Comments on

MEASUREMENT ERROR AND REGULATED FIRMS' ALLOWED RATES OF RETURN

13 September 2010

Martin Lally
Associate Professor
School of Economics and Finance
Victoria University of Wellington

1. Introduction

This paper seeks to review the analysis in Guthrie (2010) in relation to three issues: Guthrie's proposed standard deviation for the TAMRP, Guthrie's critique of Lally's (2008) estimate of the standard deviation for the TAMRP, and Guthrie's proposal to allow for a standard deviation on the risk free rate.

2. The Standard Deviation of the TAMRP

Guthrie (2010, section 4.3) recommends an estimate of 3.1% for the standard deviation of the TAMRP, on the following basis: he notes the standard errors of the Ibbotson-type estimates of the market risk premium for 17 markets (drawn from Dimson et al, 2006), expresses each of these as a proportion of the associated Ibbotson-type estimate, determines the 75th percentile of this set of 17 numbers (0.45), recommends that this 75th percentile be adopted "in view of the current uncertainty in financial markets", and then applies this 75th percentile (0.45) to the Commission's (2010) point estimate for the long-run TAMRP (7.0%) to yield the figure of 3.1%, which is his recommended estimate for the standard deviation of the TAMRP. My comments on this approach are as follows.

Firstly, Guthrie offers no explanation for why the current uncertainty in financial markets should induce the selection of the 75th percentile or in fact any percentile above the 50th. Furthermore, the cross-sectional variation in his set of figures is partly due to estimation error and partly to cross-sectional variation in the true values; neither phenomena is related to *current* uncertainty in financial markets and therefore cannot serve as a basis for raising the standard deviation of the TAMRP. Thus, Guthrie ought to have used the 50th percentile of his cross-sectional distribution (0.34), leading to an estimate for the standard deviation of the TAMRP of 2.4% rather than 3.1%.

Secondly, Guthrie applies a ratio based upon estimates of the market risk premium (MRP) to the TAMRP, and the latter is elevated relative to the TAMRP purely due to differences in definition. So, Guthrie ought to have applied the 50th percentile (0.34) to the MRP estimate corresponding to that of the TAMRP. The TAMRP is related to the MRP as follows

$$TAMRP = MRP + R_f T_I \qquad (1)$$

Using R_f = .05 and T_I = .30, a TAMRP of .07 corresponds to an MRP of .055, and therefore Guthrie ought to have estimated the standard deviation of the TAMRP at (0.34)5.5% = 1.87%.

Thirdly, Guthrie's process of dividing the standard error for each market by its Ibbotson-type point estimate of the MRP, followed by application of this ratio to the MRP estimate for New Zealand, is not fundamentally different to simply selecting the cross-country median value for the standard error of each market, and the outcome from this simpler approach would have been 1.96% (Guthrie, 2010, Table 2). However, once expressed in this way, it is now apparent that Guthrie's approach presumes that the MRP for New Zealand is estimated by selecting an Ibbotson-type point estimate from *one* market (such as the US), and then undertaking the conversion shown in equation (1) above. However, the Commission's estimate for the TAMRP was arrived at by averaging across a number of different estimates, and only one of these corresponds to the process just described (being the Ibbotson-type estimate of the MRP for the US, converted to the TAMRP in accordance with equation (1)). The effect of using multiple estimates, which are not perfectly correlated, will be to reduce the standard deviation on the pooled estimate. Thus, a sensible estimate of this standard deviation would be below the figure of 1.87% described above.

In summary, Guthrie's approach contains two implementation errors that would reduce his estimate of the standard deviation of the TAMRP from 3.1% to 1.87%. In addition, Guthrie's approach presumes incorrectly that the TAMRP is estimated from an Ibbotson-type estimate for *one* foreign market, and allowance for this erroneous presumption would give rise to an even lower figure than 1.87%. The extent of the reduction can only be determined by considering the standard deviations of the other estimators for the TAMRP, and their correlations, in the fashion shown in Lally (2008).

3. Alleged Errors in the Analysis of Lally

Guthrie (2010, Appendix C) argues that the estimate of 1.5% for the standard deviation of the TAMRP in Lally (2008) is subject to a number of errors or questionable assumptions. The most significant of these concerns, in terms of the potential to raise the estimated standard deviation of the TAMRP, relates to Lally's (2008, Appendix 2) claim that the Cornell estimators are uncorrelated with both the Ibbotson and Siegel estimators. I therefore consider this point first, followed by another issue that is given considerable attention by Guthrie, and then the remaining points.

3.1 Correlation Between Cornell and Ibbotson Estimators

Lally (2008, Appendix 2) argues that the Cornell estimators are uncorrelated with both the Ibbotson and Siegel estimators. This reduces 12 of the 28 correlations in Lally (2008, Table 9) to zero and therefore has the potential to significantly affect the estimate for the standard deviation of the TAMRP. Guthrie (2010, para 101) argues that it would be possible to use time-series data on these estimators to test this claim. However, I am not aware of a long time series of Cornell-type estimates and therefore the suggestion is infeasible.

Guthrie (2010, para 102) also claims that the forecast data in the Cornell estimator will be influenced by historical data and that this will induce correlation between the Cornell estimators and both the Ibbotson and Siegel estimators. However, even if this were true, any dependence that a Cornell-type estimate might have on historical data would involve only recent events whereas Ibbotson-type estimators are not significantly affected by events within a short period of time; any correlation would the be low. Furthermore, historical events do not induce estimation errors in Cornell-type estimators and therefore the concern raised by Guthrie would be absent even if the Ibbotson estimator were materially affected by recent events. To illustrate this point, suppose that the value of the market portfolio at time 0 arises from dividends in the preceding year of $1, an expected growth rate in dividends (*g*) of 5% p.a., and an equilibrium expected rate of return on the market portfolio (*k*) of 10%. Following the Gordon constant growth model, the value of the market portfolio at time 0 would then be as follows:

$$V_0 = \frac{\$1(1.05)}{.10 - .05} = \$21$$

Over the following year, suppose that the actual growth rate in dividends is 6%, leading investors to revise their estimate of *g* to this higher level, but *k* remains 10%. The value of the market portfolio at the end of that year (time 1) would then be as follows:

$$V_1 = \frac{\$1.06(1.06)}{.10 - .06} = \$28.09$$

So, the actual return on the market portfolio over the year would be 39% (comprising a capital gain of 34% and a dividend yield of 5%) compared to an expected return of 10%. So, any Ibbotson-type estimator that used the market return for this year would have experienced a positive shock. However, the Cornell-type estimate of the market risk premium would be correct at both times 0 and 1 so long as the party generating the Cornell estimates (the "analyst") used an estimate for *g* at each point in time that accorded with the market's contemporaneous estimate. Similarly, the Cornell-type estimate of the market risk premium would be too high (low) if the analyst's estimate of *g* were higher (lower) than the market's estimate, leading to positive (negative) correlation between the Cornell and Ibbotson estimators if the analyst systematically acted in this way. Thus, when dividends are larger than expected, positive correlation between the Cornell and Ibbotson estimators requires that analysts revise their estimates of *g* upwards even more so than the market does. Similarly, when dividends are smaller than expected, positive correlation between the Cornell and Ibbotson estimators requires that analysts revise their estimates of *g* downwards even more than the market does. These scenarios do not seem to be likely. In fact, if markets are informationally inefficient in the sense that the market's estimates of *g* are too extreme, and analysts' estimates are less extreme, then the Cornell and Ibbotson estimators would be negatively correlated. Thus, the Cornell and Ibbotson estimators are likely to be uncorrelated or negatively correlated rather than positively correlated.

3.2 Correlation Between Ibbotson and Siegel Estimators

Lally (2008, Appendix 2) estimates the correlation between Ibbotson and Siegel estimators for the same market through the use of cross-sectional data. Guthrie (2010, Appendix C.3) argues that the use of cross-sectional data may induce a biased estimate of the correlation at the individual market level. In support of this claim, he presents a simulation in which the estimated correlation coefficient does not converge on the true value as the sample size becomes very large. Guthrie's point that the use of cross-sectional data may lead to bias is correct. However the same criticism could have been raised over any use of cross-sectional data to estimate a relationship at the individual level, and any use of time-series data to estimate a relationship at the present time. Despite this, the use of such data in these ways is standard practice in Finance (and applied statistics more generally). For example, the use of time series data to estimate a firm's current beta is likely to be biased due to changes over time in the true beta, and the use of time series data to estimate the market risk premium is likely to be biased due to changes over time in the true market risk premium. Perfection is not attainable in this world.

The important issue here is whether the bias might be so severe as to materially affect (and in particular to lower) the estimated standard deviation for the TAMRP. To assess this question, I raise the estimated correlation between the Ibbotson and Siegel estimators from 0.80 to its maximum possible value of 1.0 and re-estimate the standard deviation of the TAMRP with the higher correlation. The result is to raise the estimated standard deviation of the TAMRP from .0135 to .0137. This is not material.

3.3 Other Issues

Guthrie (2010, para 100) argues that Lally's (2008, Appendix 2) omission of the Merton estimators (from the analysis leading to an estimate of the standard deviation of the TAMRP) implicitly assumes that the standard deviations of the omitted estimators and their correlations with other estimators are comparable with the retained estimators, and no evidence is offered in support of this implicit assumption. The claim regarding the implicit assumptions is not correct. It is sufficient that the omission does not materially alter the result. Furthermore, as noted in Lally (2008, Appendix 2), the Merton estimator is omitted partly because of concerns about its reliability. Nevertheless, even if it had been included, the impact on the estimated standard deviation of the TAMRP would not seem to be substantial. To illustrate this, suppose the Merton estimator has a standard deviation 50% larger than that of the included estimator with the largest standard deviation, which is the NZ Ibbotson estimator (implying a standard deviation of .041 for the Merton estimator: see Lally, 2008, Table 1). In addition, like the Ibbotson estimator, the Merton estimator draws exclusively upon historical data and therefore will not be correlated with the Cornell estimators. Also, since the NZ Siegel and Ibbotson estimators have an estimated correlation of .80 and the degree of similarity between the NZ Merton and Ibbotson estimators does not seem as strong as that between the NZ Siegel and Ibbotson estimators, suppose that the correlation between the NZ Merton and Ibbotson estimators is .70. Finally, suppose that the correlation between the NZ Merton estimator and any other estimator (X) is 70% of the correlation between the NZ Ibbotson estimator and X. With these parameters, inclusion of the Merton estimator raises the estimated standard deviation of the TAMRP from .0135 to .0150. This is not substantial.

Guthrie (2010, para 100) also argues that Lally's (2008, Appendix 2) omission of the survey-based estimators (from the analysis leading to an estimate of the standard deviation of the TAMRP) implicitly assumes that the standard deviations of the omitted estimators and their correlations with other estimators are comparable with the retained estimators, and no evidence is offered in support of this implicit assumption. However, again, the claim regarding the implicit assumption is not correct; it is sufficient that the omission does not materially alter the result. Guthrie also argues that survey-based estimators are likely to be especially strongly correlated with other estimators and he refers in particular to correlations with Cornell-type estimators. It is very likely that survey-based estimators are highly positively correlated with Cornell-type estimators. However, since Cornell estimators are likely to have low (even negative) correlations with Ibbotson and Siegel-type estimators (as discussed in section 3.1), survey-based estimators are likely to have the same feature and these Ibbotson and Siegel estimators are twice as numerous as the Cornell-type estimators in Lally's analysis. So, even if it were possible to do so, the effect of including survey-based estimators in Lally's analysis is likely to reduce the estimated standard deviation of the TAMRP; Lally's estimate would then be too high. In view of the lack of a long time series of survey-based estimates, it is difficult to empirically test the proposition that they have low or negative correlation with Ibbotson and Siegel-type estimators. However, the available evidence points to strong negative correlation. The longest survey-based series appears to be that of Graham and Harvey (2010, Table 1), who provide quarterly results from June 2000 till June 2010 from US CFOs. The two highest average values are in September 2000 and February 2009 (shortly after dramatic US market falls associated with the “tech bubble” and the “housing bubble” respectively) whilst the two lowest figures are in November 2005 and March 2006 (during a prolonged period of high US market returns).

Guthrie (2010, para 102) notes that Lally (2008, Appendix 2) assumes that the correlation between the Ibbotson and Siegel estimators is the same for any market, notes that no empirical evidence is offered in support of this claim, and implies that the assumption is unjustified. However, given that the assumed common value for this correlation has been estimated using data from a variety of countries, any variation from the assumption made would involve higher values for some countries than this common estimate and lower values for others. The effect of all this would be even less significant than changing the estimate of the common value and, as discussed in the previous section, changing the common value exerts only a minor effect on the estimated standard deviation of the TAMRP.

Guthrie (2010, para 103.1) notes that Lally (2008, Appendix 2) assumes that the correlation between the Siegel estimators for NZ and the US is equal to that for the Ibbotson estimators of the two markets, argues that the correlation between the Siegel estimators should be higher than that between the Ibbotson estimators, and therefore implies that Lally’s estimate for the standard deviation of the TAMRP should be raised. Guthrie’s claim concerning the relative values for these correlations seems correct. However, the Siegel estimator for any market is the average real market return net of an estimate for the expected long-term real risk free rate and Lally’s estimate for the latter is common to all markets. So, the correlation between the Siegel estimators for NZ and the US reduces to the correlation between the average real market returns in the two markets, and this correlation is used as the estimate (Lally, 2008, Appendix 2). Thus the correlation between the Siegel estimators for NZ and the US has been properly estimated (at 0.40) and therefore the estimated correlation between the Ibbotson estimators for NZ and the US should be less than this. However, Lally applies the same correlation of 0.40 to the Ibbotson estimators for NZ and the US. Thus, Lally has overestimated this correlation coefficient and allowance for this error would exert a downward rather than an upward effect on the estimated standard deviation of the TAMRP. The same point applies to the issue raised in Guthrie (2010, para 104).

Guthrie (2010, para 103.2) notes that Lally (2008, Appendix 2) assumes that the correlation between the Cornell estimators for NZ and the US is equal to that for the Ibbotson estimators of the two markets, and notes that Lally provides no evidence in support of this assumption. These observations are correct. However the rationale for estimating the correlation between the Cornell estimators in this way is the inability to objectively estimate it. Furthermore, this correlation contributes only one term to the covariance matrix in Lally (2008, Appendix 2). So, even substantial variations in the estimate would not materially affect the result. For example, if this estimated correlation between the Cornell estimators is doubled from 0.40 to 0.80, the estimated standard deviation of the TAMRP rises from .0135 to .0137. This is not material.

Guthrie (2010, para 105) notes that Lally (2008, Appendix 2) sets the standard deviations of the Cornell estimators equal to the average of the standard deviations for the Ibbotson and Siegel estimators, and that Lally presents no empirical evidence in support of this. These observations are correct. However the rationale for estimating the standard deviation of the Cornell estimators in this way is the inability to objectively estimate them. Furthermore these standard deviations for the Cornell estimators contribute only two terms to the covariance matrix in Lally (2008, Appendix 2). So, even substantial variations in the estimates would not materially affect the result. For example, if the estimated standard deviations for the Cornell estimators are increased by 50%, from .021 to .031, the estimated standard deviation of the TAMRP rises from .0135 to .0144. This is not material.

Guthrie (2010, para 108) notes that Lally (2008, Appendix 2) estimates the correlation between the Ibbotson estimators for NZ and the US by averaging over the cross-country correlations reported in Dimson et al (2002), and that Lally presents no evidence in support of the implicit belief that such an approach would provide a good estimate of the correlation. These observations are correct. However it is standard practice in Finance to estimate parameters by cross-sectional averaging because estimates for an individual entity or pair of entities are very imprecise. For example, the asset beta of a firm is generally estimated by averaging over estimates for many similar firms and Guthrie (2010, section 4.1) clearly has no objection to this process.

Guthrie (2010, paras 109 and 111) notes that Lally (2008, Appendix 2) estimates the standard deviation for the Siegel estimator using the estimated standard deviation for the Ibbotson estimator augmented by assumptions about the standard deviation of the expected long-run real risk free rate and its correlation with the Ibbotson estimator, and that Lally presents no evidence in support of these assumptions. These observations are correct. However, even substantial variations in the assumptions would not materially affect the result. For example, if this estimated standard deviation for the expected long-run real risk free rate were doubled, from .01 to .02, the standard deviation of the Siegel estimator for NZ would rise from only .030 to .034, that for the US from .022 to .026, and that for the "world" by a similar amount. The estimated standard deviation of the TAMRP would then rise from .0135 to .0145. This is not material.

Guthrie (2010, para 110) suggests that NZ is so different from the other markets analysed in Dimson et al (2002), in both size and geographical isolation, that its market risk premium cannot be treated as being drawn from the same distribution as these other markets' market risk premiums. However, the Ibbotson-type estimate of the NZ market risk premium provided in Dimson et al (2010) places it in the middle of the cross-country distribution and this undercuts Guthrie's claim.

Guthrie (2010, para 112) notes that Lally (2008, Appendix 2) estimates the correlation between the Ibbotson estimators for the US and a portfolio of 16 other markets from the average of the country-world correlations reported in Dimson et al (2002, Table 8-3), which yields 0.60. Guthrie suggests instead that this correlation be estimated from that between the US and the "world", from the same source, which yields 0.85. However, since the US is a substantial fraction of the "world" (which includes the US), the estimate suggested by Guthrie would be significantly biased up. The alternative approach used by Lally would be subject to less upward bias, because all but one of the 16 country-world correlations involved here constitute a small proportion of the "world" portfolio, and is therefore preferred.

3.4 Summary

This analysis of Guthrie's critique of Lally's estimate of the standard deviation of the TAMRP suggests that Guthrie's points are either invalid or are immaterial in the cases in which they might lead to underestimation. However, the latter conclusion applies to individual points rather than their aggregate. So, I simultaneously adjust all of the points for which immateriality has been suggested. The result is to raise the estimated standard deviation of the TAMRP from .0135 to .0174. This effect is not very large, it would require that *all* of these adjustments proposed by Guthrie are justified (which is doubtful), and ignores the contrary effect of other points. Furthermore almost half of this upward adjustment comes from the inclusion of the Merton estimator; however, its omission from this process for estimating the standard deviation of the TAMRP is appropriate if it has been omitted from the estimate for the TAMRP, and the latter can and has been justified on the grounds of its unreliability. All of this suggests that the estimate of .015 for the standard deviation of the TAMRP in Lally (2008, Appendix 2) does not require alteration.

4. The Standard Deviation of the Risk Free Rate

Guthrie (2010, section 4.4) argues that the appropriate risk free rate for determining the firm's cost of capital is the rate at some point during the regulatory cycle (when investment decisions are made) rather than the rate at the beginning of the cycle, and therefore use of the rate at the beginning of the cycle by the Commission would lead to an error in the rate allowed by the Commission. Guthrie estimates the standard deviation of these errors at 1.06% and uses this standard deviation to augment the estimate of the standard deviation of the WACC estimate.

To analyse this issue, suppose the regulatory cycle is five years and all investment has a life of 50 years. We start with the risk free rate, which is reset at the beginning of each five yearly cycle and applied to all new or replacement investment during the cycle. So, if the firm is contemplating new investment during the regulatory cycle and the prevailing risk free rate at this time is greater than the rate at the beginning of the cycle, the firm will be discouraged from undertaking this investment at this time. However, the cost to the firm from proceeding will be limited to the under recovery of the risk free rate for the remainder of the cycle (2.5 years on average) because the rate will be correctly reset at the end of the cycle and will continue to be correctly reset every five years thereafter for the remaining life of the investment. Thus, the problem of under compensation will be limited to 2.5 years (on average) in the total 50 year life of the investment, i.e., 5% of the life of the investment. This is a sufficiently small percentage that the firm might not be concerned, particularly since under compensation at some points will be offset over time by over compensation in other cases. Furthermore, even if the firm is discouraged from investing at this time, the firm could defer the investment until the end of the cycle (in 2.5 years on average) when the risk free rate offered by the Commission would be correctly set. The adverse effects of a small delay in the timing of the investment may not be large. Thus, the firm may not be discouraged from investing and, even in the contrary case, may simply delay the investment for 2.5 years on average.

We turn now to estimation errors in respect of other parameters, of which the most significant are the market risk premium and the equity beta. This is a much more significant issue for two reasons. Firstly, even if the new investment occurs at the beginning of the cycle, the Commission's estimates of these other parameters may be below their true values and therefore the firm will be discouraged from investing at this time; such a problem cannot arise for the risk free rate. Secondly, underestimation of these additional parameters will not necessarily be corrected at the end of the current cycle or even at the end of the following cycles; again, such a problem cannot arise in respect of the risk free rate. Thus, the possible disincentive to invest arising from possible estimation errors is much more significant in respect of parameters other than the risk free rate.

In summary, the possible disincentive to invest arising from changes in the risk free rate during a regulatory cycle is a minor issue relative to possible estimation errors in respect of other parameters. However, Guthrie treats these two issues in the same way and therefore overestimates the significance of intra-cycle changes in the risk free rate. Furthermore, these intra-cycle changes in the risk free rate are so much less significant than estimation errors in respect of other parameters that they can be ignored.

4. Conclusions

This paper has reviewed the analysis in Guthrie (2010) in relation to three issues: Guthrie's proposed standard deviation for the TAMRP, Guthrie's critique of Lally's (2008) analysis relating to the standard deviation on the TAMRP, and Guthrie's proposal to allow for a standard deviation on the risk free rate. The conclusions are as follows.

Firstly, in relation to Guthrie's estimate of 3.1% for the standard deviation of the TAMRP, his approach contains two implementation errors that would reduce his estimate of the standard deviation of the TAMRP to 1.87%. In addition, Guthrie's approach presumes incorrectly that the TAMRP is estimated from an Ibbotson-type estimate for one foreign market and recognition of this erroneous presumption would give rise to an even lower figure than 1.87%. The extent of the reduction can only be determined by considering the standard deviations of the other estimators for the TAMRP and their correlations, in the fashion shown in Lally (2008).

Secondly, in relation to the analysis in Lally (2008, Appendix 2) and Guthrie's claim that the parameter estimates that are invoked by Lally are too low, the analysis presented here shows that Guthrie's claims are invalid or are immaterial in the cases in which they are or might be valid.

Thirdly, in relation to Guthrie's proposed process for recognising intra-cycle variations in the risk free rate, this process significantly overstates the issue. In addition, the issue is so much less significant than that of estimation errors in respect of other parameters that it can reasonably be ignored.

REFERENCES

Commerce Commission, 2010, *Input Methodologies (EDS) Draft Reasons Paper*.

Dimson, E., Marsh, P. and Staunton, M., 2002, *Triumph of the Optimists*, Princeton University Press.

__________________________________ 2006, *The Worldwide Equity Premium: A Smaller Puzzle*, Technical Report, London Business School.

__________________________________ 2010, *Credit Suisse Global Investment Returns Sourcebook 2010*, Credit Suisse.

Graham, J. and Harvey, C., 2010, "The Equity Premium in 2010", working paper (available at http://ssrn.com/abstract=1654026).

Guthrie, G., 2010, 'Measurement Error and Regulated Firms' Allowed Rates of Return, paper prepared for Transpower NZ Ltd.

Lally, M., 2008, *The Weighted Average Cost of Capital for Gas Pipeline Businesses*, paper prepared for the Commerce Commission (www.comcom.govt.nz).