It served 12 United States ports and 5 Australian ports. The company also provides rail freight transport and ancillary logistics services to the mining and agricultural industries, as well as to the general freight market within Western Australia and South Australia. In addition, it owns a minority interest in railroad in Bolivia. Genesee & Wyoming, Inc. was founded in 1899 and is headquartered in Greenwich, Connecticut.
CSX Corp. (NYSE:CSX)	CSX Corporation provides rail-based transportation services in North America. The company offers traditional rail service and the transport of intermodal containers and trailers. It also provides coast-to-coast intermodal transportation services linking customers to railroads, through trucks and terminals. CSX Corporation transports crushed stone, sand and gravel, metal, phosphate, fertilizer, food, consumer, agricultural, paper, and chemical products. In addition, it delivers coal, coke, and iron ore to electricity generating power plants, as well as finished vehicles and auto parts. The company also engages in the real estate sale, leasing, acquisition, and management and development activities; the operation of a resort; and leasing equipment and vessels. As of December 28, 2007, it operated approximately 21,000 route mile rail network, 4,000 locomotives, and 222,000 freight car fleet, serving various

Company Name	Business Description
	population centers in 23 states east of the Mississippi River, the District of Columbia, and the Canadian provinces of Ontario and Quebec. CSX Corporation was founded in 1827 and is based in Jacksonville, Florida.
Union Pacific Corp. (NYSE:UNP)	Union Pacific Corporation, through its subsidiary, Union Pacific Railroad Company, provides rail transportation services in North America. It has approximately 32,205 route miles linking Pacific Coast and Gulf Coast ports with the Midwest and eastern United States gateways, and provides various corridors to Mexican gateways. The company offers transportation services for agricultural products, automotive, energy, lumber, steel, paper, food, chemicals, coal, and industrial products, as well as for finished vehicles and intermodal containers. Union Pacific Corporation was founded in 1862 and is based in Omaha, Nebraska.
Norfolk Southern Corp. (NYSE:NSC)	Norfolk Southern Corporation, through its subsidiaries, engages in the rail transportation of raw materials, intermediate products, and finished goods primarily in the United States. Its operations consist of transportation of coal, coke, and iron ore products; general merchandise traffic, which consists of automotive products, chemicals, metals and construction products, agriculture and consumer products, and paper, clay, and forest products; and intermodal traffic. Automotive products include finished vehicles and auto parts. Metals and construction products comprise steel, aluminum products, machinery, scrap metals, cement, aggregates, bricks, and minerals. Agriculture and consumer products include soybeans, wheat, corn, fertilizer, animal and poultry feed, food oils, flour, beverages, canned goods, sweeteners, consumer products, and ethanol. Paper, clay, and forest products comprise lumber and wood products, pulp board and paper products, wood fibers, wood pulp, scrap paper, and clay. Intermodal traffic includes shipments moving in trailers, domestic and international containers, and roadrailer equipment. It handles these shipments on behalf of intermodal marketing companies, international steamship lines, truckers, and other shippers. The company also transports overseas freight through various Atlantic and Gulf Coast ports, as well as provides a range of logistics services. It also operates and leases regularly scheduled passenger trains and commuter trains; acquires, leases, and manages coal, oil, gas, and minerals; develops commercial real estate; telecommunications; and leases or sells rail property and equipment. As of December 31, 2007, the company operated approximately 21,000 route miles in 22 states in the United States and the District of Columbia. Norfolk Southern Corporation was founded in 1830 and is based in Norfolk, Virginia.
Burlington Northern Santa Fe Corp. (NYSE:BNI)	Burlington Northern Santa Fe Corporation, through its subsidiaries, engages primarily in the freight rail transportation business. It transports various products and commodities, including consumer, industrial, coal, and agricultural products. The shipments of consumer products include automotive, such as motor vehicles and vehicle parts. The company also offers transportation services for industrial products, including construction products, such as clays, sands, cements, aggregates, sodium compounds, and other industrial minerals; building products comprising lumber, plywood, oriented strand board, particleboard, paper products, pulpmill feedstocks, wood pulp, and sawlogs; petroleum products, such as liquefied petroleum gas, diesel fuels, asphalt, alcohol, solvents, petroleum coke, lubes, oils, waxes, and carbon black; chemicals and plastic products, including caustic soda, chlorine, industrial gases, acids, polyethylene, polypropylene, and polyvinyl chloride; and food and beverages, such as canned goods and perishable food items, as well as cotton, salt, rubber and tires, and miscellaneous boxcar shipments. In addition, it transports coal products; and agricultural products, such as wheat, corn, bulk foods, soybeans, oil seeds and meals, feeds, barley, oats and rye, flour and mill products, milo, oils, specialty grains, malt, ethanol, and fertilizers. As of December 31, 2007, Burlington Northern Santa Fe operated a railroad system consisting of approximately 32,000 route miles in 28 states and 2 Canadian provinces. The company was founded in 1994 and is based in Fort Worth, Texas.

Company Name	Business Description
Canadian Pacific Railway Limited (TSX:CP)	Canadian Pacific Railway Limited, through its subsidiaries, operates a transcontinental railway in Canada and the United States. The company provides logistics and supply chain expertise. It offers rail and intermodal freight transportation services over approximately 13,200-mile railway network. The company transports bulk commodities, including, grain, coal, sulphur, and fertilizers; merchandise freight that consist of finished vehicles and automotive parts; and intermodal traffic, which includes time-sensitive retail goods, as well as forest, industrial, and consumer products. Canadian Pacific Railway Limited was founded in 1881 and is based in Calgary, Canada. Canadian Pacific Railway Limited (TSX:CP) operates independently of Canadian Pacific Limited as of October 01, 2001.
Canadian National Railway Company (TSX:CNR)	Canadian National Railway Company, together with its subsidiaries, engages in the rail and related transportation business in North America. It provides transportation for various goods, including petroleum and chemicals, metals and minerals, forest products, coal, grain and fertilizers, and automotive products, as well as intermodal transportation of consumer products and manufactured goods. As of December 31, 2007, the company operated a network of approximately 20,400 route miles of track spans Canada and mid-America, connecting three coasts: the Atlantic, the Pacific, and the Gulf of Mexico. It serves ports of Vancouver; Prince Rupert; B.C.; Montreal; Halifax; and New Orleans and Mobile, Alabama, as well as the cities of Toronto, Buffalo, Chicago, Detroit, Duluth, Minnesota/Superior, Wisconsin, Green Bay, Wisconsin, Minneapolis/St. Paul, Memphis, St. Louis, and Jackson, Mississippi, with connections to various points in North America. The company was founded in 1922 and is headquartered in Montreal, Canada.
Mining Services	
Orica Ltd.	Orica Limited engages in the manufacture and distribution of mining products and services, consumer products, chemical products, and chemical services. The company's Mining Services segment manufactures and supplies explosives and mining services, initiating systems, and blasting technology to the mining, quarrying, construction, and exploration industries. Its Minova segment provides specialist chemical products for underground mining and civil engineering activities. These products include resin capsules, powders, and injection chemicals for use in strata support, ground consolidation, and ventilation systems. The company's Consumer Products segment manufactures and supplies paints and other surface coatings to the decorative and technical markets; and a range of home handyman, car care, and garden care products. Its Chemnet segment engages in the distribution and trading of a range of industrial and specialty chemicals, raw materials, and ingredients, as well as provides associated services to various manufacturers. The company's Chemical Services segment manufactures and supplies a range of industrial and specialty chemicals, including chlorine, MIEX DOC resin, sodium hypochlorite, caustic soda, and related chemicals for water care, food, timber, and general industrial purposes, as well as sodium cyanide to the gold mining industry. It operates primarily in Australia, New Zealand, the Americas, Europe, and Asia. The company was incorporated in 1928 as Imperial Chemical Industries of Australia and New Zealand and changed its name to ICI Australia Limited in 1971. Further, it changed its name to Orica Limited in 1998. The company is headquartered in Melbourne, Australia.
Diversified Minerals	

Company Name	Business Description
BHP Billington Ltd.	BHP Billiton Limited, together with its subsidiaries, operates as a diversified natural resources company. The company engages in producing alumina and aluminum, copper, coal, iron ore, nickel, manganese, metallurgical coal, oil and gas, and uranium, as well as gold, zinc, lead, silver, and diamonds. BHP Billiton was founded in 1885 and is headquartered in Melbourne, Australia.
Rio Tinto Ltd.	Rio Tinto Limited engages in exploring, mining, and processing a range of metals and minerals. The company's products include alumina, aluminum, and bauxite; borates; coal; copper; diamonds; gold and silver; gypsum; iron ore; molybdenum; salt; sulphuric acid; talc; titanium dioxide; ilmenite, rutile, and zircon; uranium; and nickel, potash, lead, and zinc. It primarily operates in Australia and New Zealand, North America, South America, Asia, Europe, and Africa. The company was founded in 1873 and is headquartered in Melbourne, Australia.
Oxiana Ltd.	OZ Minerals Limited operates as a diversified mining company. It primarily produces zinc, copper, lead, gold, and silver. The company has five mining operations located in Australia and Asia, three new mining projects in development and a portfolio of exploration projects throughout Australia, Asia, and North America. OZ Minerals Limited is based in Melbourne, Australia.
Iron Ores	
United States Steel Corp. (NYSE:X)	United States Steel Corporation produces steel products. It operates through three segments: Flat-rolled Products, U. S. Steel Europe, and Tubular Products. The Flat-rolled Products segment produces slabs, sheets, tin mill products, strip mill plates, rounds, and coke. It serves customers in the service center, conversion, transportation, construction, container, and appliance and electrical markets in North America. The U.S. Steel Europe segment manufactures and sells sheet, strip mill plate, tin mill, and tubular products, as well as heating radiators and refractories. It serves customers in the central, western, and southern European construction, service center, conversion, container, transportation, and appliance and electrical, as well as oil, gas, and petrochemical markets. The Tubular products segment produces and sells seamless and welded tubular products for the oil, gas, and petrochemical markets. United States Steel Corporation also involves in the production and sale of iron ore pellets, as well as the provision of transportation services. In addition, it owns, develops, and manages various real estate assets, which include approximately 200,000 acres of surface rights primarily in Alabama, Maryland, Michigan, Minnesota, and Pennsylvania; participates in joint ventures that develop real estate projects in Alabama, Illinois, and Maryland; and owns approximately 4,000 acres of land in Ontario, Canada. Further, the company provides engineering and consulting services, which include the preparation of studies, mine and process audits, basic and detailed engineering, project and construction management, procurement, start-up and commissioning, and training and operations assistance to the mining and mineral processing sectors. United States Steel Corporation was founded in 1901 and is headquartered in Pittsburgh, Pennsylvania.
Cliffs Natural Resources Inc. (NYSE:CLF)	Cliffs Natural Resources, Inc. produces iron ore pellets and supplies metallurgical coal to the steelmaking industry primarily in North America. It operates six iron ore mines in Michigan, Minnesota, and Eastern Canada; and three coking coal mines in West Virginia and Alabama. The company also owns Portman Limited, an iron ore mining company in Australia. In addition, it has a 30% interest in the Amapa Project, a Brazilian iron ore project; and a 45% economic interest in the Sonoma Project, an Australian

Company Name	Business Description
	coking and thermal coal project. The company was formerly known as Cleveland-Cliffs, Inc. and changed its name in October, 2008. Cliffs Natural Resources, Inc. was founded in 1847 and is headquartered in Cleveland, Ohio.
Fortescue Metals Group Ltd. (ASX:FMG)	Fortescue Metals Group Limited engages in the development of Pilbara iron ore and infrastructure project. It involves in the acquisition, exploration, and production of iron ores in Australia. The company also designs, finances, and constructs rail and port facilities. Fortescue Metals Group is based in East Perth, Australia.
Mount Gibson Iron Ltd. (ASX:MGX)	Mount Gibson Iron Limited, together with its subsidiaries, engages in mining, exploring, and developing iron ore deposits in Australia. The company was founded in 1996 and is based in West Perth, Australia.
Ferrowest Limited (ASX:FWL)	Ferrowest Limited engages in mineral exploration in Australia. It holds a 100% interest in Yalgoo iron project that produces merchant pig iron from iron resources in the Yogi deposit in Yalgoo, Western Australia. The company was founded in 2005 and is based in Belmont, Australia.
Territory Resources Limited (ASX:TTY)	Territory Resources Limited, together with its subsidiaries, engages in the production, exploration, and development of iron ore properties in Australia. It owns interests in the Frances Creek project comprising 13 deposits located north of the regional town of Pine Creek; and the Mt Bundey project, which consists of 2 exploration licenses and 1 exploration license application totaling of 241 square kilometers situated in the east southeast of Darwin. The company also holds interests in the Yarram project that comprise 4 tenements on the Yarram and Batchelor prospect areas located 100 kilometers south of Darwin; and the Warrego Tailings project located 945 kilometers south of Darwin. Territory Resources is based in West Perth, Australia.
OneSteel Ltd. (ASX:OST)	OneSteel Limited engages in the mining, and manufacture and distribution of steel long products in Australia and internationally. The company's products include structural, rail, rod, merchant bar, cold finished bar, chrome plated bar, reinforcing, wire, tube, pipes, fittings, valves and actuation, rail wheels and axles, lite steel beam, grinding media, and recycled metals. It also offers aluminum, bar sections, building products, pilings, tubes, plate, railway track products, and sheet and coil products. The company's products are primarily used in the construction, manufacturing, housing, mining, agricultural, fishing and forestry, and transport and storage sectors. OneSteel Limited is based in Sydney, Australia.

APPENDIX C: ESTIMATING THE DEBT BETA

While there are difficulties in estimating debt betas, some recent academic studies have attempted to provide a framework for debt betas quantification that is consistent with the data and the theory. In particular a recent study by Stephen Schaefer and Ilya Strebulaev (Schaefer and Strebulaev, 2007)[86] estimates debt betas using a structural model framework[87] and regression analysis.

Using a large sample of bonds issued by US non-financial corporations this study estimates debt betas for a range of credit ratings. The study also confirms that on average both leverage and equity volatilities are higher for bonds with lower ratings. For example on average issues of bonds rated AAA-A have leverage of 10-32% and equity volatility of 25-31% while issues of junk bonds have average leverage ratios in the 50%(BB) to 60%(B) range and equity volatility between 49% and 69%.

Schaefer and Strebulaev (2007) estimate debt betas using the following regression:

$$r_{j,t}^{B} = \alpha_0 + \alpha_E r_{j,t}^{E} + \alpha_{r_f} r_t^{T} + e_{jt},$$

where $r_{j,t}^{B}$ is the one-month return (in excess of the one-month risk-free rate) on a (corporate) bond issued by company *j*, $r_{j,t}^{E}$ is the corresponding excess return on firm *j's* equity and r_t^{T} is the corresponding excess return on a 10-year Treasury bond. One important difference between this regression and a conventional beta regression is the presence of the Treasury return. Schaefer and Strebulaev show that despite the presence of the Treasury return the coefficient on the firm's equity does indeed measure a bond's elasticity with respect to equity[88] and this is what is required to link the bond's risk premium to the risk premium on equity.

86 Stephen Schaefer and Ilya Strebulaev (2007), Structural Models of Credit Risk are Useful: Evidence form Hedge ratios on Corporate Bonds", *Journal of Financial Economics* (forthcoming).

87 The term "structural" refers to an approach in which the behaviour of credit spreads is modelled in terms of the risk and value of the assets that collateralise the debt. It is also worth adding that the main objective of the study was to investigate whether a simple structural model of credit risk could explain the debt betas that can be observed empirically. Schaefer and Strebulaev's results are quite significant as their estimated betas are not only consistent with the data but also are supported by finance theory.

88 The bond's elasticity with respect to equity measures the percentage change in the bond price for a one percent movement in the equity price. A conventional equity beta measures the elasticity of the price of equity with respect to the market.

The results of the regressions are given in Table 17, which shows the average value of the coefficients by credit rating. The debt betas are obtained by multiplying the row labelled α_E by 100. This means, for example, that the average value of the debt beta for bonds with a BBB rating is 0.04. It should be noted that the estimated debt betas increase as one moves from high to low quality bonds: the beta for AA bonds is around 0.01 and for BB bonds is around 0.08. Another relatively recent study has come to very similar estimates.[89]

Table 17: Estimates of debt betas by credit rating[90]

	All	AAA	AA	A	BBB	BB	B
α_o	0.02	0.02	0.01	-0.00	0.00	0.07	0.79
	(0.69)	(0.60)	(0.47)	(-0.01)	(0.05)	(1.08)	(2.98)
α_{rf}	49.59	57.29	54.65	53.25	50.33	29.36	-8.70
	(34.40)	(32.71)	(45.76)	(42.64)	(26.19)	(9.28)	(-0.73)
α_E	3.79	0.61	1.17	3.16	4.00	8.27	15.22
	(14.84)	(1.14)	(3.94)	(12.07)	(13.00)	(18.18)	(15.02)
βd	0.04	0.01	0.01	0.03	0.04	0.08	0.15
$\overline{R}^2$	0.51	0.66	0.63	0.55	0.48	0.34	0.35
N	46.84	57.30	53.28	45.23	47.60	45.03	37.86
	(1360)	(23)	(126)	(620)	(466)	(101)	(22)

Source: Schaefer and Strebulaev (2007), Table IV. t-statistics are in parentheses.

89 See Vasant Naik, Minh Trinh, Srivaths Balakrishnan and Saurav Sen (2003), "Hedging Debt with Equity", Lehman Brothers, Fixed Income, Quantitative Credit Research, November 2003.

90 It is important to note that these debt betas are estimated are against the underlying equity of the firm rather than the market portfolio. However, all that is required to convert these betas to conventional betas (against the market) is to multiply them by the firm's equity beta.

Another important point that Schaefer and Strebulaev mention in their study is that debt betas obtained from regressions on *individual* bonds are very imprecise. Schaefer and Strebulaev, however, achieve a good level of precision in their paper for *average* debt betas by averaging over a large number of bonds. For BBB bonds the standard error of the *average* debt beta is approximately 0.006. Table VIII of Schaefer and Strebulaev study shows estimates of the cross-sectional standard deviation of debt betas estimated from the Merton model. For BBB the cross-sectional standard deviation of debt betas is 0.042; however, at least some of this variation is likely to be the result of estimation error in asset volatility. Taking into account the average values for debt betas in adjacent credit ratings – 0.03 for "A" and 0.08 for "BB"[91] – a standard error of 0.025 seems reasonable.

In summary, therefore, if the benchmark firm would be able to achieve a credit rating of BB, in computing the WACC for TPI CRA recommends using a debt beta of 0.08 with a standard deviation of 0.025, which suggests a range of 0.055 to 0.105 (one standard deviation either side of the mean). However, as demonstrated in our draft report, a debt beta of this magnitude has no material impact on the WACC.

91 See Table 17 above.

APPENDIX D: SENSITIVITY OF MONKHOUSE FORMULA TO PARAMETER ESTIMATES

We note in section 5.3.2 that the Monkhouse formula can be written as

$$\beta a = \frac{\beta e + \beta d \cdot X}{1 + X}$$

where

$$X = \left[1 - \left(\frac{rd}{1+rd}\right)(1-\gamma)Te\right]\frac{D}{E}$$

In this appendix we show that within a reasonable range the assumptions about rd, γ, and Te do not have a material impact on the calculation of the asset beta.

The bounds on the term in square brackets can be estimated by setting appropriate parameter values. The term $rd/(1+rd)$ will equal zero if rd =0 but will be a positive value if rd > 0. If rd = 5% then $rd/(1+rd)$ = 0.0476, and if rd = 15% then $rd/(1+rd)$ = 0.1304. It seems unlikely that a firm would have a cost of debt that falls outside of these bounds. The value of γ is discussed in section 4.2. Our view is that γ lies broadly between 0 and 0.5. We approximate the effective tax rate Te as being equal to the corporate tax rate, which is 30% in Australia, but could easily range between 20% and 40%. Given these parameters, the upper bound for the term in square brackets is [1 – 0.0476 x (1 – 0.5) x 20%] = 0.9952. The lower bound for the term in square brackets is [1 – 0.1304 x (1 – 0) x 40%] = 0.9478.

If debt is 20% of capital structure then D/E = 0.25, and X has an upper bound of 0.2488 and a lower bound of 0.2365. Assuming, for this example, a debt beta of zero, the asset beta will range between 0.8008 and 0.8087. For an equity beta equal to 1, the choice of parameters within the ranges described can alter the beta by as much as 0.008. This difference is not material and is certainly a lot less than the statistical error in the estimate of the equity beta.

If debt is 80% of capital structure then D/E = 4, and X has an upper bound of 3.9808 and a lower bound of 3.7912. Assuming, for this example, a debt beta of zero, the asset beta will range between 0.2008 and 0.2087 of the equity beta. For an equity beta equal to 1, the choice of parameters again alters the asset beta by 0.008.[92]

We conclude that the choice of parameters for calculating estimates of the asset beta is not critical, so long as the parameters selected lie within a range that is likely to apply for the comparator firm.

92 If the calculations are not rounded then there is a small difference in the error that results from differences in the D/E ratio. This difference is lost in the rounding in the calculations we have presented, and is even smaller than the potential error of 0.008.

APPENDIX E: BETA BIAS USING THE AUSTRALIAN INDEX

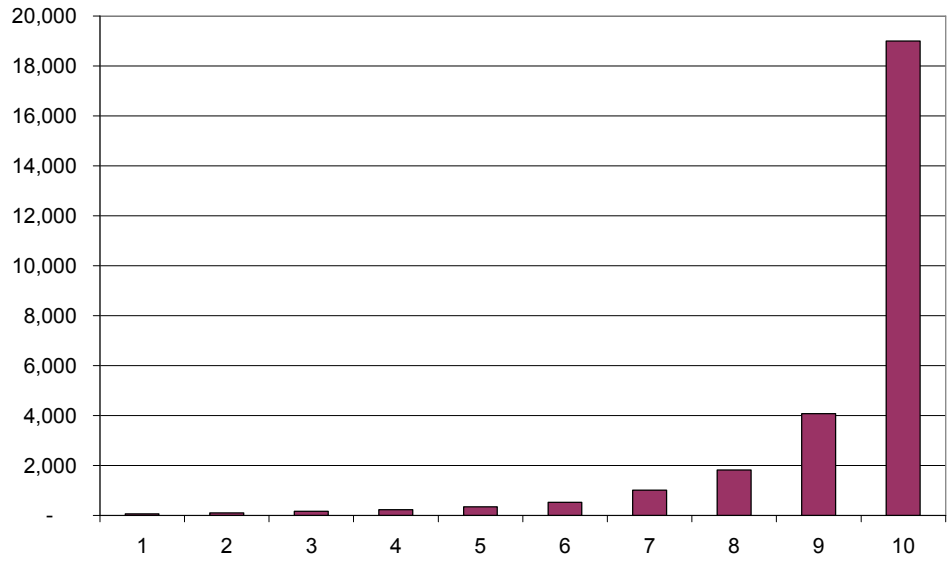
When the market value of one company (or one industry) is a significant percentage of the total market value of an index, the beta for that company (or the companies of that industry) can be substantially higher when measured against that index than they would be if measured against a broader index.

As a firm's proportion of an index increases, less of the firm's specific risks are diversified within the index. The significance of this can be demonstrated by using both mathematical intuition and by varying weights for the index and recalculating betas. The latter approach is used first below to demonstrate the dramatic effect this can have on the betas of mining stocks within the Australian stock market index. A discussion of the mathematical intuition follows. Finally, economic argument is presented to suggest that is likely that a beta measured against a broader index is more likely to reflect the expected returns of Australian mining stocks.

E.1 DEMONSTRATION OF THE IMPACT ON STOCK BETAS WHEN THEY HAVE SIGNIFICANT WEIGHTS IN THE MARKET INDEX

Figure 4 shows that market values for stocks within the Australian index are heavily skewed towards larger stocks. This is true for most exchanges butin Australia a number of individual stocks make up large portions in their own right. In the case of the 303 stocks in our sample, the top ten firms represent nearly 50% of the total market value (see Table 18).

Figure 4: Average market value by decile (000's AU$) for the 303 Australian constituents of the Australian all ordinary index that traded from 31 Dec 2002 until 31 December 2007



Source: Average of monthly data for Dec 2002 to Dec 2007 from Datastream

Table 18: Top 10 firms by market cap and their share of the total market cap

	% of total
BHP BILLITON	8.7%
TELSTRA	6.6%
NATIONAL AUS.BANK	6.3%
COMMONWEALTH BK.OF AUS.	6.0%
AUS.AND NZ.BANKING GP.	4.9%
WESTPAC BANKING	4.5%
RIO TINTO	3.2%
WESTFIELD GROUP	2.9%
WOOLWORTHS	2.4%
WOODSIDE PETROLEUM	2.3%
Total	47.6%

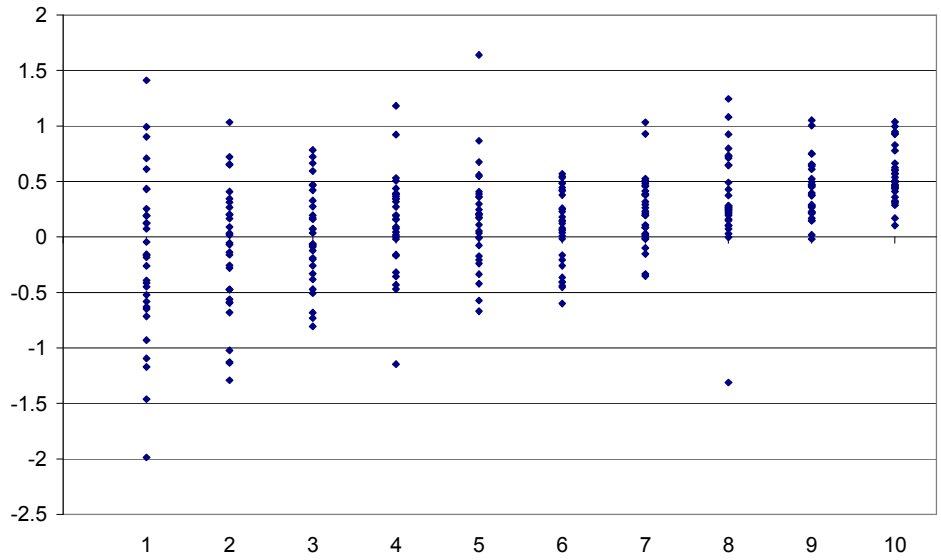
Source: Average of monthly data for Dec 2002 to Dec 2007 from Datastream

Of the largest ten firms two are mining companies and another is in the oil & gas sector. Indeed, commodity stock (i.e. metals & mining and oil & gas stocks) make up 23% of the total market capitalisation within our sample. Any commodity-specific event is not going to be diversified in the way in which it would in a broader index.

The significance of this can be demonstrated by comparing the beta of the stocks in our sample when measured against the actual index and the beta of each stock when measured against an equally weighted index (which serves as a proxy for a broader index).

The difference between the betas using market and equal weights is presented in Figure 5 with the results organised by decile. The difference for firms of all sizes can be significant, but for the largest firms (those in the 10th decile) the difference is always positive.

Figure 5: The difference between market weighted and equally weighted betas for the 3003 firms in our sample organised by market cap deciles



Source: CRA calculations based on monthly data for Dec 2002 to Dec 2007 from Datastream

Table 19: Top 10 mining firms and the difference between their market weighted and equally weighted betas

	Beta relative to actual index	Beta relative to equally weighted index	Difference
BHP BILLITON	1.72	0.92	0.93
RIO TINTO	1.23	0.75	0.54
ALUMINA	1.29	0.84	0.50
NEWCREST MINING	1.97	1.16	1.00
BLUESCOPE STEEL	1.55	1.14	0.50
COAL & ALLD.INDS.	-0.00	-0.01	-0.02
LIHIR GOLD	2.05	1.50	0.65
CSR	1.52	0.77	0.75
OZ MINERALS	1.99	1.76	0.28
FORTESCUE METALS GP.	3.02	2.44	1.24

Source: CRA calculations based on monthly data for Dec 2002 to Dec 2007 from Datastream

Table 19 presents the betas and their differences for the largest 10 mining stocks. Clearly the impact on BHP Billiton, Rio Tinto and FMG is dramatic and the use of an Australian index has a substantial impact on the beta.

E.2 MATHEMATICAL INTUITION

Betas are formally the covariance of a stock and the market divided by the variance of the market. Standard practice involves calculating betas by regressing the returns of each stock against the returns on the market. That is:

$$\delta y = \alpha + \beta \delta Mo + \varepsilon$$

Where:

δy = the row vector that represents the excess returns for an individual stock.

δMo = the row vector that represents the excess returns for the market.

β = the beta on the market for that stock

However, assuming a weight for each stock that is constant over the period, the betas for every stock in an index can be estimated with one equation. That is:

$$\beta = \frac{C\omega}{\omega' C \omega}$$

Where:

$\boldsymbol{\beta}$ = a column vector with the beta for each stock;

$\boldsymbol{w}$ = a column vector of the weight within the index for each stock (these add to 1).

$\boldsymbol{C}$ = the covariance matrix for the stocks in the index.

The numerator in this equation is of specific interest as the denominator (i.e., ***w'Cw***) is the variance of the index (and thereafter the same for all stocks). For each stock ***Cw*** is equivalent to obtaining the sumproduct of: (1) the market weights (***w***); and (2) the applicable column from ***C.*** For each stock, therefore, the beta will include the product of its own variance and its own weight in the index. The own variance factor is likely to be higher than the covariance factors within a given column. As such, the product of a a firm's own variance and weight in the index will have a significant effect on the beta that firm's stock – especially where a stock has a substantial weight within the index.

E.3 ECONOMIC INTUITION

If we were to assume that mining investors were all Australian and all of their investments were in Australia then they would expect to be rewarded for all the undiversifiable risks associated with mining. In that case, the expected return should reflect the beta as measured against the market weighted Australian index.

However, this is clearly not the case. There are significant foreign investors in Australian mining stocks. To consider the impact they might have on the expected returns in Australian mining companies it is useful to start from the proposition that the Australian market is *initially* closed to foreign investors and Australians cannot invest abroad but then these restrictions are lifted. Initially, the expected returns of the mining companies will have been a function of the beta measured against the local market . However, these higher returns will represent significant excess returns when measured by foreign investors against their own diversified portfolios. As such, they will be prepared to bid up the price of Australian mining shares until the returns become of function of their own broader portfolios.

Australian investors will then invest abroad in order to maintain a well diversified portfolio, selling Australian mining shares and acquiring others which increase the diversification of their own portfolios.

In most cases this process will not be entirely complete. Transaction and search costs will limit both Australian and foreign investors. However, where these mining stocks are listed and well followed both in Australia and abroad, it is reasonable to expect that the beta of Australian stocks when measured against a broad index will give a significantly more accurate estimate of the expected returns on those stocks than betas measured against the narrow Australia index.