INTERNATIONAL VERSUS DOMESTIC CAPM

A Report Prepared by NERA

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EXECUTIVE SUMMARY

Set out below are the arguments used in the debate so far concerning the appropriate value to be ascribed to imputation credits in regulatory decisions. This is followed by a descriptions of NERA's main findings in this report.

Arguments for a low gamma

Those ascribing a low value to imputation credits within the CAPM have tended to argue in the following logical form:

- the Australian equity market is highly integrated with the rest of the world;
- the domestic economy is dependent on foreign capital to finance its investment;
- foreign investors do not receive any value from imputation credits;
- in order for Australian companies to attract foreign equity, on which they are dependent, they must offer foreign investors the CAPM rate of return available to them elsewhere;
- as foreign investors do not value imputation credits companies must offer a post tax rate of return where the value of gamma is zero; and
- this conclusion is true despite the fact that Australian investors do place some value on gamma.

Arguments for a high gamma

Commentators supporting a higher value of γ have tended to argue that:

- international equity markets are indeed well integrated and that, in general, foreigners place little or no direct value on imputation credits paid;
- however, accepting a low value of gamma on the basis of foreign investors valuations amounts to an explicit recognition that the 'international CAPM' rather than the 'domestic CAPM' is appropriate;
- while γ may be lower under an international CAPM other WACC parameters will also be lower – specifically beta and the market risk premium (MRP). Taking all such factors into account, it is argued that moving to an international CAPM would actually reduce the estimated WACC;

- it would be perverse to recognise the role of international investors in one way (in relation to tax) but not others (in relation to beta and MRP) resulting in the estimated WACC rising when it should be falling; and

- Associate Professor Lally makes these theoretical arguments and attempts to show them at an empirical level.

NERA's Contribution

In terms of the above description of the debate, NERA's findings can be summarised as follows:

- both sides of the current debate place an inappropriately high weight on determining whether foreign investors are the marginal investor. All investors are marginal in equilibrium and it is theoretically possible to have large foreign investment and a gamma close to 1 or to have low foreign investment and a gamma close to zero;

- estimating CAPM parameters based on domestic data does not result in any *a priori* bias in the resulting WACC – even if the domestic market is perfectly integrated with the international equity market;

- consequently, the claim that a domestic CAPM (ie, with estimates based purely on observed domestic market data) will result in a higher estimated WACC than an international CAPM is, in general, false;

- the argument that internationalisation of equity markets results in an upward bias in the WACC parameters (beta and MRP) currently in use by Australian regulators should *not* be construed as an argument over the use of the international versus the domestic CAPM, rather it is best construed as an argument that:

  - integration of equity markets has occurred too recently for its impact (domestically *and* internationally) to be sufficiently reflected in historical market data; and

  - integration significantly reduces the WACC for Australian equity.

- the above argument's practical relevance to the ACCC is open to question given that, by its very nature, it is an argument that relies on a paucity of data. That is, this argument by definition involves a hypothesis that can not be empirically tested;

- in any event, a case can be made that the Australian capital market has been 'well' integrated with other capital markets for at least the last 100 years and that integrations has been 'strong' for at least 40 years. In this regard we note that, net

external borrowing averaged 3.5/26.6 percent of GDP/Fixed Private Capital Investment (non dwelling) over the period 1950 to 2002 and 2.6/59.0 percent over the period 1900 to 1950. In other words, Australia does, and always has, relied heavily of foreign capital markets to finance investment;

- Associate Professor Lally's estimate of the impact of integration on the WACC for Australian companies (specifically, a reduction in the average risk adjusted equity premium from 6% to 2.8%) is based on the following implicit assumptions:

  - world equity markets have moved from complete isolation to complete integration in the last few years (ie, historical domestic data captures none of the effect of integration but going forward domestic returns will be set consistent with perfect integration); and

  - a survey of two empirical studies estimating the beta for (some) portfolios of Australian stocks against a world market index provides sufficient justification for adopting a 0.7 equity beta for the Australian market against the world market *post integration*.

- both of the above assumptions may be viewed as extreme not least because of the existence of reputable estimates of the Australian market's beta against the world market of more than double 0.7.[1] Furthermore, the two assumptions are mutually inconsistent as the empirical studies that Lally relies on use data from 1984 onwards. Lally's calculations only make sense if the estimates of beta are *post (perfect) integration*, but for this to be true perfect integration must have occurred at least two decades ago. In which case, Lally's assumption that domestic historical data does not encapsulate the impacts of integration is incorrect.

- nonetheless, even accepting Lally's extreme (and inconsistent) assumptions his result that the international CAPM delivers lower rather than higher prices relies on further extreme assumptions – namely that assets are infinitely lived and that prices rise three percent per year. If either of these assumptions is relaxed then the opposite 'result' can be obtained.

[1] See, for example, the award winning article by Campbell H., "The World Price of Covariance Risk", Journal of Finance, (March 1991).

1. INTRODUCTION AND OVERVIEW

TransGrid has asked NERA to provide a report explaining the theoretical considerations that go to determination of the appropriate value of imputation credits in the capital asset pricing model (CAPM) used by the ACCC in its regulatory decisions. In particular, TransGrid has asked that we discuss whether the 'marginal investor' is likely to be a domestic or a foreign resident. NERA has also been asked to provide comment on Associate Professor Martin Lally's paper "The Cost of Capital under Dividend Imputation" and, in particular, the section of Lally's paper entitled 'the relevance of foreign investors'.

The most important findings in this paper are as follows:

- the existing discussion of the characteristics of *'the'* marginal investor involves an oversimplification of the debate. In economic equilibrium *all* investors must be marginal in the sense that all investors must expect adequate compensation for the perceived risk of their portfolio. If this was not the case then investors would change their portfolio until it was.

- the true value of imputation credits to be used in the CAPM (γ) requires an equilibrium analysis of the impact of imputation credits on equity prices. It is shown that γ is determined by the relative elasticity of demand for Australian equities by Australian residents and the elasticity of supply of Australian equity by foreign investors;

- even if the Australian equity market is 'perfectly' integrated into the international equity market there is no *a priori* bias introduced into the CAPM resulting from the use of domestic data to provide empirical estimates of CAPM variables (ie, beta and the market risk premium) – notwithstanding the statements of Associate Professor Lally to the contrary; and

- Associate Professor Lally's discussion of the relevance of foreign investors is problematic and involves a number of questionable theoretical and empirical assumptions.

The remainder of this report comprises two further sections. Section 2 develops a simple model of the CAPM that can be used to identify the impact of a 'shock' that changes the expected rate of return of one group of investors relative to another group in one set of assets. This model is then used to analyse the introduction of imputation credits that are only redeemable by domestic resident investors. However, precisely the same sort of analysis can be applied to any of the other myriad of differential 'transaction costs' applying to different groups of investors in the world economy.

Section 3 examines Associate Professor Lally's analysis of the role of the 'relevance of the international investor' and specifically his claim that incorporating international investors

into the CAPM analysis will result in a fall in the estimated WACC and regulated prices (even if it results in an increase in compensation for the cost of tax).

TransGrid has also asked NERA to address the appropriate value of the debt beta in the CAPM. This is discussed in section 4.

2. A SIMPLE CAPM MODEL

We believe that there has been an oversimplification in the debate so far and that the dichotomy between the international and domestic 'marginal investor' is a false and unproductive one. It is argued below that rates of return in international equity markets do not swing on who is the 'marginal investor' and that proper equilibrium analysis suggests that all investors (domestic and foreign) are marginal in the sense that all investors optimise their equity portfolio at the margin to maximise the risk adjusted expected rate of return. Indeed, this is simply a restatement of the fundamental requirements of the CAPM and those who argue that a single type of 'marginal investor' exists are making an argument inconsistent with the CAPM framework.

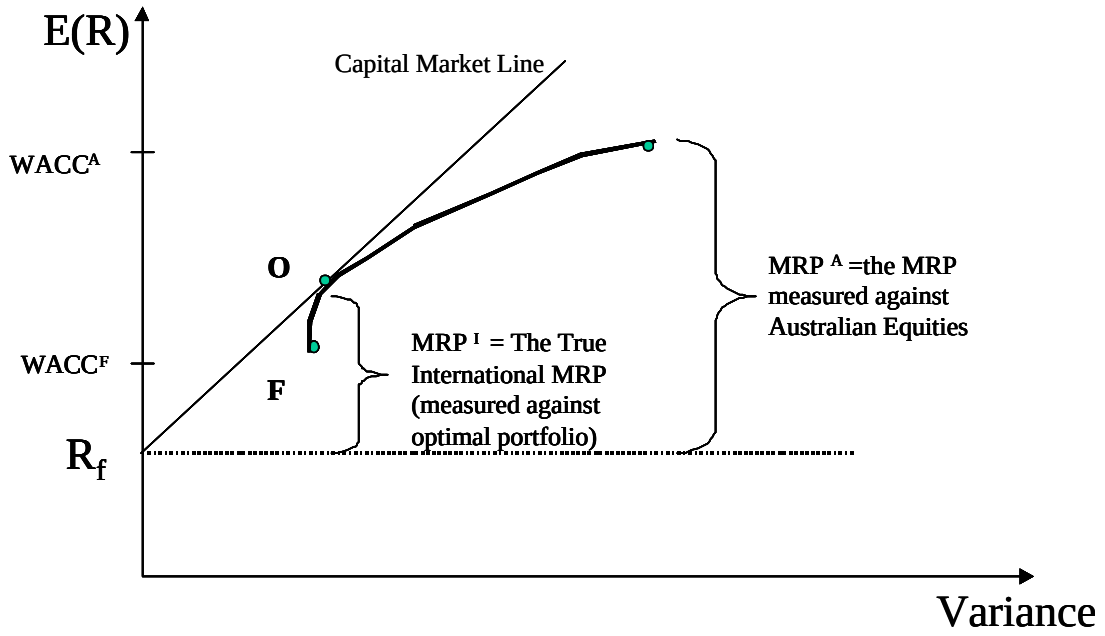
In this regard, it is useful to examine a simple CAPM model in order to show the equilibrium and disequilibrium impacts of a change in the Australian imputation system (or any other change which differentially impacts domestic and foreign residents) on the required return on capital in Australian equity markets. Obviously, this model is not intended to a realistic description of the international market for equities. However, it does clearly show the types effects the recent changes in Australia's imputation system would have on the CAPM WACC.

Imagine there are two assets 'Australian equities' and 'foreign equities'. Assume that initially there is no differential tax treatment or other transaction costs associated with investment in Australian/foreign equities by either Australian or foreign investors. That is, both Australian and foreign investors receive the same return for investing in either asset class. This scenario can be referred to as a 'perfect integration' world. In this world foreigners and domestic residents view each asset as having the same expected return and the same risk. However, in reality this will not tend to be true as:

- differential taxation treatment of equity returns will often exist depending on residency status; and

- other transaction costs and risks (including exchange rate risks) will tend to depend on residency status.

However, for simplicity we start in this 'perfect integration' world and then introduce dividend imputation to see how this differential treatment of domestic and foreign investors in Australia will affect the cost of capital in Australia. In order to graph this problem let us assume that Australian equity has higher standard deviation (risk) and expected return than foreign equity (the analysis works equivalently with the reverse assumption). These two expected return/standard deviation combinations are depicted graphically below as A (for Australian equity) and F (for foreign equity).



There is a less than perfect correlation between the two asset classes suggesting that there are benefits to investors of diversifying between the two asset classes. This is represented by the bowed line between F and A which gives the feasible set of portfolios that can be created by combining F and A.[2] Standard CAPM analysis tells us that a rational investor will locate her portfolio at the point on this feasible set that is tangent with a straight line drawn from the risk free rate. The reason for this is that for any chosen portfolio of equity on the feasible curve F-A, such as portfolio 'O', an investor can choose to combine this with investment in government debt (including negative investment, ie, borrowing). A straight line connecting the chosen equity portfolio and the risk free rate gives the expected return and variance of a combined portfolio of equities and debt. Clearly, the straight line from the risk free rate that is tangent to the feasible equity portfolio line will give the highest possible expected return for any given level of risk. This straight line dominates all other possible portfolios and is known as the 'capital market line'.[3]

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[2] In reality the feasible set will actually be an area rather than a line to the extent that Australian and foreign equities are actually comprised of many separate equities. However, for the simplicity of this analysis it is assumed that there is only two assets 'Australian' and 'foreign'.

[3] In this example we assume that the same risk free rate applies to all investors (domestic and foreign). This is consistent with our assumption that we are in a world of zero transaction costs. In such a world, residents in all countries can lend/borrow at the risk free rate in the other country and costlessly hedge this lending/borrowing in the foreign exchange market.

Point 'O' is therefore the optimal market portfolio and if all investors share the same views of expected return and variance then they will choose a portfolio that has the same weighting as portfolio 'O'. However, if some investors are risk averse they will tend to combine this portfolio with greater investment in debt and will locate somewhere to the left of 'O' on the capital market line. Those who are less risk averse will tend to locate closer to 'O' with some investors locating to the right of 'O' (ie, borrowing to finance their investment in equities).

Point 'O' is an equilibrium position. If either point A or point F changed (say due to a change in expectations about expected returns) then investors would attempt to optimise their portfolio and move to a new 'O'. Of course, in the process of doing this investors will cause further changes in A and F as their attempts to shift in/out of these assets cause their relative returns to change. However, in the end a new equilibrium will be achieved at a new 'O'.

2.1. International vs Domestic CAPM?

So far the analysis is an uncontroversial textbook description of the CAPM in a two-asset world.[4] Instead of assuming that the two assets are in equities traded in the same country we assume that they are equities traded in different countries. However, because this is a 'zero transaction cost' world this assumption makes no difference to the CAPM results.

However, it is interesting to note that the true market risk premium (the difference between expected returns on the market portfolio 'O' and the risk free rate) is smaller than the market risk premium that would be estimated by comparing the expected return on the Australian asset compared to the risk free rate. Similarly the market risk premium on the foreign asset is less than the true market risk premium.

In the context of the current regulatory debate over the use of the international versus the domestic CAPM it is highly relevant to note that any bias introduced by estimating the MRP based on one a single country's data is *exactly* counteracted by an offsetting bias in the equity beta estimated using the single country's data. In our example it is quite obvious that estimating a WACC for the Australian asset based on the assumption of an international or a domestic CAPM will both give the right result (of course, the domestic CAPM approach only gives the right result due to offsetting errors). To see this note that the true cost of capital for the Australian asset is given to us by the position of point A in the above diagram, ie, it is equal to $WACC^A$. This is also the cost of capital we estimate by:

- observing the historical market risk premium under the current equilibrium for the Australian asset (MRP^A);

[4] See Ross, Westerfield and Jaffe, Corporate Finance, (1999), Irwin McGrawHill pages 240-257)

- applying an equity beta of 1 (this is the correct equity beta by definition for the correlation of the Australian asset measured against itself); and

- adding this to the risk free rate (ie, $R_f + \beta_e^A * MRP^A = WACC^A$, which is the correct answer).

The same answer would be derived if we took the true MRP of all investors (MRP^I) and combined it with the true equity beta for the Australian asset (β_e^I) and the risk free rate. That is:

$$WACC^A = R_f + \beta_e^A * MRP^A = R_f + \beta_e^I * MRP^I$$

$$\Rightarrow \frac{b_e^A}{b_e^A} = \frac{MRP^I}{MRP^A}$$

The 'take home message' here is that adopting the international CAPM versus the domestic CAPM does not lead to any *a priori* bias in the estimated WACC provided that the equity beta and the MRP are both collected from the same market and historical data is a reasonable estimate of forward looking expectations.

This is a very important point as it has been argued, including by Lally, that use of domestic data within a CAPM model will lead to a downward bias in the estimated WACC compared to the true (international CAPM) WACC. The above analysis shows that it is false to argue that such an *a priori* presumption can be made. However, the above finding does not mean that it is wrong to presume that integration of world equity markets will reduce the WACC required by Australian companies. Rather it shows that there is no reason to believe that use of historical *domestic data* in a CAPM model will result in a lower estimated WACC than use of historical *international data* in a CAPM model.

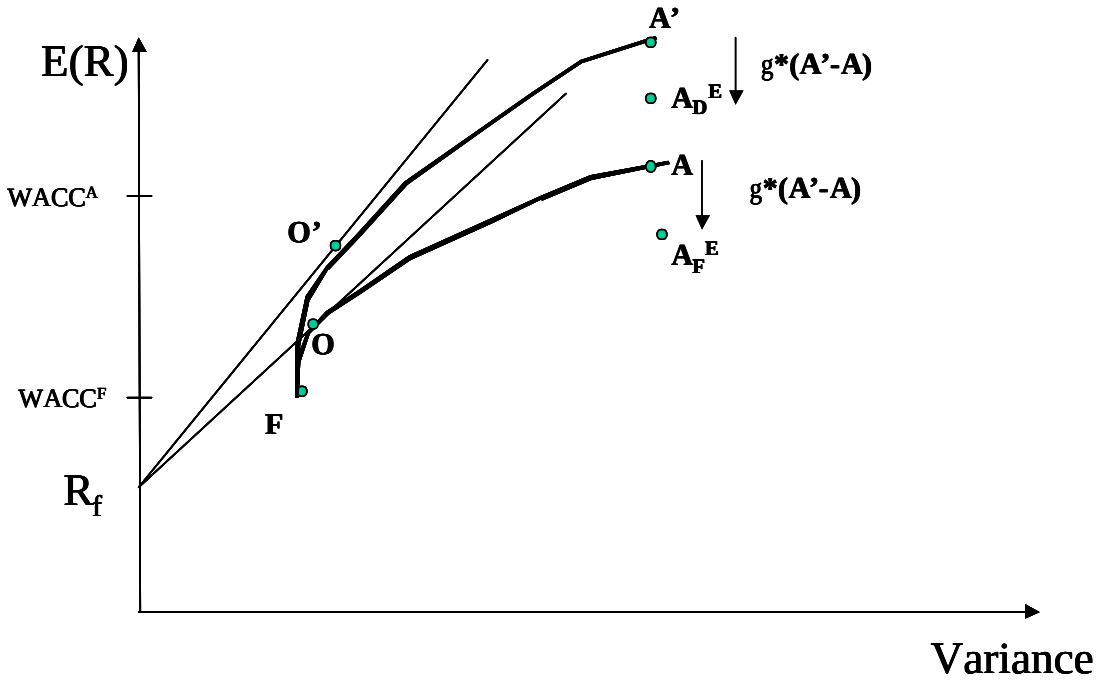
Of course, if both international and domestic historical data is a biased downwards (say because a sudden change in the level of integration of world equity markets has lowered the MRP demanded by investors) then both an international and a domestic CAPM using historical data will overestimate the true WACC (other things constant). However, this is fundamentally an hypothesis that something of sufficient importance has happened sufficiently recently to render use of historical data in the CAPM (be it domestic or international) inappropriate. While this may be the case, it must be recognised that it is an assertion of, by definition, an untestable hypothesis.

2.2. Introducing differential returns – the case of imputation credits

In order to examine at a theoretical level the impact of imputation credits on the WACC in our model (ie, the 'right' value of γ) we need to ask what happens in equilibrium to points F, A and O when imputation credits are introduced. If the position of A for residents does not

change then the value of gamma must be equal to 1 (ie, $WACC^A$ is unchanged suggesting the full value of imputation credits becomes incorporated in equity prices). If the position of A moves upwards then the impact of imputation credits in equilibrium is to increase the expected returns of Australian residents and therefore the value of gamma must be less than 1.

Initially, the answer is quite simple. For those who can enjoy the full value of imputation credits (ie, Australian residents) point A moves up by that amount, say, to A'. For those who cannot enjoy any of the value of imputation credits point A remains constant and for those in between these two extremes point A moves somewhere between A and A'.



For simplicity in this exercise let us assume that domestic residents fully value imputation credits (γ=1) and foreign residents place no value of imputation credits (γ=0). We therefore have two different feasible portfolio sets facing the different types of investors (the unchanged) FA facing foreign investors and (the new) FA' facing domestic investors. However, this is not an equilibrium as Australian investors will wish to optimise their portfolio position. Rather than holding the old portfolio O Australian investors will want to re-weight their portfolio towards the now higher returning Australian asset (ie, Australian investors will want to move towards the asset portfolio O').

The attempt to re-weight Australian investor's portfolios will tend to push the price of the Australian asset up and its expected return down[5] (and the price of the foreign asset down). This in turn will reduce the expected return received on these assets by *both* domestic and foreign residents. In our graph, A' will start moving back towards A and F will start moving up above its current position. Of course, as A' starts falling towards A the expected return for foreign investors in the Australian asset falls below its original level (ie, below A). This is because foreign investors do not benefit from imputation so any increase in the Australian asset price due to imputation necessarily reduces their rate of return. This is just another way of saying that imputation credits create a permanent differential between the expected rate of return for domestic and foreign investors.

In the graph above the final equilibrium occurs with A' falling back to A_D^E, ie, the new equilibrium rate of return on Australian assets required by domestic resident investors. A_D^E is equal to the pre imputation required rate of return (given by A) plus the full value of imputation credits to Australian residents (represented by the move from A to A') less the reduction in the equilibrium required rate of return due to increasing prices as domestic residents attempt to increase the weight of Australian assets in their portfolio. The value of gamma is given by the ratio of the distance $A'A_D^E$ divided by the distance AA'. Similarly, the new equilibrium rate of return for foreign investors is given by A_F^E, which is equal to foreigners' original required rate of return (A) less the reduction in rate of return they are prepared to accept as a result of increased demand for Australian assets by Australian residents.

Ideally, this analysis should clear up some confusion in the debate concerning the value of γ. In most discussions γ is described as the value of a dollar of imputation credits to 'an investor'. This definition has the obvious problem in that it invites competing definitions of who that investor is – leading to two different extreme values for γ (0 and 1). As this analysis clearly shows, the correct definition of γ (ie, the definition that corresponds to its actual use in regulatory decision making) is given by:

> *"g reflects the proportion of the face value of imputation credits that is capitalised into the current equity prices."*

That is, a γ of 1 suggests that the full face value of imputation credits is capitalised into current equity prices and that foreign investors have been willing to accept a corresponding reduction in their expected rate of return by this same amount. Alternatively, a γ of 0 suggests that none of the value of imputation credits has been capitalised into equity prices and that, what amounts to the same thing, foreign investors refuse to lower their required rate of return following the introduction of imputation credits.

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[5] The expected return is the value of future dividends divided by the price of the equity. As the price rises, the return on the equity must fall all other things constant.

2.3. What is the likely value of γ?

Exactly where A_D^E is located will be determined by how willing foreign investors are to accept a falling return on their Australian assets. If foreign investors are unwilling to accept any significant reduction in the expected return on their Australian assets then they will vacate the Australian market at approximately the same rate that domestic investors are entering it and the new equilibrium will involve Australian investors holding a portfolio of something like O' and foreign investors continuing to hold a portfolio of something like O.[6]

At the other extreme, if foreign investors are unwilling to reduce their holdings of foreign assets at all then Australian investors attempts to re-weight their portfolios will simply result in an increases in price and decrease in expected return until Australian investors returns are driven back down to their pre-imputation levels (and foreigners' expected returns are driven well below this level).

These extremes can be characterised as the 'foreign marginal investor' extreme and the 'domestic marginal investor' extreme. In the former case foreign investors have a perfectly elastic demand for Australian equity at the equilibrium expected rate of return that exists prior to the pre introduction of imputation credits. In the latter case foreign investors have a perfectly inelastic demand for Australian equities at the level corresponding to the portfolio O.

Of course, the truth is likely to be somewhere in between these two extremes with foreign investors having some elasticity of demand for Australian equities but not perfect elasticity. That is, attempting to locate 'the' marginal investor is theoretically misguided. The truth is that in equilibrium all investors are marginal as all investors attempt to optimise the weights of various assets in their portfolios given the expected return and co-variances between assets they face. When investors face different expected returns due to differential rates of tax they will optimise in different ways. The end impact on the WACC for Australian assets will depend on the interactions between all these investors.

However, it is not unreasonable to believe that the rest of the world's demand for Australian equities will be more elastic than Australian residents demand for Australian equities. This reflects the fact that Australian equity constitutes a very small proportion of world equity (around 1 percent) and that foreign equity investors have ample close substitutes to Australian equity with similar diversity value. That is, there are many good substitutes for Australian assets in terms of their diversity value to a foreign investor, however, there are fewer good substitutes for foreign assets in a domestic resident's portfolio.

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[6] In reality there must be some downward movement in A' in order to induce foreign investors to 'make space' for returning domestic investors. Thus the new equilibrium portfolios for foreign and Australian investors must be at least slightly to the left of O and O' respectively.

A simple example illustrates this point. Imagine the Australian market was fully segregated from the world market and that the Australian government introduced imputation credits. However, further imagine that these imputation credits were only available for mining profits earned in NSW (which represents 1% of total market profits) *and* that they were only available to 1% of all investors (say, investors with red hair). It is likely that investors with red hair would shift much of their investment in mining equity to NSW mining companies. However, it is equally likely that the other 99% of investors would sell their NSW mining equity rather than experience a reduction in their expected rate of return on these assets. That is, the 99% of all investors denied imputation credits in NSW mining concerns can do without NSW mining companies and still achieve a highly diversified portfolio. However, the 1% of investors who can access imputation credits in NSW mining cannot achieve a diversified portfolio without resort to equities outside NSW mining.

This suggests that such a policy will result in a shift in who holds NSW mining assets towards red haired investors but will not significantly push up (down) the price (return) on NSW mining equity. In order for the latter to happen non-red haired investors would have to accept a reduced return and they are unlikely to do this given the existence of close substitutes (including West Australian and Queensland mining equity). Similarly, in order for red haired investors to fully replace non red haired investors in NSW mining equity they would have to hold portfolios with 100% of NSW mining. This lack of diversity will seriously constrain the ability of red haired investors to switch into NSW mining equity..

Substituting Australian residents for 'red haired investors' and Australian equity for 'NSW mining equity' the same basic story applies for analysing the impact of dividend imputation on Australian equity markets.

For these reasons NERA considers that the theoretical analysis would suggest a low impact of imputation on the capitalised value of Australian equity (ie, a low value of γ). This would also appear to be borne out by the empirical evidence where, to the best of our knowledge, there are no studies that have identified a positive impact of the introduction of imputation (or extension of it under the Ralph reforms) on the price of Australian equity.

3. A COMPARISON WITH THE LALLY ANALYSIS

In Martin Lally's June 2002 paper to the ACCC "The Cost of Capital Under Dividend Imputation" a number of implicit and explicit assumptions are made concerning the role of international equity markets in CAPM analysis. These assumptions overwhelmingly lean in one direction (a lower WACC). We reproduce large amounts of the relevant text below.

> *"Inter alia, the Officer version of the CAPM (like the standard version) assumes that national equity markets are completely segregated."* (Page 9)

> *"These distinctions in the market risk premium and beta have significant numerical implications. In respect of the market risk premium, under the Officer model, an estimate of the Australian market risk premium is about .06 (this is discussed in section 6). By contrast, under the Solnik model in which markets are assumed to be integrated, investors will now be holding a world rather than a national portfolio of equities, and the latter will have a considerably lower variance due to the diversification effect. Since the market risk premium is a reward for bearing risk, then the world market risk premium under integration should be less than that for Australia under segmentation. Stulz (1995) argues that, if the ratio of the market risk premium to variance is the same across countries under segmentation, the same ratio will hold at the world level under integration and this fact should be invoked in estimating the world market risk premium[7]. Merton (1980) estimates the ratio at 1.9 for the US for the period 1926-78. Harvey (1991, Table VIII) offers estimates for 17 countries over the period 1970-90, which average 2.3. All of this suggests a figure of about 2.* If we use this figure then this suggests a market risk premium for the Solnik CAPM of

$$MRP_w = 2s_w^2 \qquad (8)$$

> *Cavaglia et al (2000) estimates the world market variance over the period 1985-2000 as .135². Substitution into equation (8) then implies an estimate for the world market risk premium of about .04.*

> *Turning now to the question of betas, the average Australian stock has a beta against the Australian market portfolio of 1, by construction. Similarly, the average asset worldwide has a beta against the world market portfolio of 1, but this does not imply that the average Australian stock has a beta of 1 against the world market portfolio. Ragunathan et al (2001, Table 1) provide beta estimates for a variety of Australian portfolios for the period 1984-1992, against both Australian and world market indexes. The average of the latter to the former is about .40. In addition Gray (2000) regresses the Australian index against a world index, for the period 1995-2000, and obtains a beta of .72. The fact that these estimates are less than 1 is unsurprising in view of Australia's small weight in the*

[7] It would not be sensible to attempt to estimate the world market risk premium by historical averaging over a long time-series of returns, because even if markets were currently fully integrated this would not have been true for very long.

world market index and the large weights for some markets. To illustrate this point, suppose the world comprised four equity markets with weights of .01, .245, .245 and .50. Also, the correlation between all markets is .30 (Odier and Solnik, 1993) and they have the same variance. It follows that the small market (market 1) has a beta against the world portfolio of

$$b_{1w} = \frac{Cov(R_1, .01R_1 + .245R_2 + .245R_3 + .50R_4)}{Var(.01R_1 + .245R_2 + .245R_3 + .50R_4)} = .55$$

regardless of the value for the common variance. The other three markets have betas of .84, .84 and 1.16 (the weighted average of the four betas is of course 1). Lally (1996, Appendix 2) presents a more realistic example utilizing actual country weights but the outcome is similar: ceteris paribus, very small markets have betas against a world market portfolio that are much less than 1. For illustrative purposes we will assume a beta for a typical Australian stock against the world market portfolio of .70.

We now combine this information about betas and market risk premiums. Employing the Officer CAPM in equation (4), a riskfree rate of .06, and the estimated market risk premium of .06 referred to above, the cost of equity for an average Australian stock would be

$$k_e = .06 + .06(1) = .12$$

By contrast, under the Solnik CAPM in equation (7), with the Australian riskfree rate of .06, and estimates for the world market risk premium and the beta of an average Australian stock against the world market portfolio as indicated above, the cost of equity for an average Australian stock would be

$$k_e = .06 + .04(.70) = .088$$ "

3.1. The 'Officer WACC' does not assume complete segregation

There are several areas of the above analysis that we consider to be either incorrect and/or highly adventurous. In particular:

- Lally states that the 'Officer version of the CAPM', by which he means the estimation procedures based on domestic data adopted by the ACCC and other regulators, assumes that national equity markets are completely segregated. As has been shown in the previous section this statement is incorrect and the use of domestic historical data to determine the WACC is consistent with integrated international equity markets. Furthermore, it will not result in any *a priori* bias in the estimated WACC compared to use of international historical data.

- Lally's methodological steps measure the magnitude of the impact of a move from complete segregation to complete integration of national equity markets. Both of these assumptions are extreme and not particularly relevant to the issue at hand. That is, recognising a value of gamma less than 1 does not require the assumption of perfect international integration. Indeed, the very existence of imputation credits available differentially to domestic and foreign residents means perfect (zero transaction cost) integration cannot be achieved.

- Lally's choice of two empirical studies from which he sources his data on Australian equity betas relative to the world index appears highly selective. For example, the seminal paper by Campbell[8] on this issue estimates an Australian equity beta twice that adopted by Lally.

- Lally's use of equity beta's based on historical data from 1984 onwards is inconsistent with his implicit assumption that integration has only occurred so recently that its effect on historical market data is unavailable.

It is particularly unusual that the very strong assumptions that historical Australian market data is from a perfectly segregated market is made implicitly - without any discussion of the academic literature concerning the time period over which world capital markets have been integrated. It is NERA's view world capital markets have been significantly integrated for the last 100 years. Certainly, Australia has relied on the net importation of capital in almost every year during that period. While it may well be the case that the speed at which short-term international arbitrage opportunities have become traded has dramatically increased since the development of cheaper computing and telecommunications in the 1960s and beyond, the idea that debt and equity markets prior to then were 'fully segregated' is itself a very strong assumption. Differentials in expected rates of return across international capital markets may have lasted longer in the earlier half of this century, however, the assumption that their existence did not attract any equilibrating capital flows is very strong. It is also inconsistent with the evidence on international capital flows over that period – with Australia relying heavily on foreign direct and indirect investment. Evidence of which includes:

- reliance on foreign capital to fund domestic investment has been strong throughout the last century, with net external borrowing averaging 3.5/26.6 percent of GDP/Fixed Private Capital Investment (non dwelling) over the period 1950 to 2002 and 2.6/59.0 percent over the period 1900 to 1950. That is, borrowing from the rest of

[8] Campbell, R Harvey, "The world price of Covariance Risk", Journal of Finance, (March 1991). Even abstracting from the other problems with Lally's analysis, adopting Campbell's equally valid estimate of the Australian market's beta against the world market (1.4) and accepting Lally's estimate of the world MRP of 4% gives an 'Australian post integration MRP' of 5.6% compared to Lally's estimate of 2.8%.

the world accounted for around twice as much private business investment in the first half of the last century than in the second half.

- the fact that around 30% of Australian equities are held by foreign investors;
- that Australia runs a persistent current account deficit which requires around $20-30 billion per year in foreign capital to finance. That is, the Australian economy relies on $20-30 billion of foreign investment each year in order to meet investment requirements;
- Australian equities comprise only 1% of the value of world equities suggesting that suppliers of Australian equities are 'price takers' in the international equity market.
- around 30% of Australian equities are held by foreign investors;

In any event, studies of the market risk premium over much more recent periods, when there is little doubt that world capital markets have been strongly integrated, suggest that the MRP over those periods may have been above, not below, the 6.0 percent adopted by regulators. The following table lists three of such results.

Estimates of the MRP Over Recent (Post Integration) History

Source	MRP
NEC (based on 1952 to 2003)[9]	6.6
AGSM (1999) (based on 1964-95, including October 1987)[10]	6.2
AGSM (1999) (based on 1964-95, excluding October 1987) [11]	8.2

In the light of the above dot points and table, NERA finds Lally's conclusion that the average risk adjusted Australian equity premium under integration is 2.8% to be extreme. However, it is still useful to 'sanity check' Lally's findings of the impact of integration. The original Solnik article which Lally quotes estimated that a fully internationally diversified portfolio would only reduce an investor's exposure to variance by around 67% compared to holding *a single security*. Lally's results imply that holding an internationally diversified portfolio will reduce an investor's exposure to variance by around 53% compared to holding *the Australian market portfolio.* This suggests that holding the Australian market portfolio offers hardly any more diversification value than holding a single security. This does not appear to be a credible finding.

9 National Electricity Code, schedule 6.1, section 3.2.

10 IPART, 'Regulation of New South Wales Electricity Distribution Networks,' table5.2, December 1999, p36.

11 Ibid.

3.2. Do Lally's assumptions lead to price falls under integration?

In the stylised example below, Lally shows that, assuming his estimate of a 2.8 percent Australian equity premium is correct, moving from full segregation to perfect integration results in a reduction in regulated prices – even if gamma falls from 1 to zero. That is, Lally attempts to show that any increase in prices as a result of a reduced gamma is more than offset by a decrease as a result of a lower post tax WACC. However, even if we accept Lally's extreme estimate of a 2.8 percent average Australian equity premium, the result of falling prices under integration also relies on further extreme assumption as we show below. We reproduce the relevant Lally text in full here (from pages 14 to 17).

> *"… these estimates of U may and presumably do reflect the presence of foreign investors in the Australian market, who cannot use or fully use the credits and this exerts a downward effect on the estimates[12]. However, as noted earlier, the Officer CAPM (like the standard CAPM) assumes that national equity markets are segmented. Consequently the use of an estimate for U that is potentially significantly influenced by the presence of foreign investors introduces an inconsistency into the model. One possible response to this might be to argue that the shortcoming from use of a model that fails to reflect the reality of international capital flows should not be compounded by using an estimate of U that also fails to reflect international investors. However the effect of recognising foreign investors only in this one respect would be to lower the perceived value of a firm (and hence raise the output price allowed by the ACCC). By contrast, the overall effect of internationalization is likely to involve raising the value of a firm (and hence lower the output price that should be allowed by the ACCC), because the adverse effect upon the usability of imputation credits is likely to be more than offset by the positive effects from a lower risk premium. Thus recognition of foreigners only in the estimate of U would push the calculated value of a firm further away rather than closer to the "correct" answer, i.e., it leads to a raising in the output price allowed by the ACCC when the appropriate direction is a lowering.*
>
> *To illustrate this point, consider a regulated firm that has just been set up, with no debt, and with assets costing $100m and of indefinite life. The expected output is 1m units per year and there are no operating costs. Letting the allowed output price be denoted P, then the expected cash flow in year 1 before company tax is $Pm. Taxable income is likewise and both are expected to grow at 3% pa indefinitely. Consistent with the discussion in the next section, the ratio IC/TAX is assumed to be 1. If equity markets are fully segmented then a utilization rate U of close to 1 will prevail, and we assume 1. In addition the Officer version of the CAPM is employed. Consistent with the example in the previous section, we use a riskfree rate of .06, a market risk premium of .06, and an equity beta of 1, leading to a cost of equity of .12. Following equation (2), the effective tax rate is*

[12] J.B. Were (1996) estimate that 30% of Australian equities were foreign owned. This fact alone would point to an estimate for *U* of .70, which is almost identical to the Bruckner et al (1994) estimate.

$$T_e = .30[1 - 1(1)] = 0 \qquad (10)$$

Following equation (6), the output price P should be chosen so that the present value of the cash flows to equityholders, discounted at the cost of equity of .12, equals the asset cost of $100m, i.e.

$$\$100m = \frac{\$Pm(1-0)}{1.12} + \frac{\$Pm(1-0)(1.03)}{(1.12)^2} + ... = \frac{\$Pm(1-0)}{.12-.03} \qquad (11)$$

Solving this yields an output price of ***$9****. By contrast, if national equity markets are completely integrated, then the Officer CAPM should be replaced by an international version. Following the discussion in the previous section, we invoke the Solnik model and the estimate there for the cost of equity of this firm of .088. In addition a value for U of zero is invoked. Recomputing the effective tax rate in (10) and then the output price in (11), the results are*

$$T_e = .30[1 - 1(0)] = .30$$

$$\$100m = \frac{\$Pm(1-.30)}{1.088} + \frac{\$Pm(1-.30)(1.03)}{(1.088)^2} + ... = \frac{\$Pm(1-.30)}{.088-.03}$$

Solving the last equation yields an output price of ***$8.28****. Thus the full effect of internationalization is to reduce the appropriate output price. By contrast, if one continues to use the Officer model but recognizes the effect of internationalization upon the value of U, by reducing the estimate from 1 to the generally employed figure of .60, then the last two equations become*

$$T_e = .30[1 - 1(.60)] = .12$$

$$\$100m = \frac{\$Pm(1-.12)}{1.12} + \frac{\$Pm(1-.12)(1.03)}{(1.12)^2} + ... = \frac{\$Pm(1-.12)}{.12-.03}$$

Solving the last equation then yields an output price of ***$10.23****. Thus the full effect of internationalisation would be to reduce the allowed output price by 10%, whereas recognizing only a reduction in U leads to the allowed output price rising by 14%. Thus the common practice of recognizing the effect of foreign investors in the estimate of U, but not also in the choice of CAPM, has a totally perverse effect. Accordingly it is not recommended.*

In summary then, the estimate for U of around .60 that has been deduced from ex-dividend studies is not recommended. Lonergan (2001) goes even further and argues that an appropriate estimate of U is close to zero, primarily because Australia ".. is a price-taker in the world's capital market". He goes on to note that use of a higher value for U by regulatory authorities leads to the result that "..some investors are being

deprived of part of the return to which they properly should be entitled". However, if it is true that Australia is a price-taker in the world's capital market, then it follows not only that the value of U is close to zero but also that the appropriate CAPM to employ is an international version. In the above example, the allowed output price should then fall from $9 to $8.28. However, if a value for U of zero was adopted, but the Officer model was still used, then equations (10) and (11) would become

$$T_e = .30[1 - 1(0)] = .30$$

$$\$100m = \frac{\$Pm(1-.30)}{1.12} + \frac{\$Pm(1-.30)(1.03)}{(1.12)^2} + ... = \frac{\$Pm(1-.30)}{.12-.03}$$

Solving the last equation yields an output price of ***$12.86****. However the correct figure is somewhere between $8.28 and $9. By lowering the utilization rate U, but not also modifying the form of the CAPM, a form of "cherry picking" is being practiced, whose effect is to raise the allowed output price when it should be lowered."* (Emphasis added.)

Thus, Lally shows that, in this stylised example, the correct price (assuming full integration) is $8.28 but that the price calculated assuming full segregation (and gamma=1) is above this at $9. Lally then shows that reducing gamma (to 0.6 or 0.0) while maintaining the full segregation post tax WACC will result in price rising (to 10.23 or 12.86) when it should be falling (to $8.28).

This is a surprising result as reduction in gamma from 1 to zero implies that prices should be, other things equal, 43% higher (0.3/(1-0.3)). On the other hand, Lally's estimated impact on the post tax cost of equity of internationalisation is only 26% ((12.0-8.8)/12.0). Consequently, one would reasonably expect internationalisation to result in prices rising rather than falling. The puzzle then exists as to how Lally derives his result. The key to answering this puzzle is in the following assumptions:

To illustrate this point, consider a regulated firm that has just been set up, with no debt, and with assets costing $100m ***and of indefinite life****. The expected output is 1m units per year and there are no operating costs. Letting the allowed output price be denoted P, then the expected cash flow in year 1 before company tax is $Pm.* ***Taxable income is likewise and both are expected to grow at 3% pa indefinitely****.* (Emphasise added.)

The assumptions of an indefinite life of the asset and a 3% compounding increase in prices results in revenues being back loaded compared to alternative assumptions (eg. no price rises or a finite asset life). This automatically results in a lower price profile for the scenario with the lowest discount rate. Given Lally's extreme assumptions regarding the MRP result in a lower discount rate then the back loading of revenues tends to lower prices most under that scenario (ie, the adoption of a very low discount rate). However, retaining Lally's extreme discount rates but imposing a less back loaded revenue stream gives the opposite result. That is, prices rise under 'integration' even accepting Lally's 2.8% MRP. The following table gives alternative scenarios:

Impact on Prices Under Alternative Asset Life/Price Rise Assumptions

	Prices rise at 3% and infinite life (Lally's assumptions)	Prices constant and infinite life (Alternative 1)	Life of asset = 1 year (Alternative 2)
Full Segregation (Gamma=1, MRP=6.0)	$9.0	$12.0	$12+$100=$112
Full Integration Gamma=0, MRP = 2.8	$8.3	$12.6	$12.6+$100=$112.6

The first column of figures is Lally's results. The second column is the results assuming a constant price profile but still an infinitely lived asset. This is calculated as the nominal pre tax cost of equity multiplied by the initial investment cost. The nominal pre-tax cost of equity is simply Lally's cost of equity grossed up by the effective tax rate (30%). The third column is the price that must be charged if the asset only lasts for one year. This includes the appropriate nominal return from the previous column plus the return of the original capital.

Under alternative scenarios 1 and 2, the adoption of an 'integration' assumption results in an increase in prices rather than a fall – even if Lally's extreme assumption concerning the MRP under integration is adopted.

More importantly, if it is assumed that under integration (gamma=1) the premium on the Australian portfolio only drops to 4.2%, then the correct price is $10.3 under Lally's scenario. **This is less than the price calculated if MRP is set at 6.0% and gamma is set at 0.6.** In other words, setting gamma at 0.6 and retaining an MRP of 6.0% results in an underestimate of the correct cost of equity under integration – even when the extreme infinite life of asset and escalation of prices assumptions are retained. Relaxing the later assumptions (see last two columns below) mean that setting gamma at 0.6 and MRP at 6.0% results in an even greater worse underestimate of the correct price.

Impact on Prices Under More Realistic MRP Assumptions

	Prices rise at 3% and infinite life (Lally's assumptions)	Prices constant and infinite life (Alternative 1)	Life of asset = 1 year (Alternative 2)
Full Segregation (Gamma=1, MRP=6.0)	$9.0	$12.0	$12+$100=$112
Full Integration Gamma=0, MRP = 4.2	$10.3	$14.6	$14.6+$100=14.6
Partial Integration Gamma=0.6, MRP= 6.0	$10.2	$13.6	$13.6+$100=$113.6

4. DEBT BETA

TransGrid has asked NERA to analyse the ACCC's approach to setting the debt beta in its recent decisions for other electricity transmission businesses. In particular, whether it is reasonable for the ACCC's to believe that setting the debt beta equal to zero is a 'conservative' approach. The ACCC appears to make this claim on page 37 of the ElectraNet decision.

"The ACCC also notes that a debt beta estimate of zero has been applied in its previous electricity regulatory decisions. The debt beta can be determined from the formula:

ßd = (rd - rf) / MRP

The ACCC, in the past, considered that a regulated entity with a guaranteed revenue stream would have a low systematic default risk and therefore treated the debt beta as a residual parameter. Also, providing debt margins to network service providers had been assumed to implicitly incorporate debt raising costs. However, now that debt raising costs are being considered explicitly on top of the debt margin, it implies a higher debt margin. In this case, the debt beta formula above would suggest a higher positive debt beta.

With the current proposed values for the relevant parameters (the debt margin at 1.335 and MRP at 6.0), the calculation results in a debt beta of approximately 0.22. However, following further work into the debt beta, ESC has concluded that it is likely to be between zero and 0.18 although a value towards the upper end of this range was more likely. ACG also considered this information and suggested that an appropriate range for the debt beta would be between zero and 0.15. 29.

The ACCC considers that an appropriate value for the debt beta for this decision is zero. The ACCC notes that this is also biased in favour of the service provider and it may be more appropriate to incorporate a positive debt beta in its future electricity regulatory decisions."

4.1. NERA's Analysis

The ACCC is employing some extreme assumptions when it states that the debt beta can be calculated as:

ßd = (rd - rf) / MRP

Rather the debt beta must be calculated as the ***expected*** premium on debt divided by the risk free rate. That is:

ßd = (E(rd) - rf) / MRP

Only if the expected return on debt is equal to the observed return on debt (ie, zero default expectation) are these two equations equal, and in that case the debt beta is equal to zero in

any event. However, in general, the observed debt premium consists of compensation for both:

- the actuarially expected probability / risk of default; plus
- compensation for the systemic risk of default (ie, compensation for the correlation of the probability of default with the market).

Clearly, the latter cannot exist without the former (as the systemic risk associated with debt is a function of the covariance between default risk and market returns). Therefore, any attempt to use the first of the above two equations will result in a very large overestimate of the debt beta. It follows that it is unlikely that the debt beta will be significantly above zero.

In any event, even if the value of the debt beta is marginally above zero, setting it to zero consistently across all calculations *does not* reduce the estimated WACC. It is true that a higher debt beta will result in a lower equity beta **for any given asset beta.** However, the converse is also true, a higher debt beta will result in a higher asset beta **for any given equity beta**. Given that all estimates of asset betas must, by definition, be based on observed equity betas (asset betas are unobservable directly) it follows that assuming a higher debt beta will result in a higher estimate of the asset beta. The net effect on the equity beta should be zero. This is a reflection of the fundamental theorem that risk is conserved irrespective of gearing.

As can be seen from the Monkhouse formula:

$$b_e = b_a + (b_a - b_d) \times \{1 - \frac{R_d}{1+R_d} \times (1-g) \times T\} \times \frac{D}{E}$$

For any given equity beta, the higher the debt beta the higher the associated asset beta. Thus, if the observed equity beta for a benchmarked business is 1 and it is de-levered assuming a debt beta of 0 the associated asset beta will be 0.40.[13] However, if it is de-levered using a debt beta of 0.1 then the associated asset beta is 0.46. It is therefore important that the ACCC re-examine the credibility of the below statement from page 37 of the ElectraNet decision in the light of the above analysis.

The ACCC considers that an appropriate value for the debt beta for this decision is zero. The ACCC notes that this is also biased in favour of the service provider and it may be more appropriate to incorporate a positive debt beta in its future electricity regulatory decisions.

[13] Once more assuming a gearing rate of 60 percent etc.