THE ESTIMATION OF GAMMA: REVIEW OF RECENT EVIDENCE

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EXECUTIVE SUMMARY

This report reviews recent evidence relating to the estimation of gamma, from the Independent Panel, submissions in response to the AER's Draft Rate of Return Guidelines, two new notes from the ATO, and Frontier's submission to the ERAWA. In addition, responses to a set of questions posed by the AER are offered. My response to these questions encapsulates the principal issues, which are as follows.

The first of these questions is the impact of foreign operations on the estimated distribution rate for imputation credits. Using the top 50 ASX firms, the distribution rate is estimated at 0.89. This estimate includes the effect of foreign operations, which reduce tax payments to the ATO and therefore might be expected to increase the distribution rate. However, foreign operations may also reduce the firm's dividends, and this would exert a downward effect on the distribution rate. So the issue must be empirically assessed. This is done by estimating the proportion of each firm's tax payments to foreign countries, and then regressing the distribution rate on this estimate of the foreign tax proportion; the resulting estimate of the distribution rate for a firm with no foreign operations is 0.96 with a standard error of 0.05.

The second of these questions is whether an estimate for gamma based on the ATO data for all equity is appropriate. The ATO data is highly unsuitable for estimating gamma directly because it covers all firms, which are unsuitable for estimating the distribution rate of the BEE. Alternative data sources are free of both problems, and therefore the ATO data should not be used.

The third question is whether the distribution rate and the utilisation rate should be estimated from the same group of investors. The utilisation rate is a market-wide parameter and therefore the natural choice of data to estimate it is market-wide data. By contrast, the distribution rate is a firm-specific parameter and therefore the natural choice of data to estimate it is firm-specific data. However, doing so is precluded by the likelihood that the regulated firm in question could manipulate (raise) its price or revenue cap. Furthermore the use of industry data is subject to the

problem that the set of firms is very small (three). This points to the use of a much larger set of firms.

The fourth question is whether the distribution rate should be estimated from the financial statements of the top 50 companies, and the utilisation rate from ABS data for all equity. In respect of the distribution rate, this should be estimated from financial statement data because the only alternative data (from the ATO) provides aggregate data on all firms (some of which are very unsuitable), as discussed above. In respect of which companies should be used, these should be listed firms because all regulated businesses in Australia are listed or owned by listed entities (local or foreign) and the distribution rates for unlisted firms are much lower. Principal weight should be placed on a large set of firms, for reasons given in the previous paragraph, and the natural choice is firms selected on the basis of market cap. In respect of the utilisation rate U, this should be defined in accordance with a rigorous derivation of the Officer model that the AER uses; this is a weighted average over the utilization rates of all investors in the Australian market, the Officer model assumes that national equity markets are fully segregated, which implies that the only investors in the model would be local investors, virtually all of whom can fully use the credits, and therefore U should be 1. However, since the AER prefers to recognize the existence of foreign investors, the natural course of action would be to define U as a weighted average over the utilization rates of all investors in the Australian market, both foreign and local investors, and this implies that U is equal to the proportion of Australian equities owned by local investors. Accordingly, one should use ABS information to estimate this proportion. Furthermore, since some regulated businesses are unlisted (in Australia), the CAPM should be interpreted as applying to all Australian equity rather than just listed equity, and therefore ABS data on all Australian equity should be used.

The fifth question is whether the estimate of the distribution rate (from whichever companies are used) should be adjusted to remove the effect of foreign income. The purpose of the exercise is to estimate the distribution rate for the BEE, which by definition has no foreign income. Furthermore, foreign income may affect the result. So, the effect of foreign income should be removed. The principal analysis involves regressing the distribution rate on the foreign operations proportion, which yields an estimate of the distribution rate for a firm with no foreign operations of 0.96 with a standard error of 0.05. A secondary approach has been to examine the three Australian firms with substantial regulated activities; all three have nil or minimal foreign operations and an aggregate distribution rate of 1. The latter warrants much less weight than the former, due to the small sample size, and this suggests an overall figure of 0.95 rounded to the nearest 0.05.

The sixth question is whether it is appropriate to round the distribution rate, utilisation rate or gamma and, if yes, to what degree. Within the Officer model, gamma appears in the cash flows whilst the utilisation rate appears within the MRP, which suggests that rounding be applied to both gamma and the utilisation rate. However, gamma is merely the product of the utilisation and distribution rates and these two components are individually estimated rather than gamma per se. So, rounding should occur for both the utilisation and distribution rates, and the rounded figures upon multiplication produce gamma. Furthermore the extent to which parameter values should be rounded should be based upon the degree of precision in the estimate. In respect of the distribution rate, an appropriate estimate is 0.95 rounded to the nearest 0.05. In respect of the utilisation rate, an appropriate estimate is 1 as discussed above. If account is taken of foreign investors, the best estimates come from ABS data on the proportion of Australian equities owned by local investors. Since the parameter sought is the expected value over the next regulatory cycle, there is some uncertainty arising from how much historical data to use. There are also uncertainties arising from the definition and from data quality. Taking account of all this, an appropriate estimate is 0.65 rounded to the nearest 0.05.

The last question is the value for gamma that ensures regulated firms receive an allowed rate of return that is at least sufficient to meet the ARORO. In respect of the distribution rate, this is 0.95 as discussed above. In respect of the utilisation rate, I favour a value of 1 consistent with the Officer model assuming complete segmentation of national equity markets. If foreign investors are to be recognised, as the AER prefers, the best estimate is 0.65 as discussed above. Coupled with the estimate of 0.95 for the distribution rate, the estimate of gamma is 0.6175.

1. Introduction

This report reviews recent evidence relating to the estimation of gamma, from the Independent Panel (2018), submissions in response to the AER's (2018a) Draft Rate of Return Guidelines, two new notes from the ATO (2018b, 2018c), and Frontier's (2018) submission to the ERAWA. Following this, responses to a set of questions posed by the AER will be offered.

2. Report from the Independent Panel

An Independent Panel established by the AER has recently reviewed the AER's Draft Rate of Return Guidelines and has suggested that the AER round its gamma estimate to two decimal points or the nearest 0.05 rather than its current practice of rounding to one decimal point (Independent Panel, 2018). I do not agree with this. Gamma is merely the product of the estimates of the utilisation and distribution rates, which are individually estimated. Furthermore the extent to which parameter values should be rounded should be based upon the degree of precision in the estimate. So, both the utilisation and distribution rates should be rounded, in accordance with the degree of precision in the estimates, and the rounded values then multiplied to produce gamma. In respect of the degree of rounding in the distribution and utilisation rates, I defer that issue to section 6.

3. ATO Notes

In a recent note dated 14 September 2018, the ATO (2018b) stated unequivocally that no ATO data should be used for examining the imputation system. This note appears to be prompted by concerns that its earlier advice was interpreted as applying only to the franking account data (such as by Frontier, 2018, section 3). However, for regulatory purpose, it is necessary to estimate the distribution and utilisation rates for credits, ATO data are one possible source, they *might* represent the best possible source, and therefore might warrant use despite the ATO's clear advice to the contrary. So, the issue here is not whether the ATO advises whether its data should be used but the shortcomings in this data relative to alternatives. Fortunately there are alternatives and, as will be argued, they are superior to the ATO's data.

In a further note, the ATO (2018c) investigated the hypothesis that the difference in the estimates of credits distributed that arise from the use of tax/FAB data and dividends data is due to changes over time in the set of companies appearing in the ATO data. Such changes imply that the FAB data from two points in time do not relate to the same set of companies, and neither relates to the same set of companies to which both the tax and dividend data relate. The ATO (2018c, confidential Appendix, page 2) concluded that this explains over 90% of the discrepancy identified but not explained by Hathaway (2013, 2014, 2017). The ATO's description of its methodology and data are cursory, but the conclusion is plausible and warrants abandoning estimates of the credits distributed that are based upon ATO tax and FAB data.

4. Frontier Submissions to the ERAWA

Frontier (2018, section 3) argues that, since ATO data on credits redeemed are not in dispute and the problems with the ATO company tax data are minor, these two data sets can be used to generate a reliable estimate of gamma, and that this estimate is 0.34. I concur with Frontier's comments on the quality of the redemption and company tax data, and nothing in the ATO's (2018a, 2018b, 2018c) notes is specifically inconsistent with this despite the ATO (2018b) recommending against the use of public ATO data. However, the claim that these two data sets should be used to estimate gamma suffers from two principal difficulties. Firstly, in addition to the estimate of gamma appearing within the cash flows, the Officer (1994) model in which gamma appears requires an estimate of the utilization rate in order to estimate the MRP, that estimate would presumably have to use the ATO data if gamma were estimated from the ATO data, and the possible unreliability of the ATO data in estimating the credits distributed (and hence the utilization rate) would then be problematic. Frontier (2018, section 3.5) alludes to this argument indirectly, by asserting that the ATO's dividend data (which permits the credits distributed to be estimated) is reliable (unlike the franking balance data) and this implies that the utilisation rate can be reliably estimated from ATO data (using the tax paid and the credits distributed from dividend data). This conclusion is consistent with the analysis by the ATO (2018c), which is referred to in the previous section. However, the ATO dividend data includes data from companies that liquidate and leave credits that would have been distributed had they not liquidated. Such companies necessarily have lower than normal distribution rates, and drag down the aggregate distribution rate, and are therefore not suitable firms to estimate the distribution rate of the Benchmark Efficient Entity (BEE), which has not liquidated.

The second problem with Frontier's argument is that Frontier's proposed use of ATO data necessarily uses the same set of companies for estimating both the utilization and distribution rates, there is no necessity to do so, and good reason for not doing so (because one might not want to use all firms for estimating the distribution rate, which is firm-specific, whilst one would want to use all firms to estimate the utilization rate because it is a market-wide parameter).

In respect of the question of why all firms might not be suitable for estimating the distribution rate of the BEE, there are two primary points here. Firstly, unlisted firms should be excluded because the regulated businesses are listed firms or subsidiaries of listed firms[1], and listed firms have much higher distribution rates than unlisted ones (Frontier, 2016, Table 4 reports estimates of about 50% for unlisted firms and 75% for listed firms). Since it is always sensible to distribute credits if possible, and the only restriction on doing so is the size of the firm's cash dividends, the presumed cause of the difference in distribution rates between listed and unlisted firms is lower dividend payout rates in unlisted companies. Furthermore, listed companies are generally widely held, and therefore most shareholders have very little knowledge of the actual state of affairs within these companies. Accordingly, dividends can be used to credibly signal the true state of affairs and the higher the dividend the stronger the signal of the firm's profits (Copeland et al, 2005, Ch. 16). These considerations are much less pronounced for unlisted companies, which might explain the lower payout rate and hence the lower distribution rate for

[1] In respect of businesses regulated by the AER, these are identified by the AER (2017, Tables 3.1-3.4) and all of them that are entirely or majority privately-owned appear to be listed or owned by firms that are listed. For example, Ausnet Services and the APA Group are listed in Australia, whilst Powercor Australia, Citipower and SA Power Networks are owned by Cheung Kong Infrastructure (which is listed in Hong Kong) and Spark Infrastructure (which is listed in Australia). In respect of the QCA, the privately-owned regulated businesses are Aurizon Network (listed in Australia) and DBCT Management (ultimately owned by BIP, which is listed in the US and Canada). In respect of the ERA, the privately-owned businesses are the DBP, which is owned by the DUET Group (listed in Australia), the GGP, which is majority-owned by APA (listed in Australia), and the Midwest South West Gas Distribution System, which is owned by ATCO Gas Australia, who in turn is owned by the ATCO Group (listed in Canada).

imputation credits. Furthermore, unlisted firms include sole traders who have corporatized in order to reduce their tax bill, and this requires a low dividend payout rate.

Secondly, as already noted, the ATO data includes firms that made profits and thereby generated credits but then made losses and liquidated without distributing the credits.[2] Such firms would tend to have low distribution rates and, as with unlisted firms, would not be suitable for estimating the distribution rate for the BEE. For example, suppose the ATO database comprised two firms: a regulated one that paid taxes of $100m and distributed all of the credits, and another one that also paid taxes of $100m but then made losses and liquidated without distributing the credits. The regulated firm would have a distribution rate of 1 whilst that for the other firm would be zero, and the aggregate rate would be 50%. So, the aggregate rate of 50% would significantly underestimate that for the regulated business.

To assess the implications of this point for the validity of the gamma estimate arising from the ATO data, the ATO data offers two estimates of the distribution rate: 0.47 using dividend data and 0.71 using FAB and company tax data (Frontier, 2018, para 52). Frontier (2018, para 57) also claims that the ATO data for all firms yields an estimate for gamma of 0.31. So, if the best estimate of the distribution rate for the BEE is 0.89 using financial statement data for the top 50 firms (Lally, 2018c) and the best estimate of the distribution rate of firms in aggregate is 0.47 using ATO data, the ATO estimate of gamma of 0.31 for firms in aggregate requires adjusting upwards to 0.31*(0.89/0.47) = 0.59 in order to reflect the distribution rate for the BEE. Alternatively, if the best estimate of the distribution rate for the BEE is 1 using financial statement data for the regulated energy network businesses (Lally, 2018b, pp. 19-20) and the best estimate for the distribution rate of firms in aggregate is 0.47 using ATO data, the ATO estimate of gamma of 0.31 for firms in aggregate requires adjusting upwards to 0.31*(1/0.47) = 0.66. These illustrations invoke Frontier's estimates of parameters from the ATO data. By contrast, using ATO data on all firms, the AER estimates gamma at 0.35 (AER, 2018b, Table 2) and the distribution rate at 0.57 using dividend data (AER, 2018a, page 432). If these two figures are correct, the revised estimates of gamma above of 0.59 and 0.66 become 0.55 and 0.61. All of

[2] This point was made by ATO staff during a meeting with AER and ENA representatives on 21 June 2018, which I participated in as an advisor to the AER. It is also alluded to by the AER (2018b).

these results are shown in Table 1 below. So, using unadjusted ATO data to estimate gamma could underestimate it by about 50%.

Table 1: Revised Estimates of Gamma Using ATO Data

Gamma (ATO)	Distn Rate (ATO)	Distn Rate (BEE)	Gamma (Adjusted)
0.31	0.47	0.89	0.59
0.31	0.47	1	0.66
0.35	0.57	0.89	0.55
0.35	0.57	1	0.61

Frontier (2018, section 4.1) argues that the problems with use of the ATO franking balance data apply equally to the franking balance data drawn from the financial statements of the top 20 firms, and used to estimate the distribution rates for those firms (as in Lally, 2018a, 2018c). In support of this claim, Frontier quotes from a note prepared by the ATO (2018a). However the wording in this note is rather ambiguous and was clarified verbally by the AER during the subsequent discussion with the AER that both Prof Stephen Gray (Frontier) and myself participated in (and referred to above). In particular, ATO staff explained that the composition of companies in the ATO's data changed over time, and that this fact alone could explain the marked difference in estimates of the aggregate distribution rate using dividend data and franking account balance data.

To illustrate this point, suppose that one company was present throughout the data series with an initial Franking Balance (FBI) of 0, made tax payments of \$100m, distributions of \$90m, and a closing Franking Balance (FBC) of \$10m. A second company was present at the beginning of the data series, with FBI of 0 and made tax payments of \$60m and distributions of \$20m before liquidating prior to the end of the data series with a FBC of \$40m. This data is shown in Table 2. The aggregate tax payments are then \$160m and the aggregate distributions are \$110m, implying a distribution rate of 11/16 = 0.70 using dividend data to obtain the distributions. By contrast, using franking balance data to deduce the distributions, the FBI is 0 (over both companies), the FBC is $10m (from only the first company because the second company is no longer present in the data at the terminal point), and the aggregate tax payments are $160m. This implies aggregate distributions of $150m (TAX plus the change in the franking balance), and therefore a distribution rate of 15/16 = 0.94. So, two different estimates of the distribution rate arise: 0.70 using dividend data and 0.94 using franking balance data. The latter figure is incorrect, and occurs simply because the second firm contributes to the aggregate FBI, tax and distributions data but not to the FBC data *and* the franking balances of the firms are aggregated. This clearly demonstrates a flaw in the ATO franking balance data when used for estimating the aggregate distribution rate. However, the problem does *no*t apply to estimates of the distribution rates from the top 20 or 50 companies (as in Lally, 2018a, 2018c) because there are no drop-outs. Furthermore, even if there were dropouts in the analysis of the top 20 or 50 companies, this analysis by Lally (2018a, 2018c) never aggregates over the FBI and FBC values and therefore the same problem would not arise.[3] So, Frontier's claim is incorrect.

Table 2: ATO Data

	FBI	TAX	DIST	FBC
Coy 1	0	$100m	$90m	$10m
Coy 2	0	$60m	$20m	$40m
Aggregate	0	$160m	$110m	$10m

The example also reveals a problem with the ATO data even when dividend data is used to estimate the distribution rate, and noted earlier. This approach includes data from companies that liquidate and leave credits that would have been distributed had they not liquidated. Such companies necessarily have lower than normal distribution rates, and drag down the aggregate

[3] In this 20 or 50 companies approach, the data on distributions and franking balances for each company would be used to deduce the tax payments by each company (of $100m and $60m respectively). These tax payments would then be aggregated to yield $160m, and divided into the aggregate distributions of $110m to yield the (correct) distribution rate of 0.70.

distribution rate, but they are not suitable firms to estimate the distribution rate of the Benchmark Efficient Entity (BEE), which has not liquidated.

In view of these problems with both the dividend and franking balance data of the ATO, the best estimate of the distribution rate of the BEE is obtained from financial statement data for a set of companies that have not liquidated. This approach is also favoured by the AER, the ERAWA and the QCA.

Frontier (2018, section 4.1) argues that use of financial statement data is subject to the problem that "some credits are extinguished within corporate structures without being distributed to shareholders". To illustrate this point, it refers to BHP Ltd, which distributes credits to BHP Plc, and these in turn are not distributed to shareholders, leading to an overestimation of the distribution rate. Frontier does not specify which BHP Ltd dividends it is referring to, but it appears to be the same point raised by Prof Gray during an Expert Evidence Session organised by the AER (2018c, pp. 103-104) in the course of its review of its Rate of Return Guidelines; Prof Gray described the credits distributed to BHP Plc as "completely wasted" presumably because the shareholders of BHP Plc are not Australian and therefore could not use the credits. If so, the issue is not that the distribution rate has been overestimated but that they can't be used and this is an issue involving the utilisation rate for the credits rather than the distribution rate. Rio Tinto is in the same position. Furthermore, this issue involving both companies is a highly unusual one, and a possible response to it would be to delete both BHP and Rio Tinto from the set of companies used to estimate the distribution rate for the BEE. This is also favoured because both companies have substantial foreign assets and this could affect the distribution rate for credits. Section 6 attempts to improve the estimate for the distribution rate by deleting companies with substantial foreign investment, and both BHP and Rio Tinto are thereby deleted.

Frontier (2018, section 4.1) also argues that some firms have received large tax refunds that have decreased their franking balance, leading to an overestimate of the distribution rate. Frontier (2018, section 4.4) subsequently identifies these companies as AusNet Services and AGL. To examine this issue, I start by considering a firm whose dividends are insufficiently large to distribute all of its credits. For example, it has an initial franking balance (FBI) of $20m, tax payments of \$100m, distributions of \$90m, and therefore a closing franking balance (FBC) of \$30m. Its true distribution rate would be \$90m/\$100m = 0.90, and the usual estimation process using financial statement data would correctly estimate this distribution rate as follows:

$$F = \frac{DIST}{DIST + \Delta FB} = \frac{\$90m}{\$90m + \$10m} = 0.9 \qquad (1)$$

Now suppose the firm mistakenly paid additional taxes of \$10m during this period (raising its tax payments to \$110m) and received a refund for this during the same period. Net of the refund, the taxes would still be \$100m, and none of the other figures would change. So, its true distribution rate would still be \$90m/\$100m = 0.9, and equation (1) would still correctly estimate this rate. So the presence of a tax refund does not induce an overestimate in the distribution rate.

Now suppose that the overpayment of tax instead occurred prior to period examined here, whilst the refund occurred during this period examined. In this case, the FBI would rise to \$20m. The true distribution rate in this period would still be \$90m/\$100m = 0.9, but application of the methodology in equation (1) would now lead to an estimate for the distribution rate of 1 as follows:

$$F = \frac{DIST}{DIST + \Delta FB} = \frac{\$90m}{\$90m + 0} = 1.0 \qquad (2)$$

So, the distribution rate would now have been overestimated. This analysis matches comments made by Prof Gray, during an Expert Evidence Session organised by the AER (2018c, pp. 103-104) in the course of its review of its Rate of Return Guidelines; Prof Gray stated there that overestimation of the distribution rate would require the refund to occur during the period in which the firm's distribution rate was being estimated whilst the tax payments giving rise to the refund had to predate that estimation period. The effect of this qualification by Prof Gray, supported by the examples above, is that the problem is unlikely to arise because the estimation period used by Lally (2018a, 2018c) was 2000-2017 and therefore any refunds paid during this period were unlikely to relate to overpayments prior to this period. Consistent with this, Frontier offers no examples of refunds that seem to be of this type.

Now suppose that the firm mistakenly paid additional taxes of $10m during this period (raising its tax payments to $110m) but did not receive the refund until after the end of this period. The 'true' taxes would still be $100m and the distributions would still be $90m, so the true distribution rate would still be $90m/$100m = 0.9. However, FBC would rise to $40m, and application of the methodology in equation (1) would now lead to an estimate for the distribution rate of 0.81 as follows, which is now too low rather than too high.

$$F = \frac{DIST}{DIST + \Delta FB} = \frac{\$90m}{\$90m + \$20m} = 0.81 \qquad (3)$$

These examples all assume that the firm's dividends are insufficiently large to distribute all of its credits, and therefore that the true distribution rate is less than 1. Now suppose that the firm's dividends are sufficiently high that all of its credits can be distributed, and therefore its true distribution rate is 1. Consistent with this, suppose that FBI is 0, taxes are $100m, distributions are $100m and FBC is 0. Application of the methodology in equation (1) will correctly estimate the rate at 1. If additional taxes are mistakenly paid and refunded during this period, the true distribution rate will still be 1 and the estimate using the methodology in equation (1) will be likewise.

Now suppose that the firm instead overpays tax of $10m just before the end of the period and receives the refund after the end of the estimation period. The true distribution rate will still be 1. However, FBC will rise to $10m and therefore application of the methodology in equation (1) would now produce an estimate of the distribution rate of 0.9, which is too low.

Now suppose that the firm instead overpays tax of $10m just before the beginning of the period and receives the refund just after the beginning of the period. The true distribution rate will still be 1. However, FBI will rise to $10m and therefore application of the methodology in equation (1) would now produce an estimate of the distribution rate of 1.11, which is too high.

In summary, tax refunds can lead to overestimation of the distribution rate as claimed by Frontier. However, they can also lead to underestimation. So, the estimated distribution rate may be wrong but there is no upward bias. Furthermore, most refund situations will not lead to errors in the estimate. Furthermore, neither of the examples of refunds given by Frontier (AGL and AusNet) would seem to be of the type that would give rise to estimation error.

Frontier (2018, section 4.3) argues that the 20 companies examined by Lally (2018a) and favoured by the AER are unsuitable because these companies have substantial foreign income, this is not a feature of the BEE, and foreign income drives up the credit distribution rate. It is true that these companies have substantial foreign income and that this is not a feature of the BEE. However, on the question of whether foreign income drives up the distribution rate, Frontier does not offer any empirical evidence. This claim has been made previously by Frontier (2016, section 2.3). In response, Lally (2016, section 3.5) shows that the proportion of profit from foreign operations is monotonically decreasing in the distribution rate, which is in the opposite direction to that claimed by Frontier, and the correlation between the two variables is the very striking figure of -0.95. Lally (ibid) also provides an explanation for this: firms with foreign operations retain a larger proportion of their operating cash flows in order to undertake these investments, this reduces their dividends, and therefore their distribution rate for credits. By contrast, the example offered by Frontier (2018) in support of their claim that foreign operations raise the distribution rate assumes (without presenting any evidence) that firms with foreign operations have the same payout rate as those without foreign operations. Frontier (2018) offers no response to Lally's (2016, section 2.3) empirical analysis or the explanation offered for it.

Frontier (2018, section 4.3) argues that the appropriate firms for estimating the distribution rate for the regulated businesses should match the businesses in their dividend payout rate and in their level of foreign income (zero), rather than being the largest listed firms as used by Lally (2018a). However this approach conflicts with Frontier's preference for estimating gamma directly using ATO data (as described above) because this ATO data is for all firms and therefore implicitly estimates the distribution rate using all firms. Furthermore, if a small subset of firms were to be chosen so as to match the regulated businesses in some way, there would be considerable subjectivity in doing so, both over the criteria for selecting them and over the firms that approximately satisfied the criteria, and Frontier do not offer any such set of firms.

Nevertheless, if a small subset of companies were to be chosen, the natural choice would be the set of energy network businesses firms used by the AER (2018d, Table 3) to estimate the optimal gearing and beta for the regulated businesses: APA Group, Ausnet Services, DUET Group, Envestra (now Australian Gas Networks), and Spark Infrastructure. Lally (2018b, pp. 19-20) examines the distribution rates of these firms. For the three firms for which this can be done, the distribution rates are all 1 and they all have low or no foreign income.

Frontier (2018, section 4.4) critiques the analysis in Lally (2018b, pp. 19-20) relating to the distribution rates of three energy network businesses. In particular, Frontier claims that Lally "assumes a closing FAB" for one of these firms (DUET). This claim is not correct. Instead, Lally states the following: "In respect of DUET, the Franking Account Balance for the latest available financial statements (2016) is not disclosed but the dividends paid shortly after balance date were unfranked, implying a zero Franking Account Balance at that time. Accordingly, the distribution rate for all earlier credits generated from company tax payments must be 1." So, no assumption is made here. Instead, a reasonable conclusion is drawn based on the available evidence.

Frontier (2018, section 4.4) also notes that Lally (2018b, pp. 19-20) replaced the empirical estimate of the distribution rate for another of these businesses (APA) with what it would have been if this company "had adopted what he considers to be more efficient behaviour." Nothing in this comment seems to contest what was done by Lally: to observe that APA's Franking Account Balance was always positive over the 2007-2017 period examined, that most of its distributions are nevertheless unfranked, that this was inefficient behavior and therefore its distribution rate should be treated as 1. However, even if one used the empirical estimate of the firm's distribution rate of 0.84 over the 2007-2017 period, this is still higher than Frontier supports. This firm is also examined by Lally (2018c, Table 2) in extending the analysis of the top 20 ASX firms to the top 50 firms, and its distribution rate over the longer period of 2000-2017 is estimated at 0.93. Again this exceeds Frontier's estimate.

Frontier (2018, section 4.4) also notes that Lally (2018b, pp. 19-20) concludes that the distribution rate for the last of these three companies (AusNet) over the 2007-2017 period was 1 because the 2017 FAB was below that for 2007, and Frontier critiques this conclusion because the 2017 FAB (-$26.4m) was affected by a tax refund paid shortly after that point and impounded into the FAB figure provided. I do not agree. The refund must have been preceded by a tax overpayment of the same amount, and the net effect of these two events on the 2017 FAB figure is exactly zero.

Frontier (2018, section 4.4) also claims that a materially different estimate of the distribution rate using these firms would have been obtained if the sample period of 2007-2017 used by Lally (2018b, pp. 19-20) had commenced one year earlier in 2006 or finished one year earlier in 2016. Frontier does not disclose the results of this alternative analysis. However, there is no case for using 2016 data when 2017 data are available. There is a case for using earlier data, but Frontier appears to be cherry picking 2006 rather than 2007. Even so, the effect is small. For APA Group, the 2006 FAB is -$7m and therefore the distribution rate for 2006-2017 is 0.66 rather than 0.84 for 2007-2017. For AusNet, the 2006 FAB is $10.4m and the franked dividends for 2007 are $14m, yielding a distribution rate for 2006-2017 of 1.08. Aggregating over the two companies, the result is 1.10. So, even using a start date of 2006 and disregarding DUET (with an apparent distribution rate of 1), the resulting estimate of the distribution rate for the BEE is still at least 1, and therefore continues to support the conclusion in Lally (2018c) that the appropriate estimate for the distribution rate of the benchmark firm is at least 0.89.

A more appropriate critique of my earlier analysis on these three companies would be that the sample size of three is too small. I was entirely mindful of this and concluded this analysis with the following comment (Lally, 2018b, page 20): "This limited evidence supports my earlier conclusion that the appropriate estimate for the distribution rate of the benchmark firm is at least 0.88." Thus, nothing in Frontier's (2018) critique of my earlier examination of these three energy businesses undercuts the merits of using financial statement data to estimate the distribution rate for the BEE, or of adopting of an estimate of at least 0.88.

Frontier (2018, section 4.4) argues that the use of financial statement data by Lally (2018a) to estimate distribution rates for credits presumes that all credits distributed by these firms are immediately available for shareholders to redeem, but that this might not occur because some of the immediate recipients are companies and trusts, who in turn would not pass them to the ultimate beneficiaries until these intermediaries in turn paid a dividend. So, some credits might be trapped or delayed. This is possible. However, delay per se in distributing the credits is not relevant for the present purposes. If all of the credits that are released from the companies that ultimately generated them (the "source companies") were released to intermediaries and did not reach their ultimate users for (say) two years, the credits received by the ultimate users within a particular year would be those released by the "source companies" to the intermediaries two years previously and the distribution rate to ultimate users within a year would be the same as the distribution rate by the "source companies" to the intermediaries in the same year except to the extent that the distributions to intermediaries were growing over time. So, if this growth rate were (say) 5% per year and the delay in transmitting the credits from the "source companies" to the ultimate beneficiaries were two years, the credits received by the ultimate beneficiaries within a particular year would be 90% of those distributed by the "source companies" to intermediaries in the same year, as follows:

$$\frac{Credits\ received\ by\ ultimate\ users\ in\ yr\ t}{Credits\ released\ by\ source\ companies\ in\ yr\ t} = \frac{1}{(1.05)^2} = .90$$

Furthermore, the extent to which shares in Australian companies are owned by other companies and trusts is minor. In particular, in respect of the analysis by the AER (2018b, Table 3) of the ownership of Australian listed equity, their underlying analysis estimates the listed equity value at $1,761b of which $534b is held by the "Rest of World". Of the remaining $1,227b held by Australian entities, only $125b is held by companies (10%). Furthermore, they do not record trusts as a category. So, if 10% of shares were held by intermediaries, they delayed the pass through of the credits to the ultimate beneficiaries by two years, and the growth rate in dividends were 5% per year, the credits received by the ultimate users in a particular year would be 99% of those released by the source companies in the same year as follows:

$$\frac{Credits\ received\ by\ ultimate\ users\ in\ yr\ t}{Credits\ released\ by\ source\ companies\ in\ yr\ t} = \frac{1 + 9(1.05)^2}{10(1.05)^2} = 0.99$$

Similarly, even if the intermediaries constituted 30% of the owners of shares and the delay were three years, the credits received by the ultimate beneficiaries in a particular year would still be 96% of those released by the source companies in the same year. Thus, the impact of delays in the transmission of credits from the source companies to the ultimate users would seem to be immaterial.

This leaves the issue of whether credits are trapped in the intermediaries and therefore never passed on to the ultimate users. A reasonable assumption is that the intermediaries distribute the same proportion of credits received as the source companies, and the best estimate for both is the figure of 90% (see section 6). So, if intermediaries constitute 10% of the owners of shares, the proportion of credits distributed by the source companies that reached the ultimate users would be 89% as follows:

$$0.90[0.9 + 0.1(0.90)] = 0.89$$

The shortfall from 90% in the absence of intermediaries is therefore only 1%. Even if the intermediaries constituted 20% of the shareholders in the source companies, the distribution rate would still be 88% compared to 90% without the effect of the intermediaries. All of this strongly suggests that the presence of intermediaries who might delay or trap the passing on of the credits to the ultimate users does not materially reduce the distribution rate defined as credits received by the ultimate users within a year as a proportion of those released by the source companies in the same year.

Frontier (2018a, section 4.5 and Appendix) argues that there are a number of errors in the analysis in Lally (2014, Table 2) relating to estimating the aggregate distribution rate of the largest 20 firms in the ASX over the 2000-2013 period. However Lally's (2014) analysis over the 2000-2013 period has been supplanted by Lally (2018a), in which the period of analysis is extended to 2000-2017. Some of the points raised by Frontier are correct but these arose from using 2012 rather than 2013 franking balance data because the latter were not available at the time of the Lally (2014) analysis and are irrelevant to Lally (2018a). The other points raised by Frontier are not correct, comprising apparently underestimating dividends by omitting those dividends paid under Dividend Reinvestment Plans and errors in determining Franking Balances (the latter involving conflating the Franking Balance with the maximum fully franked dividends that could be paid, incorrectly including the effect of some events after balance date, and the use of annual average rather than year-end exchange rates when converting US$ to A$).

Frontier (2018, section 5.1) argues that the equity ownership approach provides an upper bound on the estimate of the redemption rate. Prima facie, this claim has no relevance to the AER's (2018) approach because the equity ownership approach provides an estimate for the utilisation rate *U* in the Officer model, and this is a weighted average over the utilisation rates of individual investors (as recognised by AER, 2018a, page 439; 2018b, page 9). However, the argument presented by Frontier (that local investors may not be able to redeem all credits due to the 45 day rule) would equally imply that the equity ownership approach provided an upper bound on the estimate of *U*, and therefore should be addressed. The claim that some local investors cannot use all credits on dividends received by them (due to the 45 day rule) is true. However, it is implausible that there is any material group of Australian investors who hold Australian stocks for less than 45 days around an ex-dividend date, because the penalty from doing so would be large (loss of the imputation credits) and any disadvantage from simply expanding their ownership period enough to avoid the 45 day rule would seem to be much less substantial. Furthermore, any overestimate of *U* that results from ignoring such investors is likely to be dwarfed by the *underestimate* of *U* that results from assuming that no foreign investors can use the credits (which is unlikely to be true given the incentives that such investors would have to circumvent the legislation, the track record of successful efforts in circumventing legislation more generally, and the legislative responses to these efforts that reflect the successes in circumventing such legislation).

Frontier (2018, sections 5.2 and 5.4) notes some concerns expressed by the ABS over the quality of its data on the proportion of equities held by local investors, notes that this proportion has been significantly revised by the ABS, and that one feature of these revisions is surprising. Implicitly, Frontier is suggesting that these concerns are sufficient to warrant rejection of the ABS data. Rightly, Frontier (2018, para 144) argues that the quality of the ABS evidence must be assessed relative to the quality of the alternatives for estimating the utilisation rate, and Frontier favours the use of ATO data. However, the ATO evidence favoured by Frontier suffers from two considerably more significant problems than anything in Frontier's critique of the ABS data (as detailed earlier). In respect of one of these points, Table 1 above shows that the appropriate estimate of gamma could be over twice that arising from use of the ATO data simply because the ATO data reflects the distribution rate for credits of the average firm rather than the BEE. Accordingly, and notwithstanding the concerns presented by Frontier about the ABS data but consistent with Frontier's view on the need to compare the quality of competing estimators, I favour use of the ABS data for estimating the proportion of Australian equities held by local investors.

Frontier (2018, section 6) claims that the AER defines the utilisation rate as the proportion of credits that can be redeemed, that consistency requires that this be redemptions by shareholders in the BEE, and therefore that this requires information about the equity ownership structure of the BEE. This argument has no relevance to the AER because the AER does not currently define the utilisation rate in this way. Instead, the AER (2018b, page 9) currently defines the utilisation rate as a weighted average over the utilisation rates of individual investors, in accordance with rigorous derivations of the Officer model. The redemption rate for credits is at most an estimator of this parameter.

Frontier (2018, section 8.2) also claims that the upper bound on gamma from using financial statement data from firms is 0.39. As noted in Frontier (2018, para 6), this figure of 0.39 is the product of a distribution rate of 0.83 (from financial statement data) and a utilisation rate of 0.47 using a listed equity local ownership proportion of 0.47. Neither of the component figures is correct. The distribution rate should be about 0.95 (see section 6 below) and the utilisation rate should use all equity data (Lally, 2018b, page 18) for which recent results have been about 0.65 (see section 6 below). The product is 0.62 rather than 0.39.

5. Submissions to the AER

Energy Networks Australia, hereafter ENA (2018), largely repeats points made by Frontier (2018). The exceptions are thus. ENA (2018, sections 10.1 and 10.2) notes that the AER (2018a, page 396) defines gamma as "..the proportion of tax collected from the company which gives rise to the tax credit associated with a franked credit", and argues that this definition requires a redemption rate definition for the utilisation rate and use of the same group of investors for estimating the distribution and utilisation rates. Accordingly, the AER's use of listed equity to estimate the distribution rate and all equity to estimate the utilisation rate is inconsistent. The above quote on the definition of gamma comes from Officer (1994, page 4). As I have argued previously (Lally, 2016, page 8), Officer provides no formal derivation of his model and therefore it is not possible to determine unambiguously how the parameter gamma is defined in his model. It is uncontentious that gamma is the product of a distribution rate for credits (which is firm-specific) and a parameter called theta. Papers by Monkhouse (1993) and Lally and van Zijl (2003) provide rigorous derivations of the Officer model. In particular, Lally and van Zijl (2003, section 3) provide a formal derivation of a generalisation of Officer's model (with the Officer model being a special case). In this derivation, they show that theta is a complex weighted average over the "utilization" rates for imputation credits of all investors holding risky assets, where the weights involve each investor's investment in risky assets and other terms. So, theta is a market-wide parameter, whilst the distribution rate is not (although the latter might be estimated using market-wide data). Nothing in the quote from Officer, relayed through the AER, contradicts this. Thus the AER's use of listed equity to estimate the distribution rate and all equity to estimate the utilisation rate is consistent with the Officer model, providing one draws upon rigorous derivations of the model to unambiguously determine the definitions of parameters. Furthermore, despite defining gamma as in Officer (1994, page 4), the AER (2018a, page 439; 2018b, page 9) properly defines it as a weighted average over investors' utilisation rates for credits.

ENA (2018, section 10.4) also argues that the AER should estimate two values for gamma: one applicable under the current legislative situation and another reflecting the possibility that excess credits will no longer be redeemed. Furthermore, it argues that imputation credit redemptions are currently about $25b per year, that the proposed policy change will reduce this by about $6b per year, and therefore the utilisation rate by local investors should be reduced by 25%. ENA does not provide a source for the first of these figures whilst the source provided for the second figure (Australian Labour Party, 2017) supplies a larger figure but does not explain its derivation.

I therefore attempt to estimate the impact of this proposed policy change on the utilisation rate for local investors.

Under the Officer (1994) model, the utilisation rate for a particular investor U_i is the extent to which imputation credits both increase the taxable sum associated with the cash dividend and are offsettable against those tax obligations, i.e., the after-tax payoff per \$1 of fully franked dividends (with imputation credits equal to 43% of the dividend) for an investor receiving only fully imputed dividends and subject to marginal tax rate t_p is

$$\$1 - TAX = \$1 - \$1\left[(1 + 0.43U_i)t_p - 0.43U_i\right] = \$1(1 + 0.43U_i)\left(1 - t_p\right) \qquad (4)$$

Under the existing Australian tax regime, local investors have $U_i = 1$. So, investors with personal tax rates below 30% will have a tax offset arising from the imputation credits (\$0.43) in excess of the gross tax payment of \$1(1 + 0.43)t_p, and therefore will receive a refund of the unused credits. So, the after-tax payoff comprises the \$1 cash dividend plus the refund. If the refund is removed then the after-tax payoff for an investor with t_p less than 30% is simply the \$1 cash dividend and therefore the utilisation rate is the value of U_i that matches the after-tax payoff in equation (4) to \$1:[4]

$$\$1(1 + 0.43U_i)\left(1 - t_p\right) = \$1$$

So

$$U_i = \left[\frac{1}{1 - t_p} - 1\right]\left(\frac{1}{0.43}\right) \qquad (5)$$

The investors to whom the refund arises are individuals with tax rates below 30% and superannuation funds (which are taxed at 15%). The proposal is to remove the refund from these groups, except for pensioners. Plausibly, amongst individuals who own shares and with tax rates below 30%, the overwhelming majority of these shares are owned by pensioners. This leaves superannuation funds (comprising pension funds and life-insurance companies). For purposes of

[4] This process presumes that U_i is less than 1 at both points in equation (4). Literally, this is not true: U_i remains 1 at the first point at which it appears in equation (4) and is only less than 1 at the second point at which it appears in equation (4) to the extent necessary to ensure an after tax payoff of \$1. However, the Officer model (which the AER uses) applies the same value for U_i at both points, and therefore in this case U_i serves only as a device to obtain the correct post-tax payoff rather than also correctly representing the application of the tax regime to these investors.

determining the market-wide utilisation rate, the relevant investor groups are households, superannuation funds, and foreigners (as companies and investment funds are not ultimate users of credits and are mere conduits for them). The latest available data on the market weights of these three groups (September 2017) are 23%, 42% and 35% respectively (derived by the AER from ABS data). Under the current regime, the utilisation rates of these three groups are 1, 1, and 0 respectively. So, the market-wide utilisation rate is 0.65:

$$U = 1(0.23) + 1(0.42) = 0.65 \quad (6)$$

Under the proposed regime, the utilisation rate for superannuation funds (taxed at 15%) falls to 0.41 in accordance with equation (5). So, the market-wide utilisation rate would fall to 0.40 as follows:

$$U = 1(0.23) + 0.41(0.42) = 0.40 \quad (7)$$

This analysis presumes that the investment income of super funds comprises only fully franked dividends, and this is not the case. Some funds will receive unfranked dividends, and/or capital gains on shares, and/or other sources of taxable income. These all generate tax obligations, against which the excess imputation credits on the fully franked dividends would be offset before the issue of a rebate arises. Over the June 2018 quarter the asset portfolios of Australian super funds with more than four members comprised 27% local equities, 24% foreign equities, 14% property, 31% fixed income, and 4% other (APRAa, 2018, page 7). Only the local equities and property would generate imputation credits and only part of the return from such assets would be fully franked dividends. If the return on local equities and property yielded rate of return R, with half in the form of fully franked dividends, the same return applied to foreign equities, and the return on the other assets were only half of this rate, the overall rate of return would be $0.82R$ as follows:[5]

$$R_p = 0.27R + 0.24R + 0.14R + 0.17R = 0.82R$$

[5] Brailsford et al (2008, Table 1) gives average total returns and cash dividend yields for Australian equities from 1988-2005 of 12.8% and 4.5% respectively. Assuming funds tilt towards companies with fully franked dividends, which adds 2.0% to the dividend yield and the total return, the gross dividend is then approximately half of the total return.

Of this, only half of the return on local equities and property ($0.20R$) would be fully franked dividends, and therefore only one quarter of the portfolio return would be in the form of fully franked dividends. Furthermore, the realised capital gains in each year will in general be less than the capital gains earned (which are half of the first three terms in the last equation, or $0.32R$), and only 67% of the realised gains are taxable. This yields taxable capital gains that are about 33% of those earned (Lally and van Zijl, 2003, pp. 198-199), which reduces the taxable portfolio return by $0.21R$, from $0.82R$ to $0.61R$. So, for every $4 in investment income, about $1 would be in the form of untaxed capital gains and a further $1 would be fully franked dividends (comprising $0.70 in cash dividends and $0.30 in franking credits) whilst the remaining $2 would be in other forms. At a tax rate of 15%, this $3 of taxable income would generate gross tax obligations of $0.45 and imputation credits of $0.30, yielding net tax obligations of $0.15 (which is 4% of the total investment income of $4). So, the imputation credits would be fully offset against the gross tax obligations of the fund, and the proposed policy of annulling refunds would then have no effect on these funds. Consistent with this, the APRA (2018b, Table 1a) reports that, for funds with more than four members, taxes were paid (in aggregate) in each of the last two years (rather than refunds received) and that these taxes averaged about 3% of the investment income net of expenses.

This analysis applies to a typical fund. However, some funds might be tilted strongly towards local equities and property, which would reduce the tax payments and might give rise to refunds for the imputation credits that could not be offset against the gross tax obligations. The tilt would have to be quite strong to produce a tax rebate and even here the rebate would be less than that underlying equation (5) and hence the utilisation rate for such funds would be higher than determined in equation (5). Furthermore, even if a fund's assets were so strongly tilted towards local equities and property that they were receiving refunds, one would expect such funds to alter their portfolios to avoid this outcome in the event of the proposed policy being adopted. Accordingly, there is unlikely to be any material impact on the market utilisation rate from the proposal to eliminate tax refunds for superannuation funds and individuals who are not retired.

CRG (2018, section 4.7) presents a formula for the distribution rate for imputation credits for an efficiently financed regulated business, and argues that this implies a distribution rate of 1. I am sympathetic to CRG's efforts to estimate the distribution rate for a BEE rather than to invoke mere empirical estimates (which may reflect inefficient behaviour). However, CRG provides no derivation for their formula and it does not seem to me that any set of assumptions could have produced such a formula. Accordingly, no weight is warranted on CRG's submission on this point.

CRG (2018, section 4.7) also argues that the market-wide utilisation rate U should be 1 because the efficient source of equity finance for firms is from investors who can use the imputation credits (who are Australian). However, regardless of which investors are targeted by firms when issuing equity capital, secondary market transactions would determine the shareholders holding Australian shares and this would determine the cost of equity for Australian firms. Furthermore, foreigners hold a substantial proportion of Australian equity because this increases their diversification, and this lowers the cost of equity capital for Australian firms (before consideration of which investors can use the imputation credits). Furthermore, as shown in Lally (2013, section 3.9), the inability of foreigners to use the imputation credits does not offset this effect. The more appropriate argument, which CRG notes only in passing, is that the Officer model used by the AER assumes that national equity markets are completely segregated, which implies that all Australian equities are held by Australians, and therefore $U = 1$.

The NSG (2018, page 18) asserts that the top 20 listed firms used by Lally (2018a) were selected because of the availability of audited data, and notes (correctly) that all listed firms are audited. However, their first claim is not correct. The top 20 firms were selected because the exercise was intended to estimate the market-wide rate, a market-wide rate is necessarily value-weighted, and selection of the top 20 (or top 50) firms provides a better estimate of the market-wide rate than any other sample involving the same number of firms.

The NSG (2018, page 18) argues that the top 20 firms are concentrated in the finance sector and therefore the analysis should be extended beyond 20 firms. NSG's concern is presumably that the finance sector concentration has raised the distribution rate. The suggested analysis has been done by Lally (2018c), and the next 31 firms (which do not include any financial institutions) have an aggregate distribution rate of 0.93 (Lally, 2018c, Table 2), which is even higher than for the top 20 firms of 0.88 (Lally, 2018a, Table 1).

6. Questions posed by the AER

The first of these questions is the impact of foreign operations on the estimated distribution rate for imputation credits. Using the top 50 ASX firms, Lally (2018c, section 3) estimates the distribution rate at 0.89, which includes the effect of foreign operations. The effect of foreign operations would be to lower the tax payments to the ATO relative to the size of the business (providing the foreign operations lead to tax payments to foreign tax authorities rather than the ATO) and this in turn would raise the distribution rate for credits providing that the dividend payout rate was not reduced. However, firms with foreign operations may have lower dividend payout rates (to finance the foreign operations) and therefore the reduction in the tax payments to the ATO (relative to the size of the business) may be outweighed by the reduction in dividends (relative to the size of the business), leading to a reduction in the distribution rate for credits. So the issue must be empirically assessed.

This requires an estimate of the proportion of each firm's tax payments to foreign countries, over the same period used to estimate the firm's distribution rate for credits. The best readily available proxy for this tax ratio is the proportion of accounting income arising from foreign operations, from the "Segment Information" note in each firm's Annual Report. If this is not available, revenue from foreign operations is used in substitution. If this is not available, non-current assets associated with foreign operations is used. In some cases, it is readily apparent from the Annual Report that all of the firm's operations are in Australia, and therefore this ratio is zero. Data is collected for a sample of the years for which distribution rate data were collected by Lally (2018c): the financial years ending in 2017 and 2016, and also for 2010 and 2009 if the distribution rate data for the firm extends back to those years. The average is then determined for each firm, and the results are shown in Appendix 1. Of the 50 firms in question, two are not examined because data on the distribution of credits was lacking (see Lally, 2018c, Table 2), and a further four lack data on the foreign income issue. Of the remaining 44 firms, one possible approach would be to examine just those firms with low averages for the foreign operations. If the cutoff level for this foreign operations ratio were no more than 20%, there are 26 such firms (see the last column of Appendix 1, starting with CBA) and the aggregate distribution rate for these 26 firms determined in the same fashion as in Lally (2018c) is 0.93 (aggregate distributions divided by the aggregate company tax payments to the ATO). This is even higher than the figure of 0.89 obtained by Lally (2018c) from all of these 50 firms. Alternatively, if the cutoff level for this foreign operations ratio were instead no more than 10%, the number of firms would fall further to 20 with an aggregate distribution rate of 0.89. An alternative approach would be to determine the weighted median of the individual firms' distribution rates amongst these 26 (or 20) firms, i.e., starting with the firm having the highest distribution rate (using the data in Lally, 2018c, Table 1 and Table 2), and moving downwards, the tax payments of these firms are aggregated until the midpoint of the aggregate tax payments across the 26 (or 20) firms is reached. For the 26 firms, this occurs with Westpac, which has a distribution rate of 0.96, and therefore the weighted median of the individual firms' distribution rates is 0.96 (see Appendix 2). For the 20 firms, the corresponding figure is 0.92. The results are summarised in Table 3 below, along with the results for the entire set of 50 firms.

Table 3: The Effect of Foreign Operations on the Distribution Rate

Group	Sample	Aggregate	Median
All 50 firms	50	0.89	0.96
Foreign Operations ≤ 0.20	26	0.93	0.96
Foreign Operations ≤ 0.10	20	0.89	0.92

Both the aggregate distribution rate and the weighted median rate are invariant to firms merging or spinning off some operations as separate firms, and this is a desirable property (especially since some firms in these 50 have resulted from mergers or spin offs). The same property does not hold for the simple average or median of individual firms' distribution rates, and these approaches are therefore not used. However, the results in Table 3 still depend upon which subset of the 44 firms is used and data on the remaining firms is not used. A superior approach would be to use all of the data, by regressing firms' distribution rates on their foreign operations proportion, with the intercept in the regression providing the estimate for the distribution rate of a firm with no foreign operations. As with the analysis in Table 3, this regression should weight firms in proportion to their tax payments (weighted least squares). Doing so yields an intercept of 0.96 with a standard error of 0.05 (see Appendix 3). This is within the range of results in Table 3.

The second of these questions is whether an estimate for gamma based on the ATO data for all equity is appropriate. My view is that this is not an appropriate approach, for the reasons given in section 4 above.

The third question is whether the distribution rate and the utilisation rate should be estimated from the same group of investors. The utilisation rate is a market-wide parameter and therefore the natural choice of data to estimate it is market-wide data. By contrast, the distribution rate is a firm-specific parameter and therefore the natural choice of data to estimate it is firm-specific data. However, doing so is precluded by the likelihood that the regulated firm in question could manipulate (raise) its price or revenue cap by reducing its dividends (so as to reduce its distributed credits, which lowers its distribution rate and therefore raises its cost of capital estimated from the Officer model used by regulators). The use of industry data is subject to the problem that the set of firms is very small (three); the choice of whether or not to include certain marginal cases is then likely to materially affect the resulting estimate. This points to the use of a much larger set of firms, either in substitution or as a complement, and the particular firms are discussed in the next paragraph.

The fourth question is whether the distribution rate should be estimated from the financial statements of the top 50 companies, and the utilisation rate from ABS data for all equity. In respect of the distribution rate, I consider that this should be estimated from financial statement data because the only alternative (ATO) data provides aggregate data on all firms (some of which are very unsuitable), as discussed in section 4 above. In respect of which companies should be used, these should be listed firms for reasons discussed in section 4 above. Furthermore, as discussed in the previous paragraph, a much larger set than the firms with substantial regulated operations is required, and therefore points to principal use of the top 50 companies.

In respect of the utilisation rate *U*, this must be defined in accordance with a rigorous derivation of the Officer model that the AER uses, and this definition is a weighted average over the utilization rates of all investors in the Australian market. Since the Officer model assumes that national equity markets are fully segregated then the only investors in the model would be local investors. Since all of these can fully utilize the credits, *U* is then 1. However, since the AER prefers to recognize the existence of foreign investors, the natural course of action would be to define *U* as a weighted average over the utilization rates of all investors in the Australian market, both foreign and local investors, which involves only a subtle change in the interpretation of the definition. Since local investors can fully use the credits and foreigners cannot, this implies that *U* is equal to the proportion of Australian equities owned by local investors. The best data source to estimate this proportion is ABS data. Furthermore, since some regulated businesses are unlisted (in Australia), the CAPM should be interpreted as applying to all Australian equity rather than just listed equity, and therefore ABS data on all Australian equity should be used. An alternative approach, contingent upon being satisfied that the ATO dividend data (which is not affected by the problems with the franking balance data) is correct, would be to use ATO dividend data on all firms to estimate the utilisation rate, which is a proxy for the utilisation rate. Using ATO data on all firms, the AER estimates gamma at 0.35 (AER, 2018b, Table 2) and the distribution rate at 0.57 using dividend data (AER, 2018a, page 432), which implies an estimate for the redemption rate of 0.61. This data is less satisfactory because it provides an estimate of the redemption rather than the utilisation rate. However, the practical effect of this choice is mild because the estimates from both ABS and ATO dividend data are similar.

The fifth question is whether the estimate of the distribution rate (from whichever companies are used) should be adjusted to remove the effect of foreign income. The purpose of the exercise is to estimate the distribution rate for the BEE, which by definition has no foreign income. Furthermore, foreign income may affect the result. So, the effect of foreign income should be removed. This has been done primarily by regressing the distribution rate on the foreign operations proportion for the top 50 companies, and the resulting estimate of the distribution rate for the BEE is 0.96 with a standard error of 0.05. A secondary approach has been to examine the three Australian firms with substantial regulated activities (APA, DUET and Ausnet Services); all three have nil or minimal foreign operations and an aggregate distribution rate of 1. The latter estimate warrants much less weight than the former, due to the small sample size, and this suggests an overall figure of 0.95 rounded to the nearest 0.05.

The sixth question is whether it is appropriate to round the distribution rate, utilisation rate or gamma and, if yes, to what degree. Within the Officer (1994) model, gamma appears in the cash flows whilst the utilisation rate appears within the MRP, which suggests that rounding be applied to both gamma and the utilisation rate. However, gamma is merely the product of the utilisation and distribution rates and these two components are individually estimated rather than gamma per se. So, rounding should occur for both the utilisation and distribution rates, and the rounded figures upon multiplication produce gamma. Furthermore the extent to which parameter values should be rounded should be based upon the degree of precision in the estimate. In respect of the distribution rate, the estimate is 0.95 rounded to the nearest 0.05.

In respect of the utilisation rate, if account is taken of foreign investors, the best estimates come from ABS data on the proportion of Australian equities owned by local investors. The most recent estimate is 0.65 (September 2017) but the parameter sought is the expected value over the next regulatory cycle. If one judged the time-series of these values to be a random walk, the best estimate for the expected value over the next five years would be the latest observation. Alternatively, if one judged this series to be mean reverting, the best estimate would be the current observation adjusted upwards (downwards) if the current observation was unusually low (high). However, in assessing whether the latest observation is unusual, it is necessary to select a historical period and the optimal choice is not apparent. Fortuitously, this does not matter because the averages over the last five and ten years are both 0.65 and this matches the current observation. A further issue is definitional. The above figures are determined by including only households, superannuation funds and foreigners in the calculation as discussed above. The AER obtains slightly lower values by including government entities in the denominator but not the numerator (0.64 for September 2017). This is not material. A further issue concerns possible errors in the ABS data, as discussed in section 4 and emanating from Frontier (2018, sections 5.2

and 5.4), but these errors could be in either direction. This suggests an estimate of 0.65 (to the nearest 0.05). The alternative data source (ATO dividend data on all firms) generates an estimate of 0.61, which is not materially different.

The last question is the value for gamma that ensures regulated firms receive an allowed rate of return that is at least sufficient to meet the ARORO. In respect of the distribution rate, this is 0.95 as discussed above. In respect of the utilisation rate, I favour a value of 1 consistent with the Officer model assuming complete segmentation of national equity markets. If foreign investors are to be recognised, as the AER prefers, the best estimate is 0.65 as discussed above. Coupled with the estimate of 0.95 for the distribution rate, the resulting estimate of gamma is 0.6175.

7. Conclusions

This report has reviewed recent evidence relating to the estimation of gamma, from the Independent Panel, submissions in response to the AER's Draft Rate of Return Guidelines, two new notes from the ATO, and Frontier's submission to the ERAWA. In addition, responses to a set of questions posed by the AER are offered. My response to these questions encapsulates the principal issues, which are as follows.

The first of these questions is the impact of foreign operations on the estimated distribution rate for imputation credits. Using the top 50 ASX firms, the distribution rate is estimated at 0.89. This estimate includes the effect of foreign operations, which reduce tax payments to the ATO and therefore might be expected to increase the distribution rate. However, foreign operations may also reduce the firm's dividends, and this would exert a downward effect on the distribution rate. So the issue must be empirically assessed. This is done by estimating the proportion of each firm's tax payments to foreign countries, and then regressing the distribution rate on this estimate of the foreign tax proportion; the resulting estimate of the distribution rate for a firm with no foreign operations is 0.96 with a standard error of 0.05.

The second of these questions is whether an estimate for gamma based on the ATO data for all equity is appropriate. The ATO data is highly unsuitable for estimating gamma directly because it covers all firms, which are unsuitable for estimating the distribution rate of the BEE. Alternative data sources are free of both problems, and therefore the ATO data should not be used.

The third question is whether the distribution rate and the utilisation rate should be estimated from the same group of investors. The utilisation rate is a market-wide parameter and therefore the natural choice of data to estimate it is market-wide data. By contrast, the distribution rate is a firm-specific parameter and therefore the natural choice of data to estimate it is firm-specific data. However, doing so is precluded by the likelihood that the regulated firm in question could manipulate (raise) its price or revenue cap. Furthermore the use of industry data is subject to the problem that the set of firms is very small (three). This points to using a larger set of firms.

The fourth question is whether the distribution rate should be estimated from the financial statements of the top 50 companies, and the utilisation rate from ABS data for all equity. In respect of the distribution rate, this should be estimated from financial statement data because the only alternative data (from the ATO) only provides aggregate data on all firms (some of which are very unsuitable), as discussed above. In respect of which companies should be used, these should be listed firms because all regulated businesses in Australia are listed or owned by listed entities (local or foreign) and the distribution rates for unlisted firms are much lower. Principal weight should be placed on a large set of firms, for reasons given in the previous paragraph, and the natural choice is firms selected on the basis of market cap. In respect of the utilisation rate U, this should be defined in accordance with a rigorous derivation of the Officer model that the AER uses; this is a weighted average over the utilization rates of all investors in the Australian market, the Officer model assumes that national equity markets are fully segregated, which implies that the only investors in the model would be local investors, virtually all of whom can fully use the credits, and therefore U should be 1. However, since the AER prefers to recognize the existence of foreign investors, the natural course of action would be to define U as a weighted average over the utilization rates of all investors in the Australian market, both foreign and local investors, and this implies that U is equal to the proportion of Australian equities owned by local investors. Accordingly, one should use ABS information to estimate this proportion. Furthermore, since some regulated businesses are unlisted (in Australia), the CAPM should be interpreted as applying to all Australian equity rather than just listed equity, and therefore ABS data on all Australian equity should be used.

The fifth question is whether the estimate of the distribution rate (from whichever companies are used) should be adjusted to remove the effect of foreign income. The purpose of the exercise is to estimate the distribution rate for the BEE, which by definition has no foreign income. Furthermore, foreign income may affect the result. So, the effect of foreign income should be removed. The principal analysis involves regressing the distribution rate on the foreign operations proportion, which yields an estimate of the distribution rate for a firm with no foreign operations of 0.96 with a standard error of 0.05._A secondary approach has been to examine the three Australian firms with substantial regulated activities; all three have nil or minimal foreign operations and an aggregate distribution rate of 1. The latter warrants much less weight than the former, due to the small sample size, and this suggests an overall figure of 0.95 rounded to the nearest 0.05.

The sixth question is whether it is appropriate to round the distribution rate, utilisation rate or gamma and, if yes, to what degree. Within the Officer model, gamma appears in the cash flows whilst the utilisation rate appears within the MRP, which suggests that rounding be applied to both gamma and the utilisation rate. However, gamma is merely the product of the utilisation and distribution rates and these two components are individually estimated rather than gamma per se. So, rounding should occur for both the utilisation and distribution rates, and the rounded figures upon multiplication produce gamma. Furthermore the extent to which parameter values should be rounded should be based upon the degree of precision in the estimate. In respect of the distribution rate, an appropriate estimate is 0.95 rounded to the nearest 0.05. In respect of the utilisation rate, an appropriate estimate is 1 as discussed above. If account is taken of foreign investors, the best estimates come from ABS data on the proportion of Australian equities owned by local investors. Since the parameter sought is the expected value over the next regulatory cycle, there is some uncertainty arising from how much historical data to use. There are also uncertainties arising from the definition and from data quality. Taking account of all this, an appropriate estimate is 0.65 rounded to the nearest 0.05.

The last question is the value for gamma that ensures regulated firms receive an allowed rate of return that is at least sufficient to meet the ARORO. In respect of the distribution rate, this is 0.95 as discussed above. In respect of the utilisation rate, I favour a value of 1 consistent with the Officer model assuming complete segmentation of national equity markets. If foreign investors are to be recognised, as the AER prefers, the best estimate is 0.65 as discussed above. Coupled with the estimate of 0.95 for the distribution rate, the estimate of gamma is 0.6175.

APPENDIX 1: FOREIGN OPERATIONS DATA

Company	2017	2016	2010	2009	Average
CBA	0.17 P	0.17 P	0.14 R	0.17 R	0.16
BHP	0.47 A	0.50 A	0.39 A	0.43 A	0.45
Westpac	0.14 R	0.13 R	0.10 R	0.15 R	0.13
ANZ	0.33 P	0.35 P	0.29 R	0.32 R	0.32
NAB	0.17 P	0.16 P	0.26 R	0.31 R	0.23
Telstra	0.07 A	0.08 A	0.11 A	0.12 A	0.10
Woolworths	0.11 R	0.11 R	0.09 R	0.09 R	0.10
Wesfarmers	0.06 R	0.04 R	0.02 R	0.02 R	0.04
CSL	0.90 R	0.91 R	0.86 R	0.87 R	0.89
Woodside	0.09 A	0.08 A	0.03 A	0.04 A	0.06
Rio Tinto	0.54 A	0.55 A	0.56 A	0.56 A	0.55
Macquarie	0.60 R	0.59 R	0.45 R	0.45 R	0.52
Origin	0 A	0.03 A	0.27 A	0.30 A	0.15
Suncorp	0.08 P	0.20 P	0.09 P	0.11 P	0.12
QBE Insurance	0.71 P	0.59 P	0.71 P	0.71 P	0.68
Brambles	0.92 R	0.93 R	0.88 R	0.90 R	0.91
Santos	0.31 A	0.31 A	0.18 A	0.13 A	0.23
AMP	0.12 P	0.24 P	0.08 P	0.07 P	0.13
Amcor	0.96 R	0.96 R	NA	NA	0.96
Transurban	0.07 P	0.06 P	0 P	0 P	0.03
Scentre	0.05 P	0.03 P			0.06
Aristocrat Leisure	0.84 P	0.83 P	0.89 P	0.78 P	0.84
Insurance Aus	0.11 P	0.13 P	0.22 R	0.17 P	0.16
South 32	0.41 A	0.41 A			0.41
Goodman	NA	NA			
Newcrest	0.61 A	0.63 A	0.24 A	0.22 A	0.42
Sydney Airport	0 R				0

Cimic	NA	NA			
AGL	0	0	0	0	0
Fortescue	0	0			0
Treasury Wine	NA	NA			
ASX	0	0	0	0	0
Cochlear	0.88 P	0.88 P	0.91 P	0.91 P	0.91
Lendlease	0.40 R	0.43 R	0.30 A	0.64 A	0.45
APA	0	0	0	0	0
REA	0.06 R	0.04 R	0.08 R	0.11 R	0.07
Qantas	0	0	0	0	0
Ramsay Heathcare	NA	NA			
Sonic Healthcare	0.57 R	0.58 R	NA	NA	0.57
Dexus	0	0			0
Stockland	0	0	NA	NA	0
Computershare	0.88 R	0.87 R	0.83 P	0.86 P	0.86
Bluescope	0.60 P	0.89 P	0.71 P	0.62 R	0.70
Tabcorp	0	0	0	0	0
Crown Resorts	0.05 P	0.06 P	0	0	0.03
Aurizon	0	0			0
Caltex Australia	0	0	0	0	0
Medibank	0	0			0

For the 50 companies examined in Lally (2018c, Table 1 and Table 2), but excluding Vicinity and GPT (for which data on the distribution of credits was not obtainable), this table shows the proportion of operations that are foreign, based on profits (P), revenues (R) or non-current assets (A). If the proportion is recorded as zero, it will have been derived from more general comments in the Annual Report (usually the comment that all of the firm's operations are in Australia). The acronym NA indicates that information was lacking on this matter (usually because Australian operations were pooled with those from a wider geographic area). If no data is recorded above for the firm for 2010 and 2009, the distribution rate data will have been obtained from after that point (see Lally, 2018c, Appendix).

APPENDIX 2: WEIGHTED MEDIAN DISTRIBUTION RATE

This Appendix determines the weighted median distribution rate for imputation credits amongst the 26 firms with foreign operations shares that do not exceed 20%. These 26 firms are a subset of those shown in Appendix 1. The company tax payments of these 26 firms are shown in Lally (2018c, Table 1 and Table 2), and add to $138,741m. So, the median is reached with aggregate tax payments of $69,370m. The distribution rates of these 26 firms are also shown in Lally (2018c, Table 1 and Table 2). Starting with the firm with the highest rate (Scentre, 1.33), the firms are ranked by distribution rate and the tax payments aggregated until $69,370m is reached. As shown below, this occurs with Westpac, which has a distribution rate of 0.96. Accordingly, this is the weighted median distribution rate for these 26 firms.

Firm	Distribution Rate	Tax ($m)	Cumulative Tax ($m)
Scentre	1.33	98	98
Qantas	1.11	1,581	1,679
Ins Australia	1.10	3,416	5,095
Aurizon	1.01	421	5,516
Telstra	1.00	25,669	31,185
Origin	1.00	1,384	32,569
CBA	0.98	30,152	62,721
Westpac	0.96	26,478	89,199

APPENDIX 3: WEIGHTED LEAST SQUARES REGRESSION

Weighted least squares regression chooses the parameters $\hat{a}$ and $\hat{b}$ in a linear regression model to minimise the following sum

$$\sum_{i=1}^{N} w_i(Y_i - \hat{a} - \hat{b}X_i)^2$$

Defining $\bar{Y} = \sum w_i Y_i$ and $\bar{X} = \sum w_i X_i$, the estimate for the slope coefficient is as follows:[6]

$$\hat{b} = \frac{\sum w_i(Y_i - \bar{Y})(X_i - \bar{X})}{\sum w_i(X_i - \bar{X})^2}$$

and therefore the estimate for the intercept is as follows:

$$\hat{a} = \bar{Y} - \hat{b}\bar{X}$$

Also, defining σ_u^2 as the variance of the residuals around the regression line:

$$Var(\hat{a}) = \sigma_u^2\left[\sum w_i^2 + \bar{X}^2\left(\frac{\sum w_i^2(X_i - \overline{X})^2}{\left[\sum w_i(X_i - \overline{X})^2\right]^2}\right) - 2\bar{X}\left(\frac{\sum w_i^2(X_i - \bar{X})}{\sum w_i(X_i - \bar{X})^2}\right)\right]$$

Also, an unbiased estimator of σ_u^2 is

$$\widehat{\sigma_u^2} = \frac{\sum w_i(Y_i - \hat{a} - \hat{b}X_i)^2}{\left[1 - \sum w_i^2 - \frac{\sum w_i^2(X_i - \bar{X})^2}{\sum w_i(X_i - \bar{X})^2}\right]}$$

In the current case, with X_i being the foreign operations proportion for firm i, Y_i the distribution rate for firm i, and w_i the tax payments of firm i as a proportion of the aggregate tax payments of all $N = 44$ firms, the estimated slope coefficient is $\hat{b}$ = -0.30 and therefore the estimated intercept

[6] The following formulas are presented in https://en.wikipedia.org/wiki/Weighted_least_squares.

is $\hat{a}$ = 0.96. In addition, σ_u^2 is estimated at 0.017, and therefore the estimate for Var($\hat{a}$) is 0.0031, and hence the estimate for the standard error is 0.056.

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