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Estimating the WACC in a Regulatory Setting*

An assessment of Dr Martin Lally's paper *The Weighted Average Cost of Capital for Electricity Lines Businesses* of 8 September 2005, which the New Zealand Commerce Commission released and posted on its website in September 2005

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In September 2005, the New Zealand Commerce Commission (NZCC) released a document (*The Weighted Average Cost of Capital for Electricity Lines Businesses* by Dr Martin Lally, referred to as LINES hereafter) that estimates a weighted average cost of capital (WACC) for New Zealand electricity lines businesses and proposes a means for detecting future excess earnings. At about the same time, the NZCC also began seeking submissions on another document (*Draft Guidelines: The Commerce Commission's Approach to Estimating the Cost of Capital*, 2005) that addresses the topic of an appropriate framework for the WACC in the New Zealand regulatory environment. Although no specific author is attributed to the latter, its material content is drawn from LINES.

In this paper, we undertake a detailed analysis of the approach followed in LINES. We do so from the perspective of a referee who has been asked to provide a review of that report in order to assess its suitability for publication in an edited book or journal that adheres to conventional academic standards. Although LINES has not, of course, been submitted for publication or review of this kind, its contents and recommendations should nevertheless meet minimum standards of accuracy, thoroughness and consistency. It is these criteria we use to assess LINES.

Our report is motivated by a simple, but important, concern: although the cost of capital is a critical element of the revenue and price settings that materially determine the social net-benefit of income-control regulation, there are presently no institutional arrangements in New Zealand that allow for reports such as LINES to be thoroughly reviewed and debated. On the basis of our review, we conclude that such institutional arrangements are sorely needed.

Our assessment of LINES comprises two parts. In Section I, we provide an overview of what we consider to be the critical areas of concern in LINES. Section II then discusses specific errors in detail.

I Overview

The two key topics in LINES — estimation of the WACC and measurement of excess earnings — involve a combination of economics and finance. Plugging numbers into the textbook WACC formula is not a complicated exercise, although the uncertainty surrounding the various parameter values means that considerable care and objective standards are required. Derivation of the proper WACC applicable to a given situation is more difficult, and requires deeper digging into finance and economics. In addition, calculation of the regulatory rate of return and the estimation of excess earnings is complex, reflecting the dependence of these parameters on a wider range of behaviour by both the firm and the regulator.

LINES estimates the WACC of a NZ electricity lines business by estimating the values of relevant inputs — including the systematic risk of such firms, the market risk premium, and the risk-free interest rate — and then substituting these into a textbook WACC formula. We therefore begin our discussion of the areas of concern in LINES by describing, in Sections I.A and I.B, some of the flaws in its choice of these inputs. Because these inputs are subject to estimation error, the final WACC-estimate will inevitably deviate from the true value of the WACC. In Section I.C, we therefore describe some of the mistakes made by LINES when it estimates the uncertainty surrounding its overall WACC-estimate.

Having presented its estimate of the WACC, LINES goes on to recommend a method for measuring excess profits. However, as we discuss in Section I.D, the method recommended in LINES does not adequately consider the impact of price regulation on investment incentives.

Finally, Section I.E describes our concerns regarding the analytical approach in LINES and Section I.F offers some concluding remarks.

I.A Inputs: Maturity of the risk-free interest rate

The CAPM is a one-period model, so one needs to be very careful when applying it in a multi-period setting. A key issue with regard to LINES is the maturity of the risk-free interest rate term that appears in the CAPM. LINES advocates applying the CAPM to a period matching the price-setting or regulatory cycle. In principle, this is correct. However, it goes on to advocate using two different maturities of the risk-free interest rate within the same application of the CAPM. That is, using

$$E[r] = (1 - T)r^f + \beta(E[r^m] - (1 - T)r^f),$$

LINES proposes using a shorter maturity for the first appearance of the risk-free interest rate r^f than for its second appearance. Specifically, it proposes using the ten-year rate inside the market risk premium (MRP) term and either the three-year or five-year rate for the first term (for evaluating excess earnings and setting a price cap, respectively). This position is indefensible. (This issue is discussed in points #12, 23, 24, 25, 27, 28, 29, 30 in Section II.)

To see why, suppose this approach were in fact adopted. Then the allowed rate of return on assets with a beta of 1 will generally differ from the expected rate of return on the market as a whole by an amount equal to the difference between the two interest rates. When, as is usually the case, the yield curve is upward sloping, the allowed rate of return will be less than the expected rate of return on the market portfolio. LINES claims to address this issue, but its arguments are confused and ignore the central issue, which is that if the advice in LINES were followed, the NZCC would be implicitly and knowingly saying that market-determined required returns on the market as a whole are too high: *according to its own calculations*, the NZCC would not allow firms to earn their cost of capital.

Fortunately, there is a simple solution — when calculating the MRP, use the same maturity for the risk-free interest rate everywhere in the CAPM. There is no sensible reason not to adopt

this approach. LINES states that ‘data limitations’ prevent it from following this approach, but it does not explain what these data limitations are. Its argument seems to be that it is impossible to estimate an MRP using a short-term risk-free interest rate. However, at several points LINES itself converts an MRP estimated using a short-term risk-free interest rate to one corresponding to a long-term risk-free interest rate, and there is no reason why the process cannot be reversed (#26). In short, data limitations do not prevent the correct approach from being adopted.

I.B Inputs: Comparison firms

In its attempts to estimate NZ betas from overseas comparison firms, LINES starts with US electric utilities and gas distribution firms,¹ then moves to UK regional electricity companies,² and argues that the most important difference between these two sets of firms is that the former have prices reset annually and the latter have prices reset every five years. It argues for an asset beta of 0.3 for US firms and assesses the impact of five-yearly price reviews as raising the asset beta by 0.2. Finally, it argues that for the purpose of the excess earnings calculation, NZ lines businesses lie somewhere between these two alternatives and it sets the asset beta at 0.4. For price caps, it sets the asset beta at 0.5.

In order for useful asset beta estimates to be obtained, one requirement is that the comparison firms used provide a reasonable comparison for a NZ lines business. Of course, it will be impossible to find firms that provide a perfect comparison, primarily because of variations in regulatory regimes across (and often within) countries. Therefore, a second requirement for accurate asset beta estimates to be obtained is that correct inferences are drawn about the effect of regulation on risk. We assess LINES against these two criteria separately.

Choice of comparison firms. LINES incorrectly characterizes US electric utilities as being “subject to rate of return regulation with annual resetting of prices” (pg 41, ln 4). Its claim completely ignores the diversity of US electric utilities, both in terms of the operations they are engaged in and the regulation they are subject to (#37). For example, the majority of so-called ‘electric utilities’ in the US are diversified firms, doing much more than simply operate regulated electricity businesses.³ Moreover, ongoing deregulation in the US electricity sector means that there is significant diversity amongst even the electricity businesses of different firms — some are vertically integrated; some firms market electricity to customers, while others do not; of those that have energy retailing segments, some are functionally separate from generation and transmission, while others are structurally separated. When combined with the fact that many firms are multi-state operations, and so operate in markets at various stages of the deregulatory process, this means that the sample of US electric utilities used by LINES is quite unrepresentative of a NZ lines business. In addition, the claim that the US firms are “subject to rate of return regulation with annual resetting of prices” ignores the facts that incentive regulation has been adopted in many states and that rate of return regulated firms are not generally subject to annual price reviews. As a consequence of the diversity of US electric utilities, these

¹The calculation of US asset betas contains several mistakes. For example, in constructing asset betas for at least some of the US comparison firms, LINES appears to use the book value of equity to calculate the debt:equity ratio (#39). It also uses the wrong US company tax rate (#41).

²The calculation of UK asset betas in LINES does not consider the implications of using high frequency data to estimate the asset betas of firms with shares that are traded infrequently. This causes a downward bias in beta estimates, which is evident in the estimated asset betas for UK regional electricity companies (#51). It may also be a factor in the estimates of asset betas using NZ equity returns, although we cannot be certain because the frequency of the data used is not reported in LINES (#36).

³More than half the firms have non-electric business segments and more than a third have unregulated business segments (#37).

Table I: Characterizing rate of return and price cap regulation

	Rate of return regulation	Price cap regulation
Form of price restriction	All prices fixed	Price of a basket of goods capped
Frequency of reviews	Variable Next hearing held when either party requests one	Fixed period
Costs to be recovered	Actual costs Cost pass-through often allowed	Costs incurred by hypothetical efficient firm Cost pass-through sometimes allowed

firms provide an inappropriate comparison for NZ lines businesses. For the reasons discussed in #38, US gas distribution firms also provide an inappropriate comparison.

LINES also paints an inadequate picture of the different forms of price regulation, describing rate of return regulation as “price capping with annual resetting of prices so as to cover expected costs” (pg 45, ln 8). This does not characterize rate of return regulation properly. The key differences between rate of return and price cap regulation are summarized in Table I. Rate of return regulation involves the regulator setting *all* of a firm’s prices, typically for an *undetermined* period. Prices are revised after the regulator holds another formal price review, which is usually prompted by the firm requesting price changes.⁴ Prices are generally set so that the firm can expect to recover the *actual* cost of doing business. In contrast, price cap regulation allows the firm considerable freedom to adjust prices between regulatory reviews because price caps typically apply only to the price of a *basket* of the firm’s goods. The price caps are typically imposed for a *fixed* period of time and are reviewed at the end of that period. The parameters describing the price cap are usually set so that the firm can expect to recover only the costs that a *hypothetical efficient firm* would incur. In contrast to the statement quoted at the start of this paragraph, rate of return regulation does not involve price capping and prices are not generally reset annually. Its overly-simplified view of different forms of price regulation leads LINES to attach too much importance to the timing of hearings and too little to other characteristics of regulatory regimes (#32, 34, 47).

LINES also presents an inaccurate view of price cap regulation as faced by the UK firms in its sample (#52). Specifically, it states that UK regional electricity companies were unable to raise their prices within the five year regulatory cycle in response to cost increases. However, these firms operated both distribution and supply businesses and, while both were subject to price caps, the price controls imposed on supply businesses “provided for almost all costs (such as generation costs, and distribution and transmission charges) to be passed directly through to customers” during the period considered by LINES (OFFER, 1998, p. 12). The combination of this cost pass-through provision with the entry protection the supply businesses enjoyed at the time suggests that the distribution business beta, which is the one relevant for NZ lines businesses, would have been at least as high as the asset beta for the vertically-integrated regional electricity companies. Thus, the asset betas of the latter provide a lower bound for those of NZ lines businesses.

⁴Vertically-integrated firms subject to rate of return regulation frequently have so-called ‘fuel-adjustment clauses’, which allow them to pass a proportion of fuel cost shocks onto consumers automatically (that is, without waiting for a full regulatory hearing). Such clauses often mean that electricity or gas is sold to customers at cost, especially when the firm competes with rival energy marketers. In contrast, the ‘base rates’ (the distribution charge component of the customer’s bill), which are the relevant factor when forming a comparison with NZ lines businesses, are set at hearings typically held after firms request rate relief.

The effect of regulation on risk. Mistakes in characterizing rate of return and price cap regulation need not affect final beta estimates if the errors have no implications for systematic risk — if that were the case, LINES might have got the right answer even though the intermediate steps were wrong. Unfortunately, the aspects of price regulation ignored by LINES turn out to have a substantial impact on the systematic risk of regulated firms.

To illustrate, note that the asset beta of a regulated firm depends on how price regulation allocates risk between investors and consumers. Rate of return regulation immunizes investors from shocks to long-term cash flows because prices will be adjusted at future hearings to allow the firm to recover its actual costs — investors bear the consequences of any shocks to operating costs up until the next hearing (since the prices set at the previous hearing did not anticipate these shocks and cannot be changed), while consumers bear the consequences of the impact on post-hearing operating costs (since the prices faced by consumers after the next hearing will reflect the information contained in the operating cost shock). The risk of demand shocks will be allocated in the same way. Under rate of return regulation, therefore, investors only bear the consequences of shocks *until* the next hearing. Thus, if hearings are held more frequently, investors are exposed to less risk and the cost of capital will fall.

In contrast, the use of benchmark costs under incentive regulation means that investors typically bear much more of the risk of shocks to long-term cash flows. For instance, under incentive regulation a permanent negative shock to demand will be reflected in a lower rate base at the next regulatory hearing since it reduces the amount of physical capital required by a hypothetical efficient firm. Similarly, if the regulator uses the replacement cost of physical capital, rather than its historical cost, the firm is exposed to the risk of capital price shocks. However, investors only bear the consequences of shocks to replacement cost *after* the next hearing, when the rate base is recalculated. Thus, if hearings are held more frequently, investors can be exposed to more risk and the cost of capital will rise.

The discussion of the impact of review frequency on risk that is contained in LINES ignores rate base risk and so really only applies to rate of return regulation. LINES therefore concludes that less frequent hearings raise risk, but this result does not necessarily extend beyond rate of return regulated firms (#33, 114). When LINES does subsequently discuss rate base risk, it makes two errors. First, it ignores the possibility that optimization risk may contribute to a firm's overall systematic risk, which can arise due to a systematic component to optimization risk or, as a consequence of investment irreversibility, due to unsystematic optimization risk (#61, 87). Second, LINES incorrectly claims that revaluations do not affect risk since they are offset by depreciation, which is only true in the very unlikely event that the offsetting depreciation occurs within the same regulatory cycle (#60).

Conclusion on comparison firms. The overall result of these errors is that LINES chooses the wrong comparison firms and draws incorrect inferences about the asset beta. When viewed across the range of regulatory characteristics (summarized in Table I), NZ lines businesses look much more like UK regional electricity companies than US electric utilities (although, because they do not enjoy the same cost pass-through provisions, NZ firms probably face more risk than the UK ones). Thus, a thorough assessment of the various regulatory regimes suggests that the UK estimate is the better starting point for estimating a NZ asset beta. The US firms are largely irrelevant (#37, 38, 50, 56, 57). As a result of these errors, the estimate of NZ lines businesses' asset beta contained in LINES is likely to be biased downwards.

I.C Allowance for estimation error

An important output of the WACC calculation is the standard error of the WACC estimate, which measures the extent of estimation error (essentially, the standard deviation of the difference between a parameter estimate and its true value). LINES recommends using a WACC “... from the upper end [of the distribution], because the consequences of setting the WACC too low (in the form of deterring investment) are more severe than the consequences of setting it too high (in the form of imposing excessive prices upon consumers)” (pg 103, ln 6). This requires an accurate estimate of the distribution (rather than just a point estimate of the WACC itself), which in turn requires accurate measurement of the estimation error.

Often there is a direct relationship between the parameter being estimated and the data being used. For example, regressing a firm’s realized equity returns on realized market returns yields an unbiased estimate of the firm’s equity beta (assuming certain technical conditions are met). The parameter estimate will differ from the true parameter value due to sampling error. The magnitude of this sampling error is typically easily obtained from the regression output. Reporting this information is important as it gives the reader an indication of the precision of the parameter estimate. However, LINES rarely presents this information. For example, standard errors are not provided for many of the NZ MRP estimates cited in LINES, and none is provided for the asset betas of the three NZ firms analyzed (#36). Likewise, standard errors are not reported for the estimated asset betas of comparison firms (#40, 42, 43, 44, 45), survey-based MRP estimates (#10), or the long-run interest rate (#7).

The situation is more complicated when there is not a direct relationship between the parameter being estimated and the data being used. Such situations arise when using market returns from foreign markets to estimate the NZ MRP and when using realized equity returns from comparison firms to estimate a single lines business’s asset beta. In the latter case, each firm in the sample is likely to have a different true asset beta due to differences in the firms’ lines of business, regulatory regimes, and so on. There are thus two sources of estimation error if, as in LINES, the average estimated beta is used as an estimate of the asset beta for an individual firm. The first arises from the sampling error in each individual estimate, as each firm’s estimated beta differs from its true value. The second arises from the firm-specific characteristics that mean the firm’s true asset beta differs from the average of the other firms’ true asset betas. Thus, the overall estimation error has two components:

$$\text{estimation error} = \text{sampling error} + \text{intrinsic variation.}$$

Both components need to be considered when estimating a parameter, particularly when using data that are not *directly* related to the parameter being estimated.

When using data that are not directly related to the parameter being estimated — such as market returns data from foreign markets, equity returns data from comparison firms, and leverage levels from comparison firms — LINES does not consider cross-sectional variation and rarely considers sampling error (#40, 42, 43, 44, 45, 112). Often it does not even report point estimates, but just the average of the unreported point estimates. For example, it presents the average estimated asset beta of a sample of US electric and gas utilities, but offers no indication of the dispersion of the point estimates for individual firms. As we explained in Section I.B, this sample of firms is far from homogenous, so the dispersion is likely to be substantial (#37, 38). Indeed, this heterogeneity is such that the US electric utilities offer little useful information about the asset beta of a NZ electricity lines business, a view that is confirmed when one learns just how widely their individual estimated asset betas are dispersed (#58, 62).

Finally, LINES builds up its overall WACC estimate by first estimating several input parameters, such as leverage and the asset beta, where the latter is itself treated as a function of several inputs. LINES also estimates some parameters as weighted averages of estimates

of related parameters — such as estimating the MRP for NZ as a weighted average of several different MRP estimates. Both approaches involve estimating quantities as functions of several parameters. However, when doing this LINES often fails to allow for the estimation error associated with all of the inputs and the possibility that these estimation errors are correlated. For example, it ignores estimation error in its estimate of the long-term risk-free interest rate when constructing the Siegel estimate of the MRP (#1, 8, 9). It appears to ignore the correlation between estimation errors when combining different estimates of the MRP and taking a weighted average, although we cannot be certain of this as LINES provides little detail of the precise calculation (#14). When calculating the standard error of its WACC estimate, LINES does not allow for the possibility that the various inputs have correlated estimation errors and completely ignores estimation error in its (so-called ‘optimal’) leverage measure (#67, 76, 116).

All of these mistakes combine to lead LINES to ultimately choose a standard error that is almost certainly far too low (#59, 74).

I.D The effect of regulation on investment incentives

Even though electricity lines businesses have substantial sunk capital, future investment in maintenance, asset replacement, and expansion is essential. Thus, if long-run welfare is to be maximized, it is important to consider the impact of price regulation (in the context of LINES, the choice of the allowed rate of return and the measurement of excess earnings) on investment incentives. However, LINES focuses on pricing and largely ignores firms’ investment responses to regulatory settings. The assumption underlying much of the analysis in LINES seems to be that the regulator can control, rather than merely influence, every aspect of industry behaviour. However, situations where regulators completely control investment are rare.⁵ Instead, regulated firms typically retain significant investment flexibility — they can choose the timing, location and scale of their investment, for example. In such a world, investment will only occur if the firm profits from investing. Firms act in order to maximize value, and if regulatory settings mean that value is maximized by not investing, firms will not invest. LINES largely ignores these issues.

The most obvious appearance of this error in LINES is in its suggested treatment of sunk costs (#95, 98). LINES states that “the fact that a margin on WACC is appropriate for the purpose of assessing new investment does not imply that it will also be appropriate for the purpose of assessing excess profits” (pg 80, ln 23). The suggestion that existing assets should somehow be treated differently from prospective ones is alarming, as there is now an extensive literature documenting the adverse consequences of such regulatory opportunism for firms’ investment behavior. The consensus to emerge from this literature is that the sort of regulatory behavior apparently advocated by LINES is not in the best long-run interests of consumers.

The error reappears in the definition of excess profits — that they arise whenever the net present value of future cash flows is positive — and its use of the $NPV = 0$ criterion (#101). These would be appropriate if the regulator could completely control investment by the firm, since there would be no incentive effects to worry about. However, they are inappropriate when firms have investment flexibility. For example, in models where regulated firms have investment timing flexibility, investment may be delayed indefinitely if prices are set so that firms can only earn their WACC. Moreover, the cash flows allowed by the excess earnings formula in LINES will be insufficient for a firm to recover the cost of its investment if there are increasing returns to scale in investment (which is typical for electricity lines businesses) and

⁵For example, FERC controls gas pipeline investment in the US. In the US electricity sector, some firms commit to undertake specified investments in return for a rate case moratorium. In NZ, the Electricity Commission has a regulatory role with respect to Transpower’s investment, but does not control all of it.

the regulator uses benchmarking (such as the ODV methodology) to calculate the rate base.

I.E Analytical approach

Finally, we discuss several shortcomings in the overall analytical approach in LINES.

The role of simplifying assumptions. Often in this sort of work one must make simplifying assumptions in order to make the analysis tractable. However, the restrictions imposed by these assumptions should be remembered when assessing the precision of the final estimate — it is only as good as the assumptions it is based on. Such assumptions are made at many places in LINES — it assumes prices are set for fixed intervals, when the intervals' lengths are actually uncertain and endogenous (#18, 20, 22); it ignores several factors determining optimal leverage, leading to a false sense of precision of the leverage estimate (#64, 65); it considers only ex ante and ex post compensation for stranding, and nothing in between (#84) — but all these are essentially ignored when assessing the final estimates of the WACC.

The role of numerical examples. LINES frequently relies entirely on simple examples to justify its claims. These examples are often described only in terms of a particular set of parameters and frequently cover just two time periods. While such examples are useful for illustrating ideas, they do not provide an adequate basis to draw general conclusions — one can never be sure that what is true for the particular parameters or example used will be true for parameter sets not considered. This creates the most problems in Section 12 of LINES, which discusses the evaluation of excess earnings. Its definition of excess earnings is claimed to be consistent with the $NPV = 0$ principle, but this is not proved rigorously, or the implementation specifics adequately described.⁶ This contributes to several mistakes in its advice for evaluating excess earnings. For example, the discussion of treating land revaluations in LINES is incorrect (#104). Its advice regarding the treatment of ex ante compensation for optimization and stranding is also incorrect (#107, 108). Its suggested IRR measure of excess earnings is not well-defined and can be negative when the present value of excess earnings is positive, rendering it useless as a measure of excess earnings (#103).⁷

Logic. LINES confuses necessary and sufficient conditions in several places. For example, it dismisses real world phenomena if *some* explanations can be dismissed; only if *all* possible explanations could be dismissed would dismissing the real world phenomena be justified (#89). Similarly, it argues that its own preferred approach to implementing the CAPM is not a “theoretically satisfactory application of the CAPM” (pg 34, ln 8) because one particular *sufficient* condition for its legitimacy is rejected empirically (#28); this ignores the possibility that there may be other sufficient conditions that *do* hold. Conjectures can be rejected if necessary conditions do not hold, but cannot be rejected just because a particular sufficient condition does not hold.

Consistency. When assessing views contained in submissions to the NZCC, the logic in LINES seems to be that anything without overwhelming supporting quantitative evidence should be

⁶The ‘proof’ in Appendix 3 only considers the case where the firm ceases to exist after two periods.

⁷Similar examples are scattered throughout LINES. For example, its claim that we should match the maturity of the risk-free interest rate to the length of the regulatory cycle relies on cash flows being received only at the end of the cycle, which is clearly unrealistic for the three- or five-year periods considered in LINES (#19). It offers no advice on how to deal with intermediate cash flows. Similarly, it makes a sweeping statement about the implications of regulatory error based on a single (and actually invalid) example (#55).

rejected. In one case, LINES states “[t]his is pure conjecture, and should not be entertained” (pg 22, ln 26). In numerous other cases, it arbitrarily deems that the burden of proof lies with the regulated firms rather than the NZCC.⁸ We believe that finance theory has not developed to the point that this standard is reasonable or advisable. There is still much real-world behaviour that cannot be accurately quantified by finance theory, or for which there are formal models but no agreement on which model is best. To ignore such behaviour is to try to fit the real world into a straightjacket determined by a very small subset of accepted finance theory. Nevertheless, if such a standard is to be applied, it must be applied consistently. Unfortunately, such consistency is missing from LINES, which makes many claims with no more (and often less) supporting evidence than other claims that are rejected by LINES. Some examples are discussed in #5, 11, 29, 58, 63, 71, 86.

In addition to consistent treatment of the claims made by the author of LINES and by others, we would expect to see consistency *within* LINES itself. However, this is frequently not the case. For example, LINES ignores Merton-style MRP estimates, but subsequently appeals to Merton’s approach when it argues that falling volatility has reduced the MRP (#13). It uses US data to estimate NZ parameters (#31, 38), but expresses doubts about using US data elsewhere (#6, 88). It argues that airfields and electricity lines businesses face quite different risks, but uses airfields when estimating optimal leverage, despite arguing that one should only use firms with stable cash flows to do so (#66). It devotes considerable effort to technical adjustments that have only a small impact on the final WACC estimate, but claims that other adjustments with a larger effect on WACC can safely be ignored (#68, 70, 83). When estimating the asset betas of US firms, LINES appears to calculate its leverage measure using the book value of equity (#39), but rejects using book values elsewhere (#69). It uses observed averages to estimate optimal leverage (#65), but argues elsewhere that firms’ observed behaviour is unreliable because they might be acting in error (#89). It advocates using actual tax losses, but recommends using the leverage levels of hypothetical efficient firms (#113). It chooses a price cap beta that is less than the asset beta it estimates for UK firms, the only identified price capped firms in its sample (#115). Finally, LINES calculates an industry-wide WACC, but then insists that adjustments for real options destroyed by investment should be calculated on an asset-by-asset basis (#90).

I.F Summary

Estimating the cost of capital for regulated firms is an important exercise that needs to satisfy three criteria in order to be useful. First, all relevant theory must be explicitly identified and accurately characterised. Second, the chosen theoretical framework must be applied consistently to data that are relevant for the purpose. Third, uncertainty about parameter estimates obtained from the data must be precisely calculated and reported. Unfortunately, LINES suffers from significant deficiencies in all of these areas.

⁸Specific instances where evidence is dismissed because it cannot be ‘quantified’ to the standard required by LINES are discussed in #89, 91, 97.

II A detailed assessment of LINES

In this section we discuss the errors, point-by-point, in the order they appear in LINES. The section headings below correspond to those in LINES.

3. The Market Risk Premium

3.1 Alternative Methodologies

1. [pg 12, ln 5] The calculation of the standard error of the Siegel-style estimate of the MRP in LINES is incorrect. The Siegel estimate equals the historical average equity return (\hat{r}_m) less an estimate for the expected long-term real risk-free interest rate (\hat{r}_f). LINES states that “[t]he first term here is amenable to estimation of a standard deviation but the latter is not. Nevertheless, uncertainty in the latter is reflected in the range of estimates.” (pg 12, fn 6)⁹ However, it goes on to take the midpoint of this range as the estimate of the MRP (see pg 18, Table 1) and the standard deviation of the ‘historical average equity return’ as the standard error for the MRP estimate. This implicitly makes a strong assumption regarding the standard error of the risk-free rate estimate. To see why, note that the Siegel estimate of the MRP has variance

$$\text{Var}[\hat{MRP}_{\text{Siegel}}] = \text{Var}[\hat{r}_m - \hat{r}_f] = \text{Var}[\hat{r}_m] - 2\text{Cov}[\hat{r}_m, \hat{r}_f] + \text{Var}[\hat{r}_f]. \quad (\text{i})$$

$\hat{MRP}_{\text{Siegel}}$ and \hat{r}_m only have the same variance (as is effectively assumed by LINES) if

$$\text{Corr}[\hat{r}_m, \hat{r}_f] = \frac{\text{StdDev}[\hat{r}_f]}{2\text{StdDev}[\hat{r}_m]}.$$

There seems no reason why this condition should be met, and LINES provides no evidence that it does. Thus, the reported standard error associated with the Siegel estimate cannot be relied upon.

2. [pg 13, ln 10] When discussing evidence in Boyle (2005) that Merton’s method gives widely varying MRP estimates, LINES states that the “implausible variation in the market risk premium leads Boyle to conclude that this methodology cannot be relied upon. The source of the problem is the unreliable estimates of variance, and the use of only three years of data to do so contributes to that problem.” This is incorrect. First, Boyle actually concludes that the CAPM cannot be relied upon, not the Merton methodology for estimating the MRP. Second, variance can be accurately estimated using three years of data, especially if high frequency data is used. In fact, it is generally easier to estimate volatility than the mean (Campbell et al., 1997, pp. 364–366; Ingersoll, 1987, pp. 357–360). Thus, the MRP will be even more difficult to estimate than the variance of market returns.
3. [pg 14, ln 4] LINES states that “the long-run *forecast* of growth in GDP is an upper bound on long-run growth in dividends per share for existing companies” (emphasis added). This is incorrect. At best, it confuses actual and expected outcomes: while the long-run *actual* level of growth in GDP is an upper bound on long-run growth in dividends per share, the same cannot be said of its expected value. More generally, any forecast is actually a distribution, and so it makes no sense to claim it as an upper bound on anything.

⁹Incidentally, despite the claim in LINES to the contrary, there is no reason why a standard error for the expected long-term real risk-free interest rate cannot be calculated.

Table II: Survey evidence of the NZ MRP

	Lally, Roush and van Zijl (2004)			LINES
	Academics	Practitioners	Overall	
Median	7.4%	8.9%	8.9%	8.0%
Mean	7.6%	8.8%	8.4%	
Sample size	29	47	76	

4. [pg 14, ln 10] LINES uses the results of a survey of academics' and practitioners' estimates of the MRP conducted by Lally, Roush and van Zijl (2004). However, while the authors of that paper state that their survey "implies an estimate of 8.9%" (Lally et al. 2004, p. 5), LINES interprets the results of that paper as implying an estimate of just 8.0% (pg 17, ln 20). Table II summarizes the relevant information.

- Lally et al. state that they "prefer the median as [their] measure of central tendency as it is (sic) cannot be materially affected by a few extreme responses." (p. 5) The median of their sample implies an MRP of 8.9%, which is their final estimate of the MRP.
- Alternatively, one might use the mean of the overall sample. This is a weighted-average of the mean academic response and the mean practitioner response, where the weighting reflects the fact that more practitioners than academics responded to the survey (47 versus 29). This results in an estimate of 8.4%.
- In contrast, LINES takes the simple average of the median response of academics (7.4% in Lally et al., but LINES uses 7.3% instead¹⁰) and practitioners (8.9% in Lally et al, but LINES uses 8.8%), which gives its final estimate of 8.0%. However, not only is the average of two medians without any merit as an estimate, but by using an unweighted-average, LINES ignores the fact that there are 47 practitioner responses and just 29 academic ones, and so implicitly attaches substantially more weight to each academic respondent than to each practitioner respondent.

LINES does not mention, nor does it justify, these variations from the analysis in Lally et al. (2004). We can think of no justification for them.

5. [pg 14, ln 23] Lines claims that the Ibbotson methodology overstates the estimated NZ MRP due to pre-1985 regulations that controlled interest rates and mandated compulsory purchases of government bonds. According to LINES, the net effect of these controls would have been to artificially lower the riskless interest rate proxy while having no effect on the expected return on equities, thereby imparting an upward bias to the MRP. There are two problems with this line of argument. First, many aspects of the pre-1985 NZ economy were controlled, not just interest rates. Second, in contrast to the claim in footnote 9 of LINES, there is no good reason to suppose that these regulations had no effect on the expected return on equities. Indeed, a standard result from portfolio theory (see, for example, Campbell and Viceria, 2002) is that a required over-weighting of one asset class increases the demand for other asset classes that best restore investors' overall

¹⁰The difference arises because Lally et al. use a risk-free interest rate of 5.7% to convert the raw MRP estimates into values appropriate for the risk-adjusted CAPM, which "was the average yield on ten-year government stock over the period April–June 2003 adjusted for semi-annual compounding ... and this period matches the period of the survey". In contrast, LINES uses "the ten year government stock rate of 0.056 at the time of the survey (May 2003 average)".

desired risk-return balance. This suggests that mandated minimum holdings of low-risk government bonds would have been accompanied by a higher demand for high-risk equities, thereby lowering the expected return on the latter and rendering ambiguous the net effect on the MRP. These flaws in the theoretical arguments in LINES mean that the possibility of upward bias in the Ibbotson estimate of the MRP should be dismissed until such time as supporting empirical evidence is offered.

This problem reappears at pg 19, ln 18.

6. [pg 15, ln 5] LINES attaches a great deal of importance to MRP estimates from foreign markets, when it is not at all clear that estimates of MRP from foreign markets reveal *anything* about the MRP in NZ. This is surprising, as reservations about the relevance of foreign markets appear in several places in LINES. For example:
 - In refusing to consider Merton-style MRP estimates from foreign markets, LINES argues that “it is explicit in the Merton approach that the market risk premium is proportional to market volatility, and *the latter clearly varies over markets.*” (pg 16, ln 11, emphasis added)
 - LINES defends not using an international variant of the CAPM because “in using an international version of the CAPM, *estimates of the parameters needed are much less reliable than their domestic counterparts* and there is no consensus on them or even of the particular model that should be used.” (pg 9, ln 18, emphasis added)

In light of these comments, it is unclear why so much significance is attached to estimates of the MRP from overseas markets.

7. [pg 15, fn 12] LINES estimates the US long-term real risk-free interest rate using (a) the average yield on inflation-protected bonds, available in the US since 1997, and (b) the average real return on conventional government bonds during the period 1871–1926 when “inflation was stable and default risk was slight.” The first data set is sensible, but the information content of the second data set is doubtful. However, LINES ultimately takes the average of the two sample means (see point 8), so that equal weight is being attached to data from the 19th and 21st centuries.

In assessing the relative merits of the two data sets, it would be helpful if the standard deviations were reported as well as the means.¹¹ For example, LINES gives a range for the risk-free interest rate of 0.03–0.04, with the endpoints being the two sample means, but this might be giving a quite misleading impression regarding the true confidence interval. Although the standard deviation for the first data set is not reported, it would have been as easy to calculate the standard deviation as the mean. The standard deviation of returns for the second data set actually appears in Siegel (1992), and equals 6.3%. If we are willing to assume that the realized returns over that period were independently and identically distributed, the standard error for the sample mean is 0.0085. Based just on the second data set, therefore, the 95% confidence interval for the risk-free interest rate is [0.023, 0.057].

8. [pg 16, fn 13] In the calculation of a Siegel-style estimate for the US MRP, LINES repeats the mistake discussed in point 1 by not considering the standard error of the expected long-term real risk-free interest rate. That is, it claims to capture uncertainty in the estimate of the long-term risk-free interest rate by reporting a range of results and noting that

¹¹This would also serve as an input into the standard error calculation described in point 1 above.

“[f]or each point in the range, the standard deviation is that for the average real return on equities, and this is .020”, but then goes on to take the midpoint of this range as the MRP estimate (see pg 18, Table 1) and the standard deviation of the “average real return on equities” as its standard error.

9. [pg 16, ln 6] When applying Siegel’s approach to estimating the MRP for a selection of foreign markets, LINES arbitrarily adopts Siegel’s estimate of the *US* long-run real risk-free interest rate. It includes no justification for this, nor does it make any allowance for the estimation error this introduces. At the very least, this raises the term $\text{Var}[\hat{r}_f]$ in equation (i), but LINES continues to ignore sampling error surrounding the expected long-term real risk-free interest rate. This repeats the mistake discussed in points 1 and 8.
10. [pg 17, ln 5] When discussing practitioner survey data from the US (specifically, the study by Graham and Harvey (2005, Table 1)), LINES does not mention that Graham and Harvey include standard deviations for the set of survey results. For example, in the June 2005 survey, the standard deviation of the respondents’ MRP estimates is 2.2%; the median response is 2.9%.¹² Results for the other 20 quarterly surveys are similar. This variability is much greater than one would suspect simply by looking at the results presented in LINES (see pg 18, Table 1).

3.2 Conclusions

11. [pg 17, ln 23] The NZ MRP estimate calculated using the Merton methodology is deleted when calculating the overall estimate of the MRP, which has the effect of reducing this estimate by 0.5%. However, the results presented in Table 1 (on pg 18) indicate that Cornell-based estimates are stronger candidates for outlier status. Removing them, instead of the Merton estimate, raises the median MRP estimate from 0.070 to 0.079 (using just NZ data) and from 0.070 to 0.077 (using all data).
12. [pg 18, ln 1] The MRP estimates in Table 1 all reflect a ten-year horizon for the MRP. LINES discusses the possibility of using a five-year horizon and mentions “uncertainty surrounding the correct investor horizon”. However, the MRP must reflect the period over which the CAPM is being applied. According to the argument advanced in LINES, this should be the length of the regulatory cycle (or the price-setting cycle, when assessing excess profits). According to the figures contained in LINES, shifting to a five-year term for the risk-free interest rate would change the MRP estimate by between –10 and 40 basis points, which is not a trivial amount. LINES appeals to “data limitations” and the CAPM’s lack of clarity about the investor horizon, but the issue is clear: the MRP must correspond to the period over which the CAPM is being applied. This is discussed in more depth later, in our assessment of the section on the risk-free interest rate.
13. [pg 19, ln 16] LINES argues that historical estimates of the MRP “are in general liable to be biased up because market risk premiums are likely to have declined over time as a result of reductions in market volatility.” This statement implicitly invokes the Merton approach to measuring the MRP, in which the MRP is the product of a risk aversion parameter and market volatility. However, elsewhere LINES dismisses evidence based on this approach (pg 17, ln 23; pg 18, ln 8).

¹²Incidentally, the lowest value reported is 2.7%, not 2.9% as stated in LINES.

14. [pg 20, ln 10] LINES presents a standard error for the overall MRP estimate, but the process that leads to this standard error is not described in sufficient detail for it to be properly assessed. However, the few hints that are offered suggest that (in addition to the problems with the inputs to this calculation described in points 1, 8, and 9 above) the resulting standard error will be far too low. Therefore, statements in LINES relating to this process are likely to offer a misleading view of the precision of the overall MRP estimate (pg 22, ln 1; pg 25, ln 25).

The approach adopted in LINES is to form the estimate of the MRP as a weighted-average of the individual estimates presented and to calculate the standard deviation of the resulting estimate. This approach is standard. However, LINES claims that “[t]he act of forming a weighted average over a range of individual estimates will produce a standard deviation on the weighted average estimate that is *considerably* less than the average standard deviation on the individual estimates” (pg 20, ln 13, emphasis added). This is only true if the correlation between the individual estimators is low, and there are strong reasons to believe this will not be the case here.

- The Siegel, Ibbotson and Merton methods all use historical data and the studies relied on in LINES have sample periods that overlap. Thus, these estimates will almost certainly be positively correlated.
- Some inputs to the so-called forward-looking approach are influenced by historical data, in particular the growth rate in dividends per share. For example, the calculation of this figure in LINES involves subtracting 0.01 from long-run growth in GDP. Estimates of the latter figure will be influenced by historical growth rates in GDP. Further, LINES cites Bernstein and Arnott (2003) as justification for its 0.01 deduction, and Bernstein and Arnott make extensive use of historical data in justifying their conclusions.
- Respondents to surveys cannot formulate their expectations for the future without being influenced by historical outcomes that are common knowledge.

LINES claims to use 11 different estimators as inputs, which implies that 66 separate parameters are needed to completely specify the covariance matrix that lies at the heart of the calculations of the standard deviation of the weighted-average.¹³ What values do these parameters take? What justification is provided for using them? None of this is discussed. Combined with the mistakes involving standard errors described in points 1, 7, 8, and 9 and the possible assumption that the individual estimates are independent (as evidenced by the numerical example on pg 20), this casts doubt on the accuracy of the standard error presented in LINES and suggests that it is far too low.

15. [pg 21, ln 7] LINES asserts that “[o]f the estimation methods used [to estimate the MRP], the Ibbotson, Siegel and Merton approaches are not particularly sensitive to re-estimation of the parameter a few years earlier.” However, the evidence contained in LINES shows that the MRP estimates are very sensitive to the sample period chosen. For example, (a) the Ibbotson estimator is 7.3% for 1931–2002 but 7.7% for 1931–2004 (pg 11, ln 17); and (b) the Siegel estimator is 5.6–6.3% for 1931–2002 but 6.0–6.8% for 1931–2004 (pg 12, ln 16). That is, adding two more years of observations to a 70 year sample period adds approximately half a percentage point to the estimated MRP.
16. [pg 21, ln 9] LINES’s statement that “[i]n respect of the forward-looking and survey approaches, [estimates of the MRP] are not in general available at earlier points in time”

¹³The 66 parameters comprise 11 standard deviations and 55 correlations.

is incorrect. Forward-looking approaches can easily be implemented for earlier years. All that has to be done to calculate a forward-looking MRP at any earlier date is to use the data that would have been available then, which is straightforward. For example, Claus and Thomas (2001) estimate a forward-looking MRP for each year during the period 1985–1998.

3.3 Contrary Views

17. [pg 23, ln 23] LINES states that “all methods have their limitations, and therefore some (explicit) weight should be given to them all.” The logic here is incorrect. Some weight should be given to all methods only if they each have some merit, not because they all have limitations. Consider a method with absolutely no merit (and therefore presumably some limitations). If we followed the logic in LINES, some weight should still be attached to this method, which is clearly inappropriate.

This error is repeated at pg 26, ln 14.

4. The Risk Free Rate

18. [pg 29, ln 23] Throughout the discussion of this topic, LINES proceeds as though prices are set for a fixed interval, and only ever reset at the end of this period. In reality, prices will be reset when circumstances dictate and this cannot be predicted with certainty in advance. The actual revision frequency is endogenous and uncertain, not exogenous as assumed in LINES, and depends on the paths demand and other variables take. As the real options literature demonstrates, ignoring such managerial flexibility can lead to significant valuation errors. Nowhere does LINES account for this optionality.
19. [pg 30, ln 3] Another assumption underlying the analysis in LINES is that cash flows are received only at the *end* of the price-setting period. If prices were reset annually this might not matter much, but with a three- or five-year period it is clearly inappropriate to assume that cash flows are received only at the end of the price-setting period when they are actually received *during* the price-setting period.

Consider the following example. Suppose that (a) the asset life and the price-setting cycle are each two periods, (b) operating costs equal zero, (c) the cost of the asset is $B_0 = 100$ and will be depreciated by $D_1 = D_2 = 50$ each period, and (d) the one period rate is $r_{0,1} = 0.06$ this period and $r_{1,2} = 0.10$ next period.¹⁴ Since the future one-period rate is known with certainty in this example, the current two-period interest rate is

$$r_{0,2} = \sqrt{(1 + r_{0,1})(1 + r_{1,2})} - 1 = 0.0798.$$

If prices were adjusted each period in line with the prevailing one-period rate, allowed revenue would equal

$$R_1 = D_1 + r_{0,1}B_0 = 56$$

in the first period and

$$R_2 = D_2 + r_{1,2}B_1 = 55$$

¹⁴We use $r_{t,t+n}$ to denote the n -period interest rate prevailing at date t .

in the second period, and the firm's net present value would be

$$\frac{R_1}{1 + r_{0,1}} + \frac{R_2}{(1 + r_{0,2})^2} - B_0 = 0.$$

However, an alternative approach is required when prices are to be held fixed for both periods, as then (absent anticipated changes in demand) R_1 and R_2 must be equal. The implication of the analysis in LINES is that only knowledge of the two-period interest rate ($r_{0,2}$) will be required, but it is clear that the appropriate allowed revenue will also depend on the one-period interest rate ($r_{0,1}$) in this case.

20. [pg 30, ln 22] LINES asserts that the “feasible candidates for the price-resetting frequency” lie between 1 and 5 years and announces that it “favour[s] the midpoint” without providing any justification. As discussed in point 18, the ex post resetting frequency will not necessarily match the ex ante expectation. While the midpoint might seem reasonable at first glance, this is naive and ignores the lesson from the real options literature that the combination of irreversible investment and managerial flexibility means that both the expected value *and* the standard deviation matter. Simply assuming that the average outcome occurs with certainty overlooks this fundamental point.
21. [pg 30, ln 25] LINES states that “[s]ince forecast excess profits are examined, and future interest rates are indeterminable, one is bound to act as if they will not change”. This repeats the error discussed in point 20 in a different context. Even if it is not always incorporated in applied work, interest rate volatility is very important for behaviour in industries (such as the one under consideration) where irreversibilities are ubiquitous.¹⁵ Simply proceeding as though one has perfect foresight is not an innocuous assumption. Thus, when interpreting the final estimate of the WACC in LINES, as well as the excess earnings it implies, it is important to remember that the underlying calculations rest on some unnecessarily strong and unrealistic assumptions.
22. [pg 31, ln 21] LINES argues that using a three-year rate removes interest rate risk. However, this is not true when one realizes that the price-setting interval is endogenous. This error is an example of the mistakes that can arise as a consequence of making the assumption discussed in point 18.
23. [pg 32, ln 10] LINES devotes considerable space to attempting to justify the decision to use two different maturities of the risk-free interest rate in the same implementation of the CAPM. The standard CAPM is usually written in the form¹⁶

$$r = r^f + \beta(E[r^m] - r^f). \quad (\text{ii})$$

LINES proposes (pg 34, ln 15) using the three-year risk-free interest rate for the first appearance of r^f and the ten-year risk-free interest rate for the second appearance of r^f . This position is indefensible.

An important implication of the CAPM is that each asset has a so-called ‘tracking portfolio’ with a proportion β of its wealth invested in the market portfolio and the remaining proportion $1 - \beta$ invested in the risk-free asset (Grinblatt and Titman, 2002, pp. 149–151). An asset and its tracking portfolio may generate different cash flows, but any difference is uncorrelated with the return on the market portfolio and is therefore diversifiable. Thus, the difference is not priced by the market, and the expected rate of return

¹⁵See, for example, Ingersoll and Ross (1992) for the impact of interest rate uncertainty on firm decision-making.

¹⁶Using a tax-adjusted CAPM, as in LINES, does not alter the fundamental conclusion that there is only one risk-free asset.

on the asset equals the expected rate of return on its tracking portfolio. Since the latter is the weighted-average of the expected rates of return on the two components, with the weights corresponding to the portfolio weights, it follows that the expected rate of return on the tracking portfolio is

$$\beta E[r^m] + (1 - \beta)r^f.$$

This is just the standard CAPM, equation (ii). However, this formulation (and the underlying story involving the tracking portfolio) makes it clear that there can only be one risk-free asset.¹⁷

There is no need to deviate from the correct approach, which involves calculating an MRP with a horizon matching the length of the regulatory cycle. The claim that “data limitations” prevent this approach is discussed in point 26.

24. [pg 32, ln 12] Here LINES appears to concede that its approach will generally lead to the expected return on assets with a beta of 1 having an allowed rate of return that differs from the expected rate of return on the market as a whole. When, as is usually the case, the yield curve is upward sloping, the allowed rate of return will be less than the expected rate of return on the market portfolio. If the advice in LINES is followed, the NZCC is implicitly and knowingly saying that market-determined required returns on the market as a whole are too high: *according to its own calculations*, the NZCC will not allow firms to earn their cost of capital! Note that this is not a disagreement about the appropriate level of a parameter estimate, but a decision to use a parameter value that the NZCC knows to be too low.
25. [pg 32, ln 24] In trying to explain away the problem discussed in point 24, LINES includes an example with annual price setting but a CAPM corresponding to a two-year horizon and points out that it cannot be used to calculate a one-year cost of equity. It goes on to state that “[t]he choice then lies between discarding the model and adapting it to the situation in question.” There is a third, more obvious, and theoretically-correct, approach: simply use a one-year estimate of the MRP. Then the problem goes away.
26. [pg 33, ln 5] The primary justification offered in LINES for not adopting the solution discussed in point 25 appears to be that “as discussed in section 3.2, data limitations point to the use of the ten year risk free rate in estimating the market risk premium.” It is not clear, even from reading Section 3.2, exactly what these data limitations are. In fact, all of the five methods used in LINES to estimate the MRP are, or can be, applied to maturities less than ten years, as we now explain.
 - Ibbotson approach: For NZ, PricewaterhouseCoopers (2002) use one-year bonds. For the US and other foreign markets, Dimson et al. (2002) report two different equity premia, one using short-term government securities and the other using long-term government bonds.¹⁸
 - Siegel approach: All that is required to convert an Ibbotson-style estimate to a Siegel-style one is knowledge of the short-term real interest rate. In fact, Siegel reports

¹⁷If two different maturities of the risk-free interest rate are used instead, one is effectively assuming some sort of ‘three-fund separation’ result, where investors hold the market portfolio, short-term bonds, and long-term bonds. This is most definitely *not* the CAPM.

¹⁸The maturity on the bonds used varies across countries, and across time. For example, the UK bond index uses perpetual bonds for 1900–1954, and a portfolio of government bonds with a mean maturity of 20 years for 1955–2000. The US bond index uses “four percent government bonds” for 1900–1918, the Federal Reserve ten-to-fifteen year bond index for 1919–1925, and the Ibbotson Associates’ long bond index (representative of 20-year bonds) for 1926–2000.

estimates of the US MRP using both long-term and short-term interest rates (Siegel, 1992).

- Merton approach: This approach requires only an estimate of the volatility of market returns. No interest rate data are required.
- Cornell approach: Since the approach does not rely on historical interest rate data, one need only subtract the three-year rate (instead of the ten-year one) from the estimated return on the market.¹⁹
- Survey results: The Welch (2001) survey of the US MRP uses “short-term bonds”. Furthermore, LINES converts this to an MRP estimate using long-term bonds (pg 16 ln 24), so the reverse procedure must be possible. This would allow the Lally, Roush and van Zijl (2004) and Graham and Harvey (2005) surveys (NZ and US respectively) to yield MRP estimates using the three-year rate.

LINES states that the figures in Table 1 “invoke the ten year risk free rate” (pg 18, ln 1). While this is correct, it is important to note that many of the sources underlying the figures in Table 1 actually use interest rates with shorter maturities. In summary, LINES appears to *choose* to use a ten-year rate when it estimates the MRP. This maturity is not imposed by “data limitations”.

27. [pg 33, ln 6] However, LINES does not rely solely on this data issue. It goes on to argue as follows: “Furthermore, even in the absence of data limitations, the consistency argument is not compelling. It rests on the assumption that the expected market return E_m is the same for all future periods, and this appears to conflict with the fact that R_{f1} differs from R_{f2} .”

This is a ‘straw man’ argument. In keeping with the simple example discussed in point 25 above, suppose the price-setting cycle and the investor horizon are one and two years, respectively. Let $r_{t,t+n}^f$ denote the n -year risk-free interest rate at date t and let $r_{t,t+n}^m$ denote the corresponding return on the market portfolio. Three different approaches need to be considered.

- In the context of the CAPM, the correct approach is to use the MRP corresponding to the period over which the CAPM is being applied; that is

$$MRP_{t,t+1} = E_t[r_{t,t+1}^m] - r_{t,t+1}^f \quad (\text{iii})$$

- The approach advocated in LINES is to use the MRP corresponding to a longer horizon; that is,²⁰

$$MRP_{t,t+2} = E_t[r_{t,t+2}^m] - r_{t,t+2}^f \quad (\text{iv})$$

In order for this approach to be valid, the market risk premium must be independent of the horizon; that is, $MRP_{t,t+2} = MRP_{t,t+1}$ must be true.

- LINES claims that the alternative is to use the hybrid

$$E_t[r_{t,t+2}^m] - r_{t,t+1}^f \quad (\text{v})$$

¹⁹For example, LINES converts an MRP estimate originally calculated using the forward-looking approach with a five-year horizon in Lally (2001) to one with a ten-year horizon (pg 14 ln 2).

²⁰Although this is what LINES claims to use, in many cases it is effectively using a hybrid of its own: $E_t[r_{t,t+1}^m] - r_{t,t+2}^f$ (for example, when it uses Ibbotson-style estimates).

As is easily seen by comparing (iii) and (v), LINES is correct when it claims that use of the hybrid is appropriate only if $E_t[r_{t,t+2}^m] = E_t[r_{t,t+1}^m]$; that is, if the expected rate of return on the market portfolio is independent of the horizon. However, (v) is *not* the approach being suggested, so the discussion on pg 33 of LINES is irrelevant.

To summarize, the correct approach, (iii), imposes no conditions on the behaviour of the expected rate of return on the market portfolio. The approach advocated in LINES, (iv), is only valid if $MRP_{t,t+2} = MRP_{t,t+1}$. The hybrid approach, (v), is only valid if $E_t[r_{t,t+2}^m] = E_t[r_{t,t+1}^m]$. Since (iii) is easily implemented, there is no need to consider (iv) or (v), yet LINES seems determined not to use (iii). However, it has not shown that (iv) is valid, or even that it is 'less invalid' than (v).

28. [pg 33, ln 9] The point of the discussion in this part of LINES is not clear, but we think it is trying to show that a sufficient condition for the approach in (iv) to be valid — that is, for $MRP_{t,t+2} = MRP_{t,t+1}$ to hold — is that (a) the one-period MRP is constant over time and (b) interest rates satisfy the expectations hypothesis. Although LINES does not do so, it is straightforward to show that these two conditions do indeed imply that $MRP_{t,t+2} = MRP_{t,t+1}$.²¹ However, LINES concedes that the empirical evidence largely rejects the expectations hypothesis, and so concludes that its approach is invalid.²² It thus rejects (iv) on empirical grounds. As we discuss in point 29 below, it also rejects (v) on empirical grounds. Nevertheless, it proceeds to use (iv) and not (v).

However, it is a mistake to reject an approach simply because a sufficient condition for its legitimacy is contradicted by the empirical evidence. After all, there may be other sufficient conditions that *are* consistent with the empirical evidence. If this were the case, then the approach in LINES would be acceptable. Instead, what is required is empirical evidence regarding the assumption that $MRP_{t,t+2} = MRP_{t,t+1}$, since this is what is ultimately required for the approach in (iv) to be valid. Unfortunately, this is not in a form that is readily testable. However, we note that the following result holds as an identity:

$$\begin{aligned}
E_t[E_{t+1}[r_{t+1,t+2}^m]] &= E_t[r_{t+1,t+2}^m] && \text{(from the law of iterated expectations)} \\
&= E_t[2r_{t,t+2}^m - r_{t,t+1}^m] && \text{(from the definition of two-period returns)} \\
&= E_t[r_{t,t+1}^m] + E_t[2r_{t,t+2}^m - 2r_{t,t+1}^m] && \text{(from adding zero)} \\
&= E_t[r_{t,t+1}^m] && \text{(from the definition of MRP)} \\
&\quad + 2(MRP_{t,t+2} + r_{t,t+2}^f) - 2(MRP_{t,t+1} + r_{t,t+1}^f) \\
&= E_t[r_{t,t+1}^m] + 2(r_{t,t+2}^f - r_{t,t+1}^f) + 2(MRP_{t,t+2} - MRP_{t,t+1}).
\end{aligned}$$

Therefore, the condition that is required for the approach described by (iv) to be valid, $MRP_{t,t+2} = MRP_{t,t+1}$, is equivalent to the condition that²³

$$E_{t+1}[r_{t+1,t+2}^m] = E_t[r_{t,t+1}^m] + 2(r_{t,t+2}^f - r_{t,t+1}^f) + \text{noise}.$$

This is readily testable, especially using estimates of expected rates of return calculated using the forward-looking approach: if it is rejected by the data, the approach advocated in LINES is not valid.

²¹A proof is available from the authors upon request.

²²Moreover, the first component of the sufficient conditions — constancy of the MRP — seems most unlikely to hold. According to Merton (1980), the MRP equals the product of a risk aversion parameter and market volatility. It seems reasonable to assume the former is constant over time, but there is ample evidence to show that volatility is not constant over time. See, for example, Bollerslev, Chou and Kroner (1992) and Gouriou and Jasiak (2001, Chapter 6).

²³That is, the term spread $r_{t,t+2}^f - r_{t,t+1}^f$ can be used to predict the change in the expected market return

29. [pg 33, ln 21] In attempting to dismiss the approach described by (v), LINES asserts that “the consistency argument presented here requires that E_m is invariant to the choice of the future period, even in the face of R_{f1} differing from R_{f2} , and this is untenable. So, the consistency argument is flawed.”

First, no evidence supporting the claim of ‘untenability’ is presented. In fact, there exists empirical evidence that the expected return on the market is *less* sensitive than the MRP to changes in interest rates. For example, Harris and Marston (1999) estimate that a one percentage point rise in the risk-free interest rate raises the expected return on the market by less than 0.3 percentage points and therefore lowers the MRP by more than 0.7 percentage points.²⁴ These figures suggest that it might indeed be ‘less invalid’ to assume that the expected rate of return on the market portfolio is unrelated to the level of interest rates (essentially approach (v)) than to assume that the market risk premium is unrelated to the level of interest rates (essentially approach (iv)).

Second, even if the consistency argument were “flawed”, this would not validate the alternative advocated in LINES. It is not sufficient to show that the approach in (v) is invalid — the approach in (iv) must be shown to be superior.

30. [pg 34, ln 8] The summary in LINES of the issue regarding the maturity (or maturities) of the risk-free interest rate encapsulates many of the problems with its analysis. Consider the concluding paragraph in Section 4: “In summary, a theoretically satisfactory application of the CAPM is not possible and some adaptation of the model is unavoidable. In the face of various alternative adaptations, the present value principle is paramount, i.e., the present value of future cash flows should match the initial investment. This principle leads to the conclusion that the first term in the CAPM (R_{f1}) must match the price-setting period, assumed to be three years. This leaves the question of which risk free rate term should be used in estimating the market risk premium (R_{f2}), and the problem of data availability leads to use of the ten year rate here. So, R_{f1} is the three year rate and R_{f2} is the ten year rate. The principal contrary arguments here are that R_{f1} should match the life of the assets, and that R_{f1} should match R_{f2} (and the latter should be the 10 year rate on account of data availability problems). Both arguments violate the present value principle. Furthermore, the argument for matching R_{f1} and R_{f2} has the further drawback of implying a flat term structure for E_m even when the term structure for R_f is otherwise.”

First, a “theoretically satisfactory application of the CAPM” is possible. It is described by approach (iii) above.

Second, the “present value principle” leads to the conclusion that *all* terms in the CAPM should match the price-setting period, not just the first appearance of the risk-free interest rate.

Third, the concerns about data availability are unfounded.

Fourth, unless the MRP is independent of the length of the period over which it is measured, the alternative in LINES, described by approach (iv) above, violates its own $NPV = 0$ principle.

²⁴Similarly, Marston and Harris (1993) estimate that a one percentage point increase in bond yields leads to a 0.46 percentage point increase in the expected return on the market.

5. The Asset Beta

5.1 Underlying Factors

31. [pg 34, ln 23] In its discussion of the asset beta, LINES decomposes an arbitrary firm's beta into a linear combination of 'factor betas', starting from an APT-style returns process. LINES uses this decomposition to introduce its discussion of the factors determining a firm's asset beta, but in fact this decomposition highlights the dangers in using foreign comparison firms. While it is just possible that carefully selected comparison firms may have the same relationship between factors and their returns (the b_{ij} s, in terms of equation (10)) as a NZ lines business, the make-up of the US market is almost certainly different from that of the NZ market. In this case the relationship between the market return and the individual factors (that is, the $\text{Cov}[F_i, R_m]/\text{Var}[R_m]$ terms) will differ across countries. For example, NZ may have relatively more firms (compared to the US) with returns that are sensitive to factor i , in which case $\text{Cov}[F_i, R_m]/\text{Var}[R_m]$ will be different between NZ and the US. Thus, even if the b_{ij} s are comparable across countries, the overall asset betas (the β_j s) may not be. It is the latter condition, not the former one, that must hold if foreign firms are to make satisfactory comparison firms for NZ lines businesses.
32. [pg 37, ln 7] The discussion in LINES of the impact of price regulation on beta begins with a definition of rate of return regulation — "price regulation with frequent resetting of prices" — that is far too simplistic. A more thorough characterization of rate of return regulation can be found in Guthrie (2006) and is summarized in point 47 below. The two most important errors LINES makes here are (a) to assume that under rate of return regulation hearings are held at fixed intervals, and (b) to regard the timing of regulatory reviews as the *only* relevant characteristic of a regulatory regime.
33. [pg 37, ln 12] When LINES discusses the impact of price regulation on beta, it states that "as the reset interval increases, the adjustment of the output price so as to preserve the firm's rate of return is increasingly delayed; exposure to macroeconomic cost shocks then increases, and this should raise the firm's beta." As it relates to the very simplified model of rate of return regulation that LINES adopts, this statement is correct. However, it does not extend to more realistic models of price regulation.

Even if regulatory hearings were held at fixed intervals, such regulatory reviews also expose the firm to the risk that its rate base will change. Such rate base risk is typical under many schemes of incentive regulation, where allowed revenue is tied to the costs of hypothetical efficient firms. In this case, even if a regulated firm's costs have not changed its allowed revenue can change simply because these benchmark costs have changed; that is, regulatory reviews actually introduce shocks to net revenue. However, rate base risk also arises under rate of return regulation due to the prospect of cost disallowances. In both cases, more frequent hearings can actually increase the firm's beta (Evans and Guthrie, 2006). Given the diversity of regulatory regimes facing the firms in its sample (discussed in points 37 and 38 below), LINES is incorrect when it states that longer regulatory intervals will always lead to higher values of beta.

Of course, the reality is that under rate of return regulation hearings are not generally held at fixed intervals. This complicates the effect of rate of return regulation on a firm's beta, in a way that LINES does not discuss. In particular, beta will not be constant over time even if the beta of an otherwise identical unregulated firm would be. Instead, beta will typically be higher when earnings are close to the level allowed by the regulator

and lower when earnings are sufficiently high or low that a hearing is imminent. In the first case, a positive shock to the firm's profitability has little impact on the likelihood of a price change and so has a relatively large impact on the value of the firm. In the second case (when earnings are high), a positive shock to the firm's profitability make an imminent price reduction more likely, moderating the good news; the overall impact on the value of the firm is relatively small. In the third case (when earnings are low), a positive shock to the firm's profitability make an imminent price rise less likely, again moderating the good news; the overall impact on the value of the firm is relatively small. (See, for example, Brennan and Schwartz, 1982; Lewellen and Mauer, 1993). This has implications for beta estimation, since the estimated beta for a firm over any given period will vary depending on realized returns over the period, perhaps explaining some of the variation in beta estimates LINES reports in Table 3, pg 45.

34. [pg 37, ln 14] As evidence supporting its claim discussed in point 33, LINES compares asset betas of US and UK regulated firms. After adjusting for differences in market leverage, it states that the remaining "substantial residue [is] apparently attributable to the difference in regulatory cycle" (pg 37, ln 19) because UK-style price caps are typically set for five years whereas "for utilities subject to US regulation . . . prices are set for only one year" (pg 37, ln 17). This description of the regulatory regimes facing US firms is inaccurate. First, as discussed in point 47, price cap regulation is *not* just rate of return regulation with less frequent price reviews. Second, as discussed in point 37, US electric utilities are not the homogenous group that LINES appears to believe them to be.
35. [pg 39, ln 1] When discussing the impact of operating leverage on beta, LINES states: "If firms have linear production functions and demand for their output is the only random variable (i.e., monopoly power). . .". This is neither a necessary nor a sufficient condition for a firm to have monopoly power.

5.2 Estimates

36. [pg 40, ln 5] There are a number of problems with the estimates of beta for the three NZ lines businesses for which data are available. First, LINES does not state the frequency of the data. This is important since using high-frequency data results in downward-biased beta estimates if shares are traded infrequently.²⁵ Second, it restricts the sample period for all three firms to that of United Networks, which ceased trading in 2002. Equity betas should have been estimated using *all* of the data available. Third, it does not report confidence intervals for the beta estimates, information which would be readily available from the calculations.
37. [pg 41, ln 1] LINES claims that if NZ lines businesses "operated in a largely cost-plus fashion (i.e., cost and volume shocks were rapidly transmitted to their customers) then they would closely resemble US electric utilities, which are subject to rate of return regulation with annual resetting of prices". This statement contains several mistakes.

First, so-called 'electric utilities' in the US do much more than operate regulated electricity businesses. For example, Jandik and Makhija (2005) report that 57% of the firms in the industry in 1997 had non-electric segments; 34% of the firms reported unregulated

²⁵This issue is discussed further in point 51.

business segments (that is, segments outside of SIC code 49).²⁶ For example, one 'electric utility' leased Boeing 747s to KLM and Singapore Airlines; another acquired an insurance company; one bought a chain of drugstores (Jandik and Makhija, 2005, p. 66). Clearly, these activities are not comparable with those conducted by NZ lines businesses.

Second, the structure of the US industry has been changing dramatically in the last 20 years.²⁷ Many firms operate in several states, so that their operations are regulated by several state regulators, and possibly by the federal regulator (FERC) as well. Some states have restructured and now regulate only the distribution part of the utility, while others continue to regulate vertically integrated utilities. Individual distribution utilities may or may not also market electricity to customers. Some are functionally separate from generation and transmission, while others are structurally separated. Consequently, even if it were possible to isolate just the electricity businesses of the US firms, these would not generally be valid comparisons for pure lines companies.

Third, even if it is just applied to their electricity business units, the claim that the US firms "are subject to rate of return regulation with annual resetting of prices" is a gross over-simplification. It ignores the fact that incentive regulation has been adopted in many states. For example, Sappington et al. (2001) report that at least 28 electricity utilities, operating in 16 states, were subject to some form of incentive regulation in 2001. 13 of these firms faced some form of rate freeze (including moratoria on seeking reviews of existing prices), while some form of price cap was imposed on 14 firms. For details of the regulatory schemes in place, see Sappington et al. (2001, Table 2).

Fourth, it is simply incorrect to state that rate of return regulated firms are reviewed annually. The timing of hearings under traditional rate of return regulation is typically endogenous. Their frequency is driven by factors affecting the profitability of the regulated firms. For example, a surge in rate cases occurred in the early 1970s as utilities sought price increases in response to inflation and rising fuel prices. Rates were frozen in many jurisdictions during the 1990s due to factors such as the introduction of retail competition, settlements arising out of mergers, and experiments with incentive regulation.²⁸ As the periods of these rate freezes came to an end, there was another surge in rate cases.

38. [pg 41, ln 4] The grounds for using US gas distribution firms as comparison firms are also weak. The first justification offered in LINES is that these firms "appear similar" (pg 41, ln 6) to US electric utilities, but no further explanation is provided. In what way are they similar? The second justification appears to be that the NZCC has also had reason to assess beta for NZ gas pipelines firms and that "[c]onsistent treatment of the two sets of New Zealand firms suggests that both draw upon the same pool of US firms." (pg 41, ln 7) But the NZCC has also examined Fonterra recently, so according to this logic, US dairy producers would also make legitimate comparison firms for NZ electricity lines businesses.

Before such firms can be justified as comparison firms for NZ electricity lines businesses, the specific forms of regulation that affect them must be investigated. This quickly reveals that the firms do not form the homogenous group necessary for any comparison

²⁶Their sample comprised all investor-owned electric utilities in the Compustat Industry Segment database. Since only segments with sales, assets, or profits that make up at least 10% of those of the consolidated firm are reported, the true level of diversification will be even higher.

²⁷The process of deregulation in the US electricity sector is described in Joskow (2000).

²⁸See, for example, the discussion in Parmesano and Makholm (2004, Figure 1), who report there were no more than 20 "major rate cases" each year from 1997 to 2001. If LINES were correct and hearings occur annually, there would be many more than 20 hearings each year since there are 50 states and each state typically has several regulated electric utilities.

Table III: Analysis of Damodaran’s data set

	Market value D/E		Book value D/E	
	$\beta_{\text{Electricity}}$	β_{Gas}	$\beta_{\text{Electricity}}$	β_{Gas}
Median	0.357	0.225	0.276	0.159
Mean	0.398	0.241	0.349	0.180
Std dev	0.294	0.193	0.314	0.147

to be valid. Some of the firms in the sample are not even regulated. Information on the specific regulatory regimes facing the remaining firms in the US gas distribution sector is reported in Appendix A. It reveals substantial diversity across firms. Since many of the regulated firms operate in several states, and hence under several regulators, it also reveals substantial diversity *within* firms. For example, Piedmont Natural Gas distributes natural gas in three states. The most recent base rate reviews were two (North Carolina), seven (South Carolina), and three and a half (Tennessee) years apart. As Appendix A shows, the diversity within Piedmont Natural Gas is typical of firms in this industry.

39. [pg 41, ln 12] When following the procedure described in LINES, we are unable to reproduce the asset betas claimed to be derived from the Damodaran data set. As in LINES, we first selected all firms with the SIC codes 4911–4913 and 4920 and then deleted all those listed as foreign or with missing data.²⁹ This leaves 66 electric utilities and 27 gas distribution firms. Damodaran reports “three-year regression” equity betas and Value Line equity betas. We convert the regression equity betas to asset betas using Hamada’s formula with D/E equal to the book value of debt divided by the market value of equity (from Damodaran’s data set) and the same tax rate, 0.34, as in LINES. We then adjust for differences in market leverage using the formula and parameter values given on pp. 41–42 of LINES, and obtain asset betas with the properties listed in the first two columns of Table III. The resulting averages for electric utilities and gas distribution firms are 0.40 and 0.24 respectively, in contrast to the values reported in LINES, 0.35 and 0.17 respectively. However, if we measure D/E by the book value of debt divided by the book value of equity (also from Damodaran’s data set), we obtain the last two columns of Table III. The averages of 0.35 and 0.18 match the figures in LINES almost exactly, suggesting that it may have used the book value of equity to calculate leverage despite its claim to have used the “book value of debt and the market value of equity” (pg 41, ln 13).
40. [pg 41, ln 16] LINES gives the average of the asset beta estimates of the US electric utilities (and, separately, the US gas distribution firms) for which data are available from Damodaran’s website, but not the individual estimates for each firm. Nor does it report the standard errors of the individual estimates or any measure of the dispersion of these estimates. Both these pieces of information need to be reported, as they indicate the precision of individual estimates and the dispersion of beta across firms, respectively.³⁰ We demonstrate how this unreported information can be used to properly evaluate the standard error of the final asset beta estimate in point 58 below.
41. [pg 42, ln 4] LINES assumes that the US company tax rate is 0.34, which is incorrect. The top corporate tax rate was cut to 0.34 in 1986, but a new top rate of 0.35 came into effect

²⁹Our data source is the spreadsheet of data on individual US firms dated 2004 on Damodaran’s website, <http://www.stern.nyu.edu/~adamodar/pc/archives/compfirm04.xls> (accessed on 11 February 2006).

³⁰Indeed, when discussing standard errors, the source of the data used in LINES notes that “[w]hile you can get a point estimate for a beta, it is more honest to consider the range for betas.” (http://pages.stern.nyu.edu/~adamodar/New_Home_Page/cfprojectsum.htm)

in 1994 (Tax Foundation, 2005). The average and marginal tax rate for companies with taxable income exceeding \$18,333,333 is 0.35. Further, state and local income taxes, which vary from 0.01–0.12, raise the effective rate to approximately 0.40 on average (KPMG International, 2004; Tax Foundation, 2005).

42. [pg 43, ln 6] LINES only gives the average of the asset beta estimates of the US electric utilities (and, separately, the gas distribution firms) for which data are available from Bloomberg. As discussed in point 40, the precision of the individual estimates and the dispersion of the estimated betas across firms both need to be reported. Standard errors are available from Bloomberg.
43. [pg 43, ln 17] LINES only gives the average of the asset beta estimates of the US electric utilities (and, separately, the gas distribution firms) in the study by Alexander et al. (1996). As discussed in point 40, the precision of the individual estimates and the dispersion of the estimated betas across firms both need to be reported.
44. [pg 43, ln 25] LINES only gives the median of the asset beta estimates of the US electric utilities (and, separately, the gas distribution firms) for which data are available from Ibbotson. As discussed in point 40, the precision of the individual estimates and the dispersion of the estimated betas across firms both need to be reported. Ibbotson also provides company-level beta estimates that include *t*-statistics, so standard errors for the beta estimates are available and should be reported.
45. [pg 44, ln 12] LINES only gives the average of the asset beta estimates of the US electric utilities (and, separately, the gas distribution firms) for which data are available from Standard and Poors. As discussed in point 40, the precision of the individual estimates and the dispersion of the estimated betas across firms both need to be reported.
46. [pg 44, ln 21] When comparing the results for US electric utilities and gas distribution firms, LINES states that “[t]he median for gas distribution firms (.22) is below that of electric utilities (.27). However, the overall discrepancy is less than one standard deviation of the estimate, and therefore is not statistically significant.” LINES does not present a value for “one standard deviation of the estimate”, nor does it describe how the standard deviation is calculated. In fact, it is not even clear what “estimate” is being referred to.
47. [pg 45, ln 7] LINES defines rate of return regulation as “price-capping with annual resetting of prices so as to cover expected costs”, but this is overly simplistic. As discussed in Guthrie (2006), rate of return regulation and price cap regulation differ along several dimensions.

Rate of return regulation involves the regulator setting *all* of the firm’s prices, typically for an *undetermined* period. Prices are revised after the regulator holds another formal price review, which may be prompted by the firm requesting price changes. If prices are revised frequently it is because the firm files for a price review frequently. Prices are usually set so that the firm can expect to recover its *actual* cost of doing business.

Price cap regulation allows the firm considerable freedom to adjust prices between regulatory reviews because price caps typically apply only to the price of a *basket* of the firm’s goods. The price caps are typically imposed for a *fixed* period of time, and reviewed at the end of that period. The parameters describing the price cap are usually set so that the firm can expect to recover only the costs that a *hypothetical efficient firm* would incur.

In contrast to the claim in LINES, the difference in the timing of price changes under the two regimes may not be all that significant. Joskow (1973, 1974) reports evidence that

inflation shocks and fuel cost shocks trigger formal price reviews under rate of return regulation. Since the 1970s, fuel cost shocks have largely been negated by so-called ‘fuel adjustment clauses’, which allow firms to pass the full cost of fuel onto customers. This leaves inflation, which is handled by the firm’s ability to request a price rise. Firms subject to price caps also often have the ability to pass specific cost shocks onto customers. For example, during the period 1990–1994, the so-called price cap on the supply operations of UK regional electricity companies actually provided for all generation costs, and distribution and transmission charges, to be passed directly through to customers (OFFER, 1998, p. 12). In addition, price caps are usually set up in such a way that prices can be automatically adjusted in line with inflation. This suggests that the timing differences between the two regimes are not all that significant, at least as far as two of the main factors — inflation and fuel cost — are concerned.

48. [pg 45, fn 49] LINES states that “... the Value Line estimates did fall in the period 1998–2003. For example, Damodaran’s industry average Blume betas for 2003, 2002 and 2001 are .46, .37 and .32 (each based on the preceding five years of data).” There must be a mistake here, because these figures indicate that beta actually rose, from 0.32 in the first period to 0.46 in the third period.
49. [pg 46, ln 6] LINES states that “UK regulated firms in the gas and electricity industries ... were subject to price capping, with five yearly price resetting, in the period 1990–1994.” However, beta is a forward-looking concept, so it not just the *current* regulatory regime that is relevant, but also beliefs regarding the *future* regulatory regime.³¹ In point 53 below, we note that the price caps imposed on the distribution operations of regional electricity companies were replaced by a hybrid price cap/revenue cap after the 1990–1994 regulatory cycle. To the extent that the introduction of these alternatives was anticipated prior to that date — as would seem likely, given the extensive discussions that typically precede regulatory changes (Binder, 1985) — the effect of the revenue caps on beta would have been felt prior to their introduction, affecting the beta estimates cited in LINES. The pure ‘price cap’ beta would then be higher than the figures cited in LINES.
50. [pg 46, ln 8] LINES argues that the difference in betas between US and UK electric utilities helps “establish the effect of capping prices over a longer period than one year.” This would only be the case if the only important difference between firms in the two countries was the frequency with which regulatory settings are reviewed. This is clearly not the case, as we discuss above in point 47. In addition, comparing US electric utilities with UK firms shares all of the problems that arise when comparing US electric utilities with NZ firms, discussed in point 37.
51. [pg 46, ln 10] Although LINES does not mention this, Alexander et al. (1996, pp. 25–26) note that their UK regional electricity company asset beta estimates are very sensitive to the frequency of the data used in their OLS regressions. For example, beta estimates for the industry as a whole over the full five years are 0.58 (daily data), 0.70 (weekly

³¹For example, Grout and Zalewska (2005) have conducted a careful empirical study of the impact of imposing a formal earnings-sharing mechanism on price-capped firms. For an equally-weighted portfolio of 15 price-capped firms in the UK, they estimate that the equity beta fell by 0.42 (with a standard error of 0.06), relative to the beta of a control portfolio of firms drawn from the FT30 index, during the period between July 1997 and August 1999 when the UK government was considering imposing a formal earnings-sharing mechanism on price-capped firms. For individual electricity generation and supply companies, the corresponding reductions in the equity beta were 0.41 (0.16), 0.41 (0.11), 0.44 (0.10), 0.55 (0.10), and 0.41 (0.08). Note that there was no change in regulation during their sample period, just the possibility of a future change, so the results reveal just how sensitive beta is to *future* regulatory settings.

data), and 0.96 (monthly data), while estimates for the US are much less sensitive to the frequency of the data. As they explain, this is consistent with UK regional electricity companies' shares being "relatively infrequently traded" (Alexander et al., 1996, pg 26). The academic literature confirms that the betas of infrequently-traded stocks are underestimated when using daily data, and that using lower frequency data is advisable.³² This suggests that the two higher beta estimates reported by Alexander et al. are more reasonable. At the very least, 0.58 is downward-biased. LINES neglects to mention any of this when choosing the estimate of 0.58.

52. [pg 46, ln 22] When comparing asset betas for UK price-capped firms and NZ electricity lines businesses, LINES makes the following statement: "The UK firms would be unable to raise their prices within the five year regulatory cycle in response to cost increases. By contrast, the New Zealand firms could raise prices, even over the price threshold (and they might not fear the resulting forward-looking investigation of excess profits if the price increase was merely in response to a cost increase). Accordingly, the price-capped firms would have higher asset betas than the New Zealand firms." The first sentence is incorrect. During the period 1990–1994 considered by LINES, the price controls imposed on the supply operations of UK regional electricity companies "covered almost all . . . supply business customers and provided for almost all costs (such as generation costs, and distribution and transmission charges) to be passed directly through to customers" (OFFER, 1998, p. 12).³³ The combination of this cost pass-through provision with the entry protection the supply businesses enjoyed during the period studied in LINES suggests that the distribution business beta, which is the one relevant for NZ lines businesses, would have been at least as high as the asset beta for the vertically-integrated regional electricity companies in the UK.
53. [pg 46, fn 51] LINES justifies ignoring UK data past 1994 because "the regulatory regime was altered essentially from price to revenue capping". According to Littlechild (2003, p. 292), who was the electricity regulator from 1989 to 1998, the price cap imposed on the transmission firm was converted from an average revenue cap to a total revenue cap. For the distribution businesses of the regional electricity companies, the regulator "moved to a 'hybrid' cap in which the 'driver' was a 50-50 weighting of output and number of customers (that is, it was a 50-50 weighting of an average revenue and total revenue cap)." Therefore, estimates of beta for the regional distribution companies during the 11 years since the end of the period used in LINES would still provide useful information. In particular, they would provide a lower bound on the price-cap beta for electric utilities. It is simply not credible to use evidence from US firms but ignore evidence from UK firms during this period.
54. [pg 46, fn 52] LINES states: "This is not only immaterial but would lead to a lower rather than a higher asset beta for airfields." Presumably "airfields" should be "lines companies" here.
55. [pg 47, ln 4] While trying to justify its decision to set the NZ firms' asset beta less than their UK counterparts', LINES asserts that "[p]rice-cap firms would also be subject to regulatory errors, some of which may increase their asset betas."

Footnote 53 purports to describe an example of such a regulatory error, but the nature of the error is not apparent. All it seems to be describing is a situation where a regulator

³²This is discussed in more detail by Grinblatt and Titman (2002, p. 157).

³³The regulator only removed the provision for automatic pass-through of generation purchase costs in April 1998 (OFFER, 1998, p. 12).

sets prices and then future unpredictable shocks occur. This is not regulatory error, but a regulator operating without perfect foresight. All this example tells us is that shocks arising between regulatory hearings can affect beta at the revision date.

Furthermore, if some regulatory errors increase beta, then some will also decrease beta. LINES provides no evidence that regulators make beta-increasing errors more often than they make beta-decreasing ones.

56. [pg 47, ln 5] The final claim made in LINES to support its assertion that NZ firms should have lower systematic risk than their UK counterparts is that “price-cap firms may also have been less likely to have lowered their output prices within the regulatory cycle so as to conform more closely with costs (because their regulatory regime clearly encourages the earning of excess profits within the regulatory cycle, subject to the price cap); this is likely to have increased their asset betas relative to the New Zealand firms.” LINES does not even attempt to offer an explanation for why NZ firms would be any different, and we can think of no convincing reason why they behave any differently from UK firms. NZ firms, like the distribution operations of their UK counterparts, could receive the full benefit of any cost reductions without breaching their price caps. The claim in LINES should be disregarded unless a convincing justification can be provided.
57. [pg 47, fn 54] LINES attaches more weight to US evidence than its UK counterpart because “more evidence is available concerning the US firms”. However, the overlapping samples (in terms of both firms and sample periods) in the US means that Table 3 provides a misleading impression of the US data available. More importantly, as we have discussed in points 37, 38, 52, and 56, the UK firms give a vastly superior comparison, even if there are fewer observations. LINES should attach far greater weight to the UK evidence, and reduce its dependence on the US evidence.
58. [pg 48, ln 1] LINES attempts to “formalize [its] uncertainty over [the] point estimates” it uses to calculate the overall asset beta estimate by specifying a standard error for each parameter. There is nothing whatsoever in LINES to provide a justification for these numbers.

The variation across firms described in point 37 above suggests that different US electric utilities will have different asset betas — not just different asset beta estimates, but different actual asset betas. LINES does not consider the implications of such cross-sectional variation. As we now show, this implies that the true standard error for the asset beta estimate will be substantially larger than the value chosen in LINES.

Suppose there are N firms in the sample, and that the true asset beta of firm n is

$$\beta_n = \beta + \theta_n, \quad n = 1, \dots, N,$$

where each θ_n is independently distributed with mean zero and standard deviation σ . The cross-sectional variation in asset betas will be due to intrinsic differences between the firms, perhaps of the type described in point 37. Suppose that we have an estimate of each firm’s asset beta. In particular, for firm n we can observe

$$\hat{\beta}_n = \beta_n + \varepsilon_n, \quad n = 1, \dots, N,$$

where each ε_n is distributed with mean zero, variance ϕ^2 , and correlation $\text{Cor}[\varepsilon_m, \varepsilon_n] = \rho \geq 0$ when $m \neq n$. It follows that $\hat{\beta}_n - \beta_n$ has mean 0 and standard deviation ϕ . Thus, ϕ measures the precision of each firm’s beta estimate, information that is readily obtained during the estimation process.

The average and sample variance of the N estimates are

$$\bar{\beta} \equiv \frac{1}{N} \sum_{n=1}^N \hat{\beta}_n$$

and

$$s^2 \equiv \frac{1}{N-1} \sum_{n=1}^N (\hat{\beta}_n - \bar{\beta})^2$$

respectively. Since

$$\frac{1}{N-1} \sum_{n=1}^N (\hat{\beta}_n - \bar{\beta})^2 = \frac{1}{N-1} \sum_{n=1}^N \left(\theta_n - \frac{1}{N}(\theta_1 + \dots + \theta_N) + \varepsilon_n - \frac{1}{N}(\varepsilon_1 + \dots + \varepsilon_N) \right)^2,$$

it follows that

$$E[s^2] = E \left[\frac{1}{N-1} \sum_{n=1}^N (\hat{\beta}_n - \bar{\beta})^2 \right] = \sigma^2 + (1 - \rho)\phi^2.$$

This motivates using $\hat{\sigma}$ as the estimate of σ , where

$$\hat{\sigma}^2 = s^2 - (1 - \hat{\rho})\hat{\phi}^2.$$

Under a broad range of conditions, $\hat{\phi}$ can be a consistent estimate of ϕ and $\hat{\rho}$ a consistent estimate of ρ , in which case $\hat{\sigma}^2$ is a consistent estimate of σ^2 .

If for some reason we wanted to estimate the average asset beta of firms in the industry, we would use the ‘average of the estimates’, $\bar{\beta}$. Since

$$\bar{\beta} - \beta = \frac{1}{N} \sum_{n=1}^N (\hat{\beta}_n - \beta) = \frac{1}{N} \sum_{n=1}^N (\varepsilon_n + \theta_n),$$

it follows that $\bar{\beta} - \beta$ has mean 0 and variance

$$\frac{\sigma^2}{N} + \frac{\phi^2}{N}(1 + \rho(N-1)).$$

Thus, the ‘average of the estimates’ is an unbiased estimator of β and as N grows very large, the standard error of this estimator approaches $\rho^{1/2}\phi$.

However, we are interested in estimating the actual asset beta of a single firm, not the average asset beta of all firms in the industry. That is, we want to use the ‘average of the estimates’ to estimate the asset beta $\beta_0 \equiv \beta + \theta_0$ for a single firm, labelled 0, using estimated asset betas from a set of different firms, labelled $1, \dots, N$. Since

$$\bar{\beta} - \beta_0 = (\bar{\beta} - \beta) + (\beta - \beta_0) = \frac{1}{N} \sum_{n=1}^N (\varepsilon_n + \theta_n) - \theta_0,$$

it follows that $\bar{\beta} - \beta_0$ has mean 0 and variance

$$\sigma^2 + \frac{\sigma^2}{N} + \frac{\phi^2}{N}(1 + \rho(N-1)).$$

Now, as long as the true asset beta varies across firms, we cannot get a precise estimate of β_0 even if $\rho = 0$ and N is large. Using the estimates of σ , ϕ , and ρ inferred from our sample, the estimated variance of $\bar{\beta} - \beta_0$ can be written

$$\text{EstVar}[\bar{\beta} - \beta_0] = \left(\frac{N+1}{N} \right) s^2 + \hat{\phi}^2(2\hat{\rho} - 1).$$

Table IV: Standard error of electric utility asset beta

		$\hat{\phi}$			
		0.0	0.1	0.2	0.3
$\hat{\rho}$	0.0	0.32	0.30	0.25	0.10
	0.5	0.32	0.32	0.32	0.32
	1.0	0.32	0.33	0.38	0.44

Table V: Confidence interval for electric utility asset beta

Data set	$\hat{\beta} < 0.1$	$0.1 \leq \hat{\beta} \leq 0.5$	$0.5 < \hat{\beta}$
Book value of equity, $T_c = 0.34$	15%	61%	24%
Market value of equity, $T_c = 0.35$	14%	52%	35%

For example, using the Damodaran data on US electric utilities discussed in point 39, with D/E based on the market value of equity and the correct US tax rate of 0.35, gives $s = 0.314$. Damodaran does not provide sufficient data on his website for us to be able to calculate $\hat{\phi}$ and $\hat{\rho}$, although they could be readily calculated if the underlying returns data were available. Therefore, in Table IV we report the implied standard errors of the average estimated asset beta if it is used to estimate the asset beta of a generic US electric utility for various combinations of $\hat{\phi}$ and $\hat{\rho}$, given the estimate $s = 0.314$. Based on this table, which covers the range of feasible values of $\hat{\phi}$ and $\hat{\rho}$, a sensible choice for the standard error of the US asset beta would appear to be closer to 0.3 than the value, 0.1, chosen in LINES.

59. [pg 48, fn 55] LINES explains that, assuming its beta estimate is normally distributed with its chosen standard error, the probability that the true beta value is between 0.10 and 0.50 is 0.95. It concludes that it is “virtually certain that the asset beta for the US firms” is in this range. We consider two sets of beta estimates in assessing the merits of this claim. First, we look at the distribution of the asset beta estimates from the Damodaran data set that we think were used in LINES (that is, those calculated using a tax rate of 0.34 and leverage based on the book value of equity). Second, we look at the distribution of what we believe to be more useful asset beta estimates (that is, calculated using a tax rate of 0.35 and leverage based on the market value of equity).³⁴ Table V reports the distribution of beta estimates for the two data sets. Only 61% of firms have estimated asset betas in what LINES claims is the 95% confidence interval for the true asset beta, based on its own calculations. When the correct leverage measure and tax rate are used, only 52% of firms have estimated asset betas in what LINES claims is the 95% confidence interval. The table thus provides further evidence that the standard error adopted in LINES is far too low.
60. [pg 48, ln 22] When LINES discusses the implications of the ODV asset valuation methodology for asset betas, it argues that “[o]nly the act of optimising introduces risk, because changes in replacement cost are treated as income items and therefore only affect the depreciation path over time.” This statement is incorrect because it ignores the possibility that the initial revaluation and the subsequent depreciation might occur in separate review periods.

To see why the statement is incorrect, note that the $NPV = 0$ principle is equivalent to requiring that at each point in time the present value of the firm equals its rate base, where

³⁴See the discussion in points 39 and 41 for an explanation of the differences in leverage measure and tax rate.

all investment expenditure is added to the rate base dollar-for-dollar.³⁵ This condition on the rate base implies that it evolves according to

$$B_{t+1} = B_t + CAP_{t+1} + REV_{t+1} - DEP_{t+1},$$

where B_t is the rate base at date t , CAP_{t+1} is capital expenditure at date $t + 1$, REV_{t+1} is the revaluation of the rate base at date $t + 1$, and DEP_{t+1} is depreciation at date $t + 1$. The $NPV = 0$ principle therefore amounts to requiring that the present value at date t of

$$(CF_{t+1} - CAP_{t+1}) + B_{t+1}$$

equals B_t , where CF_{t+1} is the firm's operating cash flow at date $t + 1$. Equivalently, it amounts to requiring that the present value at date t of

$$CF_{t+1} + B_t + REV_{t+1} - DEP_{t+1}$$

equals B_t . The firm's WACC reflects the systematic risk of this expression; that is, it incorporates compensation for the systematic risk of operating cash flows and for the systematic risk of $REV_{t+1} - DEP_{t+1}$. In fact, it can be shown that the WACC is

$$WACC = r_{t,t+1}^f + \lambda_t \text{Cov}_t \left[\frac{CF_{t+1} + REV_{t+1} - DEP_{t+1}}{B_t}, r_{t,t+1}^m \right],$$

where $\lambda_t = (E[r_{t,t+1}^m] - r_{t,t+1}^f) / \text{Var}_t[r_{t,t+1}^m]$ is the market price of risk. (More details can be found in Evans and Guthrie, 2005a.) Therefore, the WACC in period t depends on the systematic risk of $REV_{t+1} - DEP_{t+1}$ (as well as CF_{t+1}). LINES seems to be arguing that since revaluations alter depreciation, the effect of any shock to REV_{t+1} will be cancelled out by an offsetting shock to DEP_{t+1} . However, there is no reason to believe that the shock to depreciation will occur in the same period as the revaluation shock. More realistically, any shock to REV_{t+1} will result in changes to DEP_{t+2} , DEP_{t+3} , and later values. Moreover, because these subsequent changes to depreciation will then be anticipated, they will not affect future values of the WACC.

61. [pg 48, ln 24] LINES argues that "the act of optimisation would inject only industry specific risk at most, i.e., this would not be a market risk. Accordingly the asset beta of the firm would be unaffected." However, LINES subsequently states that optimization can be demand driven.³⁶ A necessary condition for the quoted comment to be correct is thus that *all* demand shocks are unsystematic, which is untenable for the industry considered here. Also, as Evans and Guthrie (2005a) explain, the irreversible nature of much infrastructure investment means that even an unsystematic component of optimization risk can affect a firm's overall level of systematic risk. Thus, LINES is incorrect when it argues that the prospect of optimization has no effect on a firm's asset beta.

5.3 Contrary Views

62. [pg 51, ln 5] LINES dismisses the use of the three NZ beta estimates due to the "enormous estimation errors". The variation in the estimated asset betas may reflect estimation error, as LINES claims, or may indicate that the three firms have quite different asset

³⁵A minimal set of additional conditions usually imposed on the rate base is that it is zero before the firm starts business, that it must always be nonnegative (an ongoing participation constraint reflecting the limited liability of the firm's shareholders), and that it must never be greater than the market value of an unregulated monopolist (in order to be feasible). For example, see Greenwald (1980, 1984).

³⁶From pg 71, ln 20: "The reasons for [optimisation] include penalising over-investment (gold plating), technology improvements, and reductions in demand."

betas (which have been precisely estimated). The reader cannot tell which is the case because standard errors for the three estimates are not reported. (Also see the discussion of point 36.)

63. [pg 52, ln 1] In commenting on Ferguson and Shockley (2003), LINES states that “even if the effect of including risky debt in the market portfolio proxy were to raise the betas of the lines businesses, the downward effect upon the market risk premium may offset it.” Or it may not offset it. This statement is pure speculation. Its inclusion is another example of the inconsistent application of the ‘burden of proof’ in LINES and it should be contrasted with the rejection of others’ claims in LINES as “pure conjecture”.

More importantly, the fundamental point of Ferguson and Shockley (2003) is not that the omission of debt securities from the market portfolio biases beta downwards, but rather that the extent of this bias *increases* with the firm’s *actual* leverage. In short, the betas of firms with different leverage differ in a fundamental way. As a practical matter, this might simply be ignored if leverage differences across lines companies were small, but the figures in Table 2 of LINES indicate this is not the case.

6. Leverage

64. [pg 53, ln 21] LINES states that a firm’s optimal leverage “cannot be directly determined, as it reflects a trade-off between competing considerations such as taxes, bankruptcy costs and the financial flexibility offered by debt.” It neglects to mention the many other factors that determine a firm’s optimal leverage, such as the tradability of the firm’s shares, conflict between bondholders and shareholders, the presence of diffuse shareholders, information asymmetries, and the extent of product market competition. See, for example, Grinblatt and Titman (2002, pp. 557–690).
65. [pg 53, ln 24] LINES advocates using “optimal leverage”, which we take to be the leverage that a hypothetical efficient electricity lines business would adopt, and then goes on to claim that optimal leverage “could be inferred from examining the average level amongst relevant firms. Recent leverage values for firms within the industry are admissible”. However, implicit in this approach is the belief that firms’ actual leverage differs from optimal leverage (otherwise the more-easily measurable actual leverage could be used). LINES offers no explanation for why averaging over firms that do not choose the same leverage as a hypothetical efficient electricity lines business will result in an accurate estimate of the latter’s leverage. Deviations between actual and optimal leverage will depend on fundamental firm characteristics, as described in point 64, and will not necessarily average out to zero.³⁷ To simply take the average across a set of firms is naive and will not yield a sensible estimate of the optimal leverage for an individual lines company.³⁸
66. [pg 53, ln 28] LINES claims that observed leverage from firms in “monopolistic industries with stable cash flows” can be used to infer optimal leverage for lines businesses,

³⁷Furthermore, the optimal leverage of a firm will depend on the costs that it faces. Actual firms choosing actual leverage face actual costs. A hypothetical efficient firm choosing “optimal leverage” faces efficient costs. Average actual leverage and optimal leverage are therefore likely to be fundamentally different.

³⁸One cannot even say that, assuming firms behave optimally (a possibility that LINES doubts elsewhere), average observed leverage equals optimal leverage for an ‘average’ firm, since optimal leverage L^* may be a nonlinear function of firm-specific parameters x , in which case $L^*(\text{Aver}[x]) \neq \text{Aver}[L^*(x)]$ in general.

and goes on to suggest using airfields. However, its use of airfields' leverage is inconsistent with its earlier arguments that airfields face different risks from electricity lines businesses (see pg 36, ln 3; pg 36, fn 39; pg 38, fn 41; pg 49, ln 3).

67. [pg 54, ln 1] LINES reports the average leverage of NZ firms, but gives no indication of the extent of variation across firms. We note that in the sample of US electric utilities in the Damodaran data set discussed in point 39, the mean value of L is 0.46 and the standard deviation is 0.15, so there is clearly substantial variation in leverage across firms. (These figures apply to leverage calculated using the market value of equity.)
68. [pg 54, ln 11] In discussing whether to use firms' actual leverage, LINES claims that using actual leverage in place of its preferred level of $L = 0.4$ "would affect WACC by less than .30%. Whether this is a sufficiently large figure to be troubled with is debatable." We note that LINES puts considerable effort into adjustments, such as that for differences in market leverage across countries, that lead to smaller changes in the WACC. If it is to be consistent, either variations in leverage across firms should be taken more seriously or these other adjustments should be ignored.
69. [pg 54, ln 14] Another reason for not using actual leverage that is offered by LINES is that "actual leverage cannot be determined for most of the lines businesses because it must be assessed in market value terms and this requires the firm to be listed". However, as we discuss in point 39, LINES appears to have used the book value of equity to calculate leverage when analyzing Damodaran's set of US electric utilities, in which case it is applying an inconsistent standard.

7. The Debt Premium

70. [pg 56, ln 1] LINES considers the impact on WACC of different levels of leverage. "If a higher leverage level were invoked, with an associated increase in the debt margin, the WACC would be increased, but not significantly." For example, it claims that raising leverage and the debt premium to 50% and 1.4% respectively increases the WACC by 0.15%. The inference seems to be that uncertainty surrounding the level of leverage is unimportant.³⁹ As we noted in point 68 above, LINES puts considerable effort into adjustments, such as that for differences in market leverage across countries, that lead to smaller changes in the WACC. If it is to be consistent, either uncertainty surrounding leverage should be taken more seriously or these other adjustments should be ignored.
71. [pg 57, ln 17] LINES offers no evidence in support of its claim that an allowance of "about .003" for debt issue costs (when coupled with swap contracts) is appropriate. The claim is pure conjecture and is another example of the inconsistent application of the 'burden of proof' in LINES.

8. The Form of Ownership

72. [pg 58, ln 4] LINES claims that "[t]he implications of [non-investor ownership] for the asset beta have already been discussed, and it has been suggested that quantification is impossible." The only mention of this issue that we can find prior to this point in

³⁹Indeed, as we discuss in point 74 below, in the subsequent WACC calculation, leverage is assumed to be observed without error.

LINES is in the executive summary (which just states that the form of ownership might affect the beta “and this appears impossible to quantify” (pg 4, ln 27)) and at pg 48, fn 56 (which asserts that businesses that “are not embedded within private sector firms” may “operate in a more cost-plus fashion”). Neither constitute an adequate discussion of the implications of non-investor ownership for the asset beta.

73. [pg 58, ln 25] LINES claims that quantifying the premium for the non-tradability of shares in some line businesses “does not seem to be possible”, and proceeds to make no adjustment to its WACC estimate. It is true that there is no means of measuring this premium that is used as widely as the CAPM is used to estimate required rates of return for tradable assets. However, a substantial academic literature in finance provides empirical evidence that, by comparison with the highly liquid securities assumed in the CAPM analysis, investors require a higher rate of return to invest in illiquid assets. It also provides theoretical evidence that such premia are rational and suggests explicit ways of measuring them.⁴⁰

9. WACC

9.1 Estimates

74. [pg 59, ln 28] Here LINES states its point estimates and standard errors for the parameters needed to calculate WACC. As discussed in point 14 above, the standard error for the MRP is likely to be significantly higher than the value used in LINES. As discussed in points 58 and 59 above, the asset beta’s standard error in LINES has no objective basis and is likely to be far too low. Finally, as discussed in point 67 above, the standard error for the estimate of “optimal leverage” is likely to be large, not zero as assumed in LINES.
75. [pg 61 ln 9] When referring to the MRP and the three components of its asset beta, LINES states that “the true but unknown values for these four parameters are independent...”. In fact, the values of these parameters are constants, not random variables as implied by the reference to their “independence”. We presume LINES is referring to the parameter estimates. Parameters and parameter estimates are fundamentally different objects.
76. [pg 61, ln 11] The calculation of the standard error of the WACC estimate in LINES relies crucially on the estimates of the inputs being independently distributed.

However, the way in which the inputs are constructed ensures that this is almost certainly not going to be the case. For example, the parameter Δ has been estimated essentially by subtracting the estimated US asset beta from the estimated UK asset beta. Thus, it is almost certainly correlated with the former, which also appears in the WACC calculation; for example, if the US beta estimate is drawn low, $\hat{\Delta}$ is likely to be drawn high. More precisely, if $\hat{\Delta} = \hat{\beta}_{UK} - \hat{\beta}_{US}$, it follows that

$$\text{Cov}[\hat{\beta}_{US}, \hat{\Delta}] = \text{Cov}[\hat{\beta}_{US}, \hat{\beta}_{UK}] - \text{Var}[\hat{\beta}_{US}].$$

This equals zero if and only if

$$\text{Corr}[\hat{\beta}_{US}, \hat{\beta}_{UK}] = \frac{\text{StdDev}[\hat{\beta}_{US}]}{\text{StdDev}[\hat{\beta}_{UK}]}.$$

⁴⁰See, for example, Acharya and Pedersen (2005) and Longstaff (2005).

That is, a necessary condition (and by no means a sufficient condition) for the calculations in LINES to be legitimate is that the correlation coefficient for the UK and US estimates is equal to the ratio of the standard deviations. There is no reason to believe that this will be the case, in which case the calculation of the WACC's standard error is invalid.

Moreover, even if the measurement errors are uncorrelated, cross-firm variations in asset beta, leverage, the debt premium, and so on, will almost certainly be correlated.

77. [pg 61, fn 69] LINES comments that "even if the beta and the market risk premium were estimated from the same data, multivariate normality in asset returns would imply the independence of these estimates". However, it is widely accepted that asset returns are *not* multivariate normally distributed, so the quoted comment cannot justify the assumption made in LINES that its parameter estimates are independent.
78. [pg 62, ln 4] There is a typo in Table 4, which reports the asset beta estimate as 0.50 instead of the 0.40 used elsewhere.
79. [pg 63, ln 18] The attempt to analyze the sampling distribution of its WACC estimate is unsatisfactory. The approach in LINES is to fit three different distributions (normal, lognormal, and gamma) to its chosen mean and standard deviation and compare various percentiles. For the chosen mean and standard deviation, the results are similar across the three distributions, although this will not necessarily be the case if more realistic standard errors are used.

A much better approach would be to simulate the distribution of the WACC estimate by simulating the underlying parameters. For example, one might simulate 1000 estimates of the market risk premium, asset beta, and leverage, and generate the 1000 implied estimates of the WACC. The distribution of these estimates would approximate the true sampling distribution of the WACC.

LINES rejects this approach because "such a simulation would require knowledge of the shape of the probability distributions for each of the four underlying parameters for WACC, and these distributions are not known." (pg 63, ln 20) However, one could vary the assumed distributions for the inputs when carrying out the simulation exercise. The results would be far superior to the approach adopted in LINES, which is simply to vary the assumed distribution for the final WACC estimate and ignore the underlying sources of variation.

9.2 Further Considerations

80. [pg 66, ln 11] There are two problems with the estimation of the asset beta appropriate for input into an international CAPM.

First, the point estimate is unfathomable. LINES presents estimates for the betas of NZ equities against world stock indices as a proportion of their betas against a local stock index. Its estimates are summarized in Table VI. LINES then claims: "All of this points to an estimate of about 0.70, which is invoked." But this is the lowest of the estimates reported and for a sample period that ended in 1992. For the most recent data cited in LINES, the ratio is in fact 0.82. If 0.82 is used instead of 0.70 in the subsequent calculations, the increase in WACC from using a domestic CAPM instead of an international one is just 0.2%, not the claimed 0.4%.

Table VI: Implementing an international CAPM

Sample period	$\frac{\hat{\beta}_{World}}{\hat{\beta}_{NZ}}$
1973 – 1992	0.70
1980 – 2001	0.77
1980 – 1990	0.72
1991 – 2001	0.82

Second, this is another situation where LINES does not include the standard errors of its estimates. Had it done so, the reader would be in a much better position to assess the merits of its arguments.⁴¹

10. Comparison with Australian Regulatory Judgements

81. [pg 70, ln 9] LINES claims that an asset beta of 0.4 is representative of the decisions made by Australian regulators and that “these numbers are offered in the context of setting revenue caps for five years, and therefore are not directly comparable with the estimate of .40 offered in [LINES] for the purpose of assessing excess profits.” However, revenue caps should expose firms to less risk than the regime in NZ, so the NZ beta should be higher than the Australian values. That is, the evidence in LINES suggests that its estimate is too low.
82. [pg 70, ln 20] LINES claims that “[r]evenue caps involve less risk to the firm than price caps, because exposure to volume shocks is removed.” This statement is incorrect. Revenue caps *reduce* exposure to volume shocks, they do not *remove* it.
83. [pg 71, ln 1] LINES reports that Australian regulators have adopted a leverage level of 0.6, in contrast to its preference for 0.4, and then dismisses the difference because adopting the Australian leverage assumption would “raise the WACC by only 0.16%.” As we noted in points 68 and 70 above, LINES puts considerable effort into adjustments, such as that for differences in market leverage across countries, that lead to smaller changes in the WACC. If it is to be consistent, either uncertainty surrounding leverage should be taken more seriously or these other adjustments should be ignored.

11. Allowances for Other Issues

11.1 Asymmetric Risks

84. [pg 72, ln 15] Apart from the specific mistakes discussed below, the discussion of the implications of asset stranding and optimization risk in LINES suffers because of its unrealistic view of the world. It asserts that firms deal with these and similar risks “either by raising prices ex-ante or ex-post to protect itself.” There are two problems here.

First, LINES ignores the much more likely possibility that the firm adopts a strategy somewhere between these two extremes, and so provides no guidance on how to treat the issue as it typically arises in the real world. Such real-world features as long-term contracts,

⁴¹Furthermore, LINES only provides the source for the 1973–1992 results. More information, such as data frequency and the nature of the portfolios used, is necessary before one can have confidence in the results.

which may restrict firms' price responses, make consideration of such partial-insurance responses especially important and should not simply be ignored.

Second, it focuses exclusively on the price implications of asymmetric risk, ignoring the fact that firms have other, non-price, responses to the risk of future adverse events. If regulation exposes firms to such risks, they will try to mitigate these risks by, for example, delaying their investment, investing in assets with short lead-times, favouring projects that offer flexibility over scale or that involve greater non-sunk costs relative to sunk ones.⁴² The way in which regulators compensate firms for such risks can have a significant impact on welfare. The discussion of these issues in LINES is inadequate.

These mistakes are repeated at pg 74, ln 7.

85. [pg 73, ln 6] The discussion of how the regulator should treat stranding is confused. The first suggestion in LINES is that stranded assets be removed from the rate base and that firms be offered "some form of ex-ante compensation". Its second suggestion is that stranded assets not be removed from the rate base "in which case no ex-ante compensation is required." But then it goes on to argue "[r]egardless of which approach is adopted by the Commission, the business must still protect itself against a real economic risk, and it must do so by increasing prices ex-ante." In one sentence it states that the second approach does not require ex ante compensation, but then it argues that the firm must be allowed such compensation in the form of high prices ex ante. Which is it?

This confusion appears again in the discussion of evaluating excess earnings in the presence of stranding and optimization risk. See points 107 and 108 below.

86. [pg 73, ln 16] When discussing the importance of compensating firms for bearing the risk of asset stranding, LINES argues that "the issue may not be substantial in the present context because stranding is most likely to occur for dedicated assets (supplying individual industrial consumers, which are at risk of closure) and the lines businesses may have entered into bilateral contracts to manage such risks." It offers no supporting evidence whatsoever for these claims. In fact, it recognises some contradictory evidence, which it then largely ignores. Unless supporting evidence *can* be provided, its claims should themselves be ignored.
87. [pg 73, ln 24] Despite recognizing that both asset stranding and optimization can arise due to negative demand shocks,⁴³ LINES argues that ex ante compensation should cover only the expected cost, with no allowance for a risk premium,⁴⁴ and that "discount rate adjustments [for stranding and optimization risks] involve superfluous detail at best". The argument that compensation for "expected" stranding and optimization costs can be incorporated in the cash flows is correct, as is the observation that incorporating them in the discount rate involves an additional layer of (unnecessary) calculations. However, the same cannot be said of the compensation that is required for the bearing the systematic risk associated with these events. Like compensation for any systematic risk, this is most naturally incorporated in the discount rate.⁴⁵ As long as *some* demand shocks are systematic, stranding and optimization risk will have a systematic component. Moreover,

⁴²This extensive literature is surveyed in Guthrie (2006).

⁴³From pg 71, ln 20: "The reasons for [optimisation] include penalising over-investment (gold plating), technology improvements, and reductions in demand."

⁴⁴From pg 73, ln 24: "By their very nature these asymmetric risks are cash flow issues rather than discount rate issues, i.e., they are compensation for expected losses rather than investor aversion towards dispersion of actual outcomes around the expectation."

⁴⁵The comparison of the treatment of future operating costs is informative. Compensation for expected future operating costs is usually incorporated in the cash flows, while compensation for bearing the systematic risk asso-

as Evans and Guthrie (2005a) explain, the irreversible nature of much infrastructure investment means that even an unsystematic component of demand risk can affect a firm's overall level of systematic risk. It is thus incorrect to argue that the prospect of optimization is not a "discount rate issue". (A similar mistake is discussed in point 61.)

11.2 Market Frictions: Costs of Financial Distress

88. [pg 75, ln 11] LINES largely dismisses the empirical evidence on US hurdle rates of Poterba and Summers (1995), stating that extrapolating this evidence to NZ firms "warrants some caution" and that various explanations for these high hurdle rates are possible. With respect to the first comment, LINES extrapolates evidence on US electric utilities to NZ firms, so one wonders what is special about the Poterba and Summers study. With respect to the second comment, all of the possible explanations for the high hurdle rates suggested in LINES are applicable to regulated firms, so should not be ignored.
89. [pg 75, ln 20] LINES claims there are three difficulties with several papers providing evidence that project-specific risks affect hurdle rates (Mukherjee and Hingorani, 1999; Keck et al., 1998; and Graham and Harvey, 2001).

First, it claims that "*most* of the non-market risks referred to in the last two papers are macro-economic rather than project-specific" (emphasis added). For this point to be relevant, *all* of the non-market risks would have to be macro-economic rather than project-specific. However, this is not the case. Moreover, *none* of the non-market risks in Mukherjee and Hingorani (1999) is macro-economic.

Second, it claims that "in respect of Mukherjee and Hingorani in which project-specific risks are apparent, the quantitative effect upon hurdle rates is not indicated." Nevertheless, the demonstrated existence of capital rationing indicates that the premium is positive, so arbitrarily setting it to zero ensures that allowed returns are too low.

Third, "reference to the actual behaviour of firms presumes that firms are acting appropriately, and yet both Keck et al. and Graham and Harvey identify a number of ways in which the firms appear to be acting in error." Elsewhere, however, the actual behaviour of firms is used to estimate parameters of interest (for example, the "optimal leverage" of firms). If real-world firms do in fact act in error, this casts further doubt on the optimality of the leverage estimate adopted in LINES. More generally, it is inappropriate to simply ignore real-world behavior whenever it cannot be explained by a small subset of accepted finance theory.

11.3 Timing Flexibility

90. [pg 79, ln 7] LINES states that a timing option premium should be calculated for each of a firm's assets, rather than one for the firm as a whole. However, requiring asset-specific timing option premia is clearly impracticable. Furthermore, the same could be said of the use of a WACC. Finance theory purists would require a separate WACC for each different type of asset, yet LINES is content to calculate a single WACC for the firm as a whole. In fact, it goes further and calculates a single WACC that is to be applied to several

ciated with future operating costs is usually incorporated in the discount rate. Compensation for future stranding and optimization costs can be treated similarly.

different firms.⁴⁶ How can it then reasonably expect firms to calculate timing premia for individual *projects*?

91. [pg 79, ln 11] LINES argues that a portion of the value of timing options might derive from market power. Since a simple formula decomposing the value of the timing option into these two components has not been presented to the NZCC, LINES subsequently ignores the value of timing options altogether. That is, without providing any theoretical or empirical evidence of its own, it proceeds as though market power makes up 100% of the option's value. The debate concerning the extent to which competition erodes the value of investment timing options is not settled. For example, although it has been shown that competition reduces their value in some circumstances (Grenadier, 2002; Lambrecht and Perraudin, 2003), the generality of this result has been questioned (Novy-Marx, 2004). Therefore, to simply assume that market power makes up 100% of the option's value is unreasonable. It will generally have the effect of lowering the estimate of the cost of capital.

A similar mistake is discussed in point 97.

92. [pg 79, ln 26] LINES requires that firms "demonstrate that any timing option was ever exercised" in order to receive compensation in the form of a WACC premium, but this misses the point. When a firm with timing flexibility invests, it exercises an option to invest and destroys an option to wait and possibly invest later. The WACC premium is compensation for the value of the option that is destroyed. Demonstrating that an investment option has been exercised is trivial — the mere existence of the asset proves that investment has taken place. Of more relevance is whether a delay option was destroyed. Most investments made by electricity lines businesses have some timing flexibility (for example, maintenance and investment upgrades), so this condition is also easily satisfied. Moreover, investment can destroy many options — such as those relating to location, scale or type, for example — not just the option to delay. Their value should also be reflected in the WACC premium. In short, investment flexibility is widespread. Investment *inflexibility* — the now-or-never investment options needed for the $NPV = 0$ principle to be appropriate — is the exception rather than the rule.

93. [pg 80, ln 6] LINES claims that "... there is no margin that can be added to WACC that would ensure that firms invest at the socially optimal time (or even at the point that they would in the absence of regulation)."

The first part of this statement is irrelevant: even if there were no WACC premium that results in socially-optimal investment timing, there may be one that results in investment timing that raises overall welfare beyond that achieved without a WACC premium. Surely such a premium should be used.

The second part of this statement is clearly incorrect: if the premium added to the WACC were sufficiently large to ensure that the firm's prices were effectively unregulated, the firm's investment would match that of an unregulated firm.

94. [pg 80 ln 9] LINES claims that setting the allowed rate of return above the WACC would induce a regulated firm to invest immediately: "since [the] firm would receive the same

⁴⁶LINES dismisses Transpower's suggestion that asset betas should be calculated for individual lines businesses. It states (pg 53, ln 4): "it does not seem to be possible to assign different estimates across the lines businesses, even if there are grounds for supposing that a particular company has a lower value than another. The primary source of evidence in this area are estimates drawn from large sets of foreign firms, and the resulting estimates do not lend themselves to differentiating amongst the lines businesses."

margin regardless of when it invested, [it] would be encouraged to invest at the earliest possible time so as to maximise the period for which the margin was earned.” To see how this claim is false, suppose, for example, that the premium over the WACC is so large that the firm’s prices are effectively unregulated. LINES is then arguing that such a firm would invest immediately, but this ignores the principle that delay can be valuable to unregulated monopolists. Indeed, it argues earlier for the validity of this very principle. (For example, see pg 78, ln 21.)

11.4 Firm Resource Constraints

95. [pg 80, ln 23] LINES states that “the fact that a margin on WACC is appropriate for the purpose of assessing new investment does not imply that it will also be appropriate for the purpose of assessing excess profits.” This statement is alarming, since it suggests that existing assets should somehow be treated differently from prospective ones; that is, once the firm has made an (irreversible) investment, the rules should somehow change. There is now an extensive literature documenting the adverse consequences of such regulatory opportunism for firms’ investment behavior.⁴⁷ The consensus to emerge from this literature is that the sort of regulatory behavior apparently advocated by LINES is not in the best long-run interests of consumers.
96. [pg 80, ln 25] When discussing the opportunity cost that arises when investment in one project precludes investment in another (due to firm resource constraints), LINES asserts that “the existence of this opportunity cost *may* simply reflect the existence of excess profits on the adopted project”. This is incorrect. The existence of this opportunity cost (in fact, the existence of any opportunity cost) can only indicate that an opportunity has been lost when investment occurred. Presumably the meaning intended is that the existence of this opportunity cost may simply reflect the existence of excess profits on the project that was *not* adopted.
97. [pg 81, ln 10] LINES rejects any premium for firm resource constraints because of its advocates’ “failure to even quantify the WACC margin”. That is, it arbitrarily sets the premium equal to zero. Making some sort of judgement call is inevitable in this instance, as there is no established formula for calculating a premium for resource constraints, but arbitrarily choosing a value of zero is clearly incorrect.
A similar mistake is discussed in point 91.

11.5 Information Asymmetries

98. [pg 81, ln 20] In arguing that a premium should not be added to the WACC to reflect information asymmetries, LINES argues that “the fact that a firm might be discouraged from undertaking *new* projects for fear that doing so would reveal the *true* situation within it ... does not have any bearing on the question of whether it is earning excess profits on its *existing* projects” (original emphasis). See point 95 for a discussion of the consequences of following this advice.

⁴⁷See Blackmon and Zeckhauser (1992) for an accessible introduction to this literature and Guthrie (2006) for a recent survey.

99. [pg 81, ln 26] In further developing its argument, discussed in point 98, that a premium should not be added to the WACC to reflect information asymmetries, LINES claims that “even in respect of new projects that are undertaken in these circumstances, it would be inappropriate for the Commission to add a margin to WACC, as this would constitute justifying higher prices to customers merely because existing shareholders in the firm have failed to convey information to new shareholders prior to the share issue. The appropriate solution to this informational problem is improved dissemination of information.” This comment flies in the face of thirty years of corporate finance research.⁴⁸ Information asymmetries cannot be fixed simply by firms improving the “dissemination of information”. They are intrinsic.
100. [pg 82, ln 20] The final justification in LINES for not adding a premium to the WACC to reflect information asymmetries is that “[s]hareholders in aggregate are unaffected” by information asymmetries; that is, they only generate a transfer between shareholders and can thus be ignored. This argument would be reasonable if the regulator could completely control investment by the firm, but such situations are rare.⁴⁹ Instead, firms exercise considerable control over their own investment behaviour. In the situation discussed in LINES, the firm’s existing shareholders would not allow the firm to invest without a premium. For example, suppose a project will cost \$100 but in order to raise the funds from outside investors (who have less information than insiders), the firm must issue securities that it knows are worth \$110. It will only invest if the value of the cash flows the regulator allows it to earn from the project are greater than or equal to \$110. Unless it can somehow force the firm to invest, the regulator must allow cash flows worth \$110 or the firm will not invest. The \$10 is not an “excess profit”; it is an intrinsic cost of raising capital.

12. Employing the WACC to Assess Excess Profits

12.1 Assessing Excess Profits in Dollar Terms

101. [pg 82, ln 23] The definition of excess profits contained in LINES — that they arise whenever the net present value of future cash flows is positive — is inadequate because it ignores the consequences of such a restrictive definition for the regulated firms’ investment incentives. This definition would be appropriate if the regulator could completely control investment by the firm, since there would then be no incentive effects to worry about. However, as discussed in point 100, situations where regulators completely control investment are rare. Instead, regulated firms typically retain significant investment flexibility — they can choose the timing, location and scale of their new investment and maintenance, for example. In such a world, investment will only occur if the firm profits from making them. Firms act in order to maximize value, and if regulatory settings mean that value is maximized by not investing, firms will not invest. There are many reasons why this is exactly what would occur if the $NPV = 0$ standard applied.⁵⁰ For example, in models where regulated firms have investment timing flexibility, investment is delayed indefinitely if prices are set so that firms can only earn their WACC (Evans and Guthrie,

⁴⁸See, for example, Stiglitz (2000) for a survey of the contribution of asymmetric information to the understanding of economics and Tirole (2006) for a textbook treatment of the role of information asymmetries in corporate finance.

⁴⁹For example, FERC controls gas pipeline investment in the US. In the US electricity sector, some firms commit to undertake specified investments in returns for a rate case moratorium. In NZ, the Electricity Commission has a regulatory role with respect to Transpower’s investment, but does not control all of it.

⁵⁰This literature is surveyed in Guthrie (2006).

2005b; Guthrie et al., 2005). Moreover, the cash flows allowed by the excess earnings formula in LINES will be insufficient for a firm to recover the cost of its investment if there are increasing returns to scale in investment (which are typical in these industries) and they use benchmarking (such as the ODV methodology) to calculate the rate base (Evans and Guthrie, 2006).

102. [pg 83, ln 16] There must be an error here. In the table on this page, year 2 depreciation is equal to \$7m, but the accompanying discussion suggests that depreciation in year 2 should actually equal \$5m.

12.2 Assessing Excess Profits in Rate of Return Terms

103. [pg 85, ln 9] LINES proposes measuring excess profits in rate of return terms using a measure that it calls an “internal rate of return (IRR) premium”. The claim is that the present value of excess earnings is positive if and only if this IRR premium is positive. The problems with this approach are twofold. First, this premium is not well-defined — there can be many different IRR premia satisfying the definition proposed in LINES. Second, and more importantly, some of these IRR premia may be positive and some negative, preventing one from drawing any definite conclusion about the firm’s excess earnings. The problems are most easily illustrated using a simple counter-example to the result that LINES claims to prove in Appendix 5. Using the notation of Appendix 5, suppose that

$$B_0 = 100, \quad CF_1 - CAP_1 = 220, \quad CF_2 - CAP_2 + B_2 = -120.75, \quad k = 0.1.$$

The first equation on pg 122 defines the IRR premium p . For the parameters here, this equation becomes

$$100 = \frac{220}{1.1 + p} - \frac{120.75}{(1.1 + p)^2}.$$

It is easily shown that this equation has *two* solutions, $p = -0.05$ and $p = 0.05$, proving that the “IRR premium” is not even well-defined.⁵¹ Furthermore, the two possible values of p have opposite signs, so someone following the advice in LINES could infer that excess earnings are positive or negative, depending on which value for p they adopt. (For the example here, the present value of excess earnings is 0.2066.) In short, as it is defined in LINES, the IRR premium contains no information about excess earnings.

12.3 Revaluations of Land

104. [pg 87, ln 7] LINES devotes a great deal of effort to describing the different treatment of land and physical capital in excess earnings evaluations. However, the differences are relatively minor. All that is required for the present value of excess earnings to accurately detect a nonzero NPV over any period of time is that at the end of this period the book value of assets (be they land or physical capital) equals their market value. When the end of the period corresponds to the end of the assets’ physical lives this condition will obviously hold, since both book and market values will equal the assets’ salvage value. However, because land will typically have value indefinitely, we cannot assume that the book and market values of land will ultimately converge like this. One way to force

⁵¹This is to be expected — it is well known that cash flow streams can have multiple IRRs when cash flows change sign more than once (Grinblatt and Titman, 2002, pp. 345–357).

convergence is to ensure that the book value of land always equals its market value, which is the approach advocated in LINES. However, despite its claim to the contrary, this is not the only approach. An alternative is not to revalue land, but to instead include the profits from any land sales.

For example, all that is required to remedy the problem highlighted by the numerical example beginning on pg 89 of LINES is for the firm to have to include its profit from selling land in its excess earnings calculation. As measured by the difference between the sale value and the book value, this profit is \$3.4 million. Excess earnings in years 1 to 9 remain

$$E[\text{excess earnings}]_t = 1.49(1 - 0.33) - 0.10 \times 10 = 0, \quad t = 1, \dots, 9,$$

while excess earnings in year 10 become

$$E[\text{excess earnings}]_{10} = 1.49(1 - 0.33) + 3.4 - 0.10 \times 10 = 3.4$$

million dollars. The present value of excess earnings is then equal to

$$PV[\text{excess earnings}] = \frac{0}{1.10} + \dots + \frac{0}{(1.10)^9} + \frac{3.4}{(1.10)^{10}} = 1.31$$

million dollars, which equals the NPV. (As discussed in point 106, the calculations in LINES contain an error. The correct NPV is 1.31, not 2.) Thus, if proceeds from asset sales are included in the calculation of excess earnings, it is not necessary to include land revaluations. That is, land can be treated in the same way as physical capital without ruining the excess earnings calculation.

This error is a reminder of what can go wrong when one tries to draw sweeping conclusions from a simple numerical example.

105. [pg 88, ln 17] LINES argues that land revaluations should be included in the calculation of excess earnings. This is one area where LINES actually considers investment incentives, since it argues that if land revaluations are not allowed for, the firm will eventually exit the business and sell its land. On the face of it, that argument seems sensible. However, it ignores the fact that regulated firms operating in infrastructure industries do not have abandonment options that are as unfettered as assumed in LINES. For instance, long-term contracts with customers (which LINES discusses on pg 37, ln 3) will make it expensive for firms to shut down as easily as envisaged in LINES. Regulated firms (and especially entities such as community trusts) have universal service obligations or other restrictions imposed on them that restrict or eliminate abandonment options. The implications of these situations for land revaluations need to be carefully considered.

106. [pg 90, ln 3] LINES claims that

$$NPV = \frac{1}{1.10} + \dots + \frac{1 + 13.4}{(1.10)^{10}} - 10 = 2.$$

In fact, it equals 1.31, not 2.

12.6 Revaluations and Optimisations

107. [pg 97, ln 6] The recommendation of how excess earnings should be calculated in the presence of asset stranding and optimization is incorrect. When considering the possibility that an asset is optimized out of the rate base, so that “subsequent depreciation and

cost of capital figures are reduced”, LINES dismisses treating this as a “revaluation of the asset to zero” to be included in the excess earnings calculation. Its argument is that such an action “circumvents the very act of reducing depreciation and cost of capital, leaving the business with the ex-ante compensation (possibly in the form of a ‘margin on WACC’) as a gift.” This advice is incorrect and the mistake arises because the interpretation of ex post and ex ante compensation for stranding risk in LINES is wrong. The correct interpretation is as follows:

- If ex post compensation is allowed, the firm is permitted to continue to recover the cost of the stranded asset. In effect, the asset stays in the rate base, so there is no revaluation to consider.
- If ex ante compensation is allowed, the firm is not permitted to continue to recover the cost of the stranded asset. In effect, the asset is removed from the rate base.

With ex ante compensation, the rate base is reduced when an asset is stranded. If the corresponding revaluation is not included in the excess earnings calculation, the $NPV = 0$ principle is violated — all else equal, the NPV is negative — and the firm will not invest in the first place.

To further clarify the source of the problems in LINES, we discuss the forms that ex ante compensation can take. As discussed in point 87 above, the firm bears two costs when stranding will not be compensated ex post: (a) the expected cost of stranding, which is most naturally treated via the cash flows; and (b) the systematic risk associated with stranding, which is most naturally treated via the discount rate. However, ex ante compensation for asset stranding can be achieved in several ways. For example:

- The most natural approach is to compensate the firm for expected costs via the cash flows and systematic risk via the discount rate. That is, excess earnings equal

$$E[\text{Excess earnings}] = E[CF] - E[-REV] - E[DEP] - kB, \quad (\text{vi})$$

where k is the WACC (and reflects all sources of systematic risk, including that due to the risk of stranding). Compensation for the expected costs associated with stranding appears in $E[-REV]$, and compensation for their systematic risk is contained in kB . Note that even if a cash flow adjustment is used, the regulator still needs to allow for the systematic risk of stranding. This approach is discussed further in Evans and Guthrie (2005a).

- Alternatively, compensation for expected costs can be achieved by adding a premium to the WACC. According to this approach, excess earnings equal

$$E[\text{Excess earnings}] = E[CF] - E[DEP] - k'B, \quad (\text{vii})$$

where k' is the sum of the WACC and a premium to compensate the firm for expected optimizations:

$$k' = k + \frac{E[-REV]}{B}.$$

Here compensation for the two costs associated with stranding appears in one place in the excess earnings calculation: both compensation for expected costs and compensation for systematic risk appear in k' . Compensation for expected costs appears in $\frac{E[-REV]}{B}$ and compensation for systematic risk appears in k . Since expected costs are compensated via the discount rate, they do not need to be treated as a cash flow item.

In either case, the possibility of future stranding will make $E[REV]$ negative, and therefore $E[-REV]$ positive. In the case of equation (vi), adequate ex ante compensation (that is, the $NPV = 0$ principle) requires that expected operating cash flows equal the sum of this cost, expected depreciation, and a return on capital (calculated using the WACC). In the case of equation (vii), adequate ex ante compensation requires that expected operating cash flows equal the sum of expected depreciation and a return on capital (calculated after adding a positive premium to the WACC).

LINES claims that incorporating the revaluation in the excess earnings calculation would make the mistake of “leaving the business with the ex-ante compensation (possibly in the form of a ‘margin on WACC’) as a gift.” But, as equations (vi) and (vii) reveal, incorporating the revaluation is a *necessary step* in determining just how much ex ante compensation there should be.

108. [pg 97, ln 14] The numerical example purports to disprove the legitimacy of the approach described in point 107, but in fact confirms it. In terms of equations (vi) and (vii), expected operating cash flow is $E[CF] = 110$, the rate base is $B = 100$ and the WACC is $k = 0.10$, while the prospect of stranding leads to expected revaluations of $E[REV] = -5$ and expected depreciation of $E[DEP] = 95$. The first approach, described by equation (vi) implies expected excess earnings of

$$E[\text{Excess earnings}] = E[CF] - E[-REV] - E[DEP] - kB = 110 - 5 - 95 - 0.1 \times 100 = 0,$$

as required. The second approach, described by equation (vii) uses a discount rate of

$$k' = k + \frac{E[-REV]}{B} = 0.10 + \frac{5}{100} = 0.15$$

and implies expected excess earnings of

$$E[\text{Excess earnings}] = E[CF] - E[DEP] - k'B = 110 - 95 - 0.15 \times 100 = 0,$$

as required. Notice that this is identical to the approach used in the numerical example in LINES. Thus, rather than demonstrating why expected revaluations due to stranding should not be included, the example illustrates why they *must* be included.

12.8 Statistical Estimation Issues

109. [pg 99, ln 14] LINES states that “Boyle and Guthrie (2002) hint at the necessity for a classical statistical analysis. . .”. Actually, they do more than that. They state that “[i]f the ex post IRR is to be used to detect monopoly profits, then detailed statistical analysis needs to be performed.” (Boyle and Guthrie, 2002, p. 4)
110. [pg 99, ln 18] When referring to Boyle and Guthrie (2002), LINES states that “it is implicit in this thinking that the evaluation is conducted upon past rather than future Excess Earnings.” Actually, the paper cited *explicitly* considers ex post evaluations, not implicitly as LINES claims.⁵² However, proper statistical analysis is just as important when assessing future earnings since the parameter estimates underlying the excess earnings assessment are all subject to estimation error. One should look to see whether, subject to this error, one can be confident that excess profits will be earned in the future. LINES claims (pg 100, ln 1) parameter estimation errors are a “distinct point”, but they are not.

⁵²The title of the paper in question is “Can Ex Post Rates of Return Detect Monopoly Profits?” (emphasis added).

111. [pg 99, ln 20] The assertion in LINES that “the standard tests would require that the annual figures be independent” implies a peculiar definition of standard: since at least as long ago as 1963 the treatment of dependence in time series has been “standard” in econometrics texts (for example, see Johnston, 1963).

This mistake is repeated at pg 99, ln 26.

112. [pg 99, ln 22] LINES claims that the data underlying a forward-looking assessment of excess earnings “suffer not just from the possibility of being unrepresentative of the underlying population but also from the possibility of estimation error”. While seemingly aimed at dismissing the importance of proper statistical analysis, this merely confirms its importance. In particular, LINES continues to overlook variation that is due to intrinsic variability of the business. This source of variation is discussed in point 58 above.

12.9 Tax Issues

113. [pg 100, ln 25] When discussing the treatment of tax losses, LINES states that “if the lines business in question is part of a larger entity that is able to offset at least part of the tax losses for the lines business, then the tax savings arising from the portion of the tax losses that can be immediately offset requires no present value adjustment and the present value adjustments to the remainder will tend to be smaller and possibly unnecessary.” This approach is inconsistent with its handling of leverage: “if efficient costs are utilised in assessing excess profits, then consistency demands the use of optimal leverage” (pg 53, ln 18). In order for LINES to be consistent, if it advocates using the costs and leverage of a hypothetical efficient lines business, then tax losses should be treated in the same way. In particular, whether or not the regulated firm is part of a larger entity should be irrelevant.

13. Estimating WACC in Setting a Price Cap

114. [pg 102, ln 14] LINES repeats its earlier error, discussed at point 33, when it mistakenly claims that less frequent reviews of a price cap will raise risk. As we discussed earlier, when (as is typical under price cap regimes) allowed revenue is based on the costs incurred by a hypothetical efficient firm, regulatory reviews can introduce risk, not diminish it. In this case, less frequent reviews of a price cap can actually lower risk.
115. [pg 102, ln 22] The estimate of the WACC that LINES recommends for setting a price cap is inconsistent with the empirical evidence it relies on for calculating a WACC to be used to evaluate excess earnings. It argues here that “the price cap situation [is] equated with the situation facing UK price-capped electric utilities,” but uses an asset beta of 0.5. The only evidence it presents regarding the asset betas of UK price-capped electric utilities gives a beta of 0.6 (without an adjustment for market-leverage differences) or 0.56 (with such an adjustment).⁵³ Using the figure of 0.56 in the calculation on pg 102 yields a cost of equity of $k_e = 0.108$ and $WACC = 0.085$. By ignoring its own empirical evidence, LINES has managed to reduce the WACC estimate by half of a percentage point.⁵⁴

⁵³These estimates are reported on pg 46, ln 13.

⁵⁴Furthermore, as discussed in point 51, the value of 0.56 is an underestimate of the true beta due to the high frequency of the data used by Alexander et al. (1996).

116. [pg 103, ln 1] LINES provides no details of the inputs used to calculate the standard error for its estimated price cap WACC. This process will be subject to the criticisms discussed in point 74 and 76.
117. [pg 103, ln 6] LINES mentions the asymmetric response of overall welfare to the regulator's choice of allowed rate of return, but provides no evidence as to the magnitude of the asymmetry. Ample evidence is available. For example, Dobbs (2004) shows that setting a price cap too low has a much greater adverse impact on investment than setting it too high. Similarly, Evans and Guthrie (2005b) model the impact of the choice of allowed rate of return on overall welfare when firms have timing flexibility and find that the asymmetry is severe.
118. [pg 103, fn 94] LINES discusses how ex post compensation could be implemented by allowing accelerated depreciation once the prospect of stranding becomes clear. However, this will not always be feasible: the asset is being stranded because of reduced demand, so raising prices further may be impracticable.
119. [pg 104, ln 11] When discussing reasons for ex post compensation for asymmetric risks not being given, LINES only mentions imprudent management by the firm. However, the possibility that an ex post assessment of investment deems imprudent an investment decision that was prudent ex ante (that is, hindsight bias) also needs to be considered, as does regulatory opportunism. LINES notes this, pointing out that "a regulator's promise to provide ex-post compensation must be worth less than face value, in which case businesses face a disincentive to invest." However, it does not draw the obvious conclusion, which is that some form of ex ante compensation is required (such as a WACC premium) even when ex post compensation is 'promised'.

14. Conclusions

120. [pg 105, ln 15] Many of the shortcomings of the statistical analysis in LINES are revealed in its statement that "[i]n recognition of possible estimation errors for some of these parameters, the standard deviation of the WACC estimate is estimated at 1.1%." First, estimation errors are *inevitable*, not "possible". Second, they arise in *all* parameter estimates, not "some". Third, one cannot reasonably argue that the standard deviation in LINES was "estimated" in any statistical sense.

Appendix 3

121. [pg 112, ln 5] There is an obvious mistake here: the initial formula for the NPV has period-specific discount rates, k_1 and k_2 , but the remainder of the appendix uses a single discount rate k . Clearly the proof as it stands is invalid, but presumably it is easily fixed. How is k related to k_1 and k_2 ? Does the method rely on there being a single discount rate?

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A US Gas Distribution Firms

In this section we summarize the regulatory environments in which US gas distribution firms operate. The firms comprise all those in the list provided by Damodaran that have SIC codes of 4920, except that one overseas firm (not listed on a US exchange) was deleted.⁵⁵ This leaves 29 firms.

AGL Resources (ATG) This firm's principal business is distributing natural gas in Florida, Georgia, Maryland, New Jersey, Tennessee and Virginia.

- *Florida* (Florida Public Service Commission). Rates last changed in February 23, 2004.
- *Georgia* (Georgia Public Service Commission). Since deregulation in 1997, AGL has distributed gas for other firms. A three-year earnings-sharing scheme became effective on May 1, 2002, with an authorized return on equity of 11% and an earnings band based on a return on equity of 10% to 12%, subject to certain adjustments, with three-quarters of any earnings above a 12% return on equity shared with Georgia customers and one-quarter retained by AGL.
- *Maryland* (Maryland Public Service Commission). Rates last changed in June 1992.
- *New Jersey* (New Jersey Board of Public Utilities). Base rates were frozen for five years from November 9, 2004. Earnings over an 11% return of equity are to be shared with ratepayers in the fourth and fifth years.
- *Tennessee* (Tennessee Regulatory Authority). A purchased gas adjustment (PGA) clause has been in place since March 10, 2004 which allows the firm to automatically adjust its gas prices in response to reflect the market price of gas. Base rates were unchanged during the period 1995–2004.
- *Virginia* (Virginia State Corporation Commission). The last rate case was in 1996.

Sources: 10-K for year ended December 31, 2004; various press releases from AGL Resources, its subsidiaries, and their regulators.

AmeriGas Partners (APU) This firm is a propane distributor. Its prices are not regulated.

Source: 10-K for year ended September 30, 2005.

Atmos Energy (ATO) This firm's principal business is distributing natural gas in Colorado, Kansas, Kentucky, Louisiana, Mississippi, Tennessee and Texas, with more limited service areas in Georgia, Illinois, Iowa, Missouri and Virginia. PGA clauses are in place.

- *Colorado* (Colorado Public Utilities Commission). The firm filed for a rate increase in November 2000. The new tariffs came into effect on May 4, 2001. The firm was forced to issue a one-time credit to its customers in July 2004 as a result of a regulator-initiated inquiry into the firm's earnings.
- *Georgia* (Georgia Public Service Commission). The firm filed for a rate review on May 20, 2005. At the time, base rates had last increased in 1996.
- *Illinois* (Illinois Commerce Commission). The most recent rate case request was filed on 1 November 2000. At that time, the most recent rate case had been held in 1997.

⁵⁵The list of firms was downloaded from <http://www.stern.nyu.edu/~adamodar/pc/datasets/indname.xls>. on January 6, 2006, and was described as being current as of January 2005.

- *Iowa* (Iowa Utilities Board). The most recent rate case resulted in base rates being reduced. The new tariffs were approved on March 26, 2001.
- *Kansas* (Kansas Corporation Commission). The firm filed for a rate review on June 6, 2003. This was the first request for a rate increase since ATMOS Energy acquired the Greeley Gas Company in 1993 and the United Cities Gas Company in 1997. New rates came into effect on March 1, 2004. The firm was not allowed to request a review prior to September 1, 2005.
- *Kentucky* (Kentucky Public Service Commission). Base rates were last changed on 21 December 1999. A PGA clause is in place.
- *Louisiana* (Louisiana Public Service Commission). An earnings sharing mechanism is in place. Since 2001 the firm must file annually to compare its earnings with a benchmark, which is indexed for inflation, annual changes in labor costs, and customer growth. Rates are adjusted every two years and the earnings sharing mechanism will stay in place for 20 years.
- *Mississippi* (Mississippi Public Service Commission). An earnings-sharing mechanism, which requires annual filing, has been in place since October 2005. Prior to this, the firm had been required to file for rate adjustments every six months.
- *Missouri* (Missouri Public Service Commission). The last rate review resulted in new rates coming into effect on October 14, 1995. A PGA clause allows the firm to change gas charges twice during the year, plus an optional unscheduled filing during the winter season.
- *Tennessee* (Tennessee Regulatory Authority). Rates last changed on November 15, 1995.
- *Texas* (Railroad Commission of Texas). Municipalities have original jurisdiction over the rates charged to customers located within city limits. However, the firm filed a system-wide rate case with the Railroad Commission of Texas on May 24, 2004, which applied to all 437 cities served by the firm.
- *Virginia* (Virginia Corporation Commission). The firm filed a rate case in March 2000 and February 2004.
- *West Texas* (Railroad Commission of Texas). The firm filed rate cases in the city of Amarillo in August 1999 and June 2003. Base rates in the city of Lubbock increased in 1999 and March 2004.

Source: 10-K for year ended September 30, 2005; company press releases.

Cascade Natural Gas (CGC) This firm distributes natural gas to customers in the states of Washington and Oregon.

- *Washington* (Washington Utilities and Transportation Commission). Cascade filed a request for a general rate case on February 14, 2006. Prior to that date, the most recent general rate case filing was in 1995. A PGA clause is in place.
- *Oregon* (Oregon Public Utility Commission). Two-thirds of the incremental change in the actual cost of gas supplies can be automatically passed onto customers. The firm must share one third of earnings in excess of a threshold return on equity with customers. This threshold was originally set at a 13.25% return on equity and is adjusted each year by 20% of the movement in the average of the annual yields, reported monthly, for five-, seven-, and ten-year US Treasury debt securities.

Source: 10-K for year ended September 30, 2005; various press releases from Cascade Natural Gas.

Chesapeake Utilities Corporation (CPK) This firm's principal business is the distribution and transmission of natural gas on the Delmarva Peninsula and in parts of Florida. Other activities include operations in propane distribution and wholesale marketing, advanced information services and other related services throughout the eastern US.

- *Interstate* (FERC). Owns and operates an interstate natural gas pipeline and provides open access transportation services. Both pricing and investment in facilities are subject to FERC regulation.
- *Delaware* (Delaware Public Service Commission). A PGA clause is in place, with annual reviews. A general rate case was held in 1995. Since then, the firm has filed for general rate increases in September 1998 and August 2001.
- *Florida* (Florida Public Service Commission). Regulatory reform in this state required unbundling of the natural gas commodity and transportation components, and the Florida division exited the commodity merchant function. The most recent tariff revision requests were filed on March 29, 2002 and August 25, 2004. The former completed the unbundling process while the latter involved a revenue-neutral adjustment to tariffs.
- *Maryland* (Maryland Public Service Commission). The regulator approved new base rates in 1997 and the firm submitted revised tariffs in December 1999 in response to changes in the way utilities were taxed in Maryland. A PGA clause is in place.

Source: 10-K for years ended December 31, 2000–2005.

Corning Natural Gas Corporation (CNIG) This firm purchases and distributes natural gas in Corning, New York, and also operates residential and commercial real estate businesses.

- *Corning, New York* (Public Service Commission of New York State). The last formal price review, which occurred in January, 2003, set an allowed rate of return of 10.5% and allowed the firm to petition for relief if the actual rate of return fell below 5.5%. The firm sought such relief on March 12, 2004 and changes were approved by the regulator on September 1, 2004. A PGA clause is in place.

Source: 10-K for year ended September 30, 2004.

EnergySouth Inc (ENSI) This firm distributes and stores natural gas in Alabama.

- *Alabama* (Alabama Public Service Commission). An earnings sharing scheme came into effect on October 1, 2002 for an initial three-year period, which has subsequently been extended for a further four years. The firm is allowed a return on equity in the range 13.35% to 13.85%. If the return falls outside this range, prices are automatically adjusted so that the actual return is 13.60%. A PGA clause is in place.
If growth in operations and maintenance expenditure per customer exceeds the change in the CPI by more than 1.5%, quarter of the difference is borne by the firm; if is more than the 1.5% below the change in the CPI, the firm keeps half the difference. The firm is allowed to adjust its prices to certain large customers in order to compete with alternative energy sources and recover any losses incurred in this way from its other customers.

The firm is allowed to recover the full costs of (a) extraordinary operations and maintenance expenses resulting from events such as severe weather; and (b) losses of revenue from any large individual industrial or commercial customer that cause its return on equity to fall below 13.35%.

- *Inter-state storage and transportation* (FERC). The firm is allowed to charge market-based prices for interstate storage services. Interstate transportation prices were last set on June 3, 2002. The firm filed for a price review on March 9, 2004, but the review was still pending in September 2005.

Source: 10-K for year ended September 30, 2005.

Ferrellgas Partners L.P. (FGP) This firm is a propane distributor. Its prices are not regulated.

Source: 10-K for year ended July 31, 2005.

KeySpan Corporation (KSE) The firm distributes natural gas in New York, Massachusetts and New Hampshire, and also has involvement in the electric utility industry. The firm's gas operations are vertically integrated, but it also provides access to competing gas marketers. All gas subsidiaries have PGA clauses.

- *Massachusetts* (Massachusetts Department of Telecommunications and Energy). The prices of two of the firm's subsidiaries in Massachusetts have been frozen for ten year periods ending in 2008 and 2009. A 'Performance Based Rate Plan', lasting for up to ten years, was approved for the third subsidiary during 2004.
- *New Hampshire* (New Hampshire Public Utilities Commission). The firm has been required to provide access to competing gas marketers since November 1, 2001. As part of the deregulatory process, base rates were revised, but the changes were revenue neutral.
- *New York* (New York Public Service Commission). The firm's two subsidiaries in New York are subject to an earnings sharing scheme, according to which they must pass onto customers 60% of earnings up to one percentage point above a threshold return on equity and 50% of earnings above the threshold return. The thresholds are 11.10% and 13.25% for the two subsidiaries.

Source: 10-K for year ended December 31, 2004.

Laclede Group (LG) This firm distributes natural gas in Missouri. Its unregulated activities (mainly gas marketing) generated 39% of the firm's revenue in the year ended 2005.

- *Missouri* (Missouri Public Service Commission). Tariffs were changed on October 1, 2005. The most recent general rate increase prior to that date was in 2002. A PGA clause is in place.

Source: 10-K for year ended September 30, 2005; various press releases from Laclede Group.

Markwest Hydrocarbon (MWP) This firm gathers and processes gas in the Appalachian Basin and owns several gathering systems and four intrastate pipelines in Texas, New Mexico, Louisiana, Mississippi and Oklahoma, and offshore in the Gulf of Mexico, as well as a 250-mile intrastate crude oil pipeline and a 90-mile gas pipeline and processing facility in Michigan.

FERC does not regulate the firm's (interstate) Appalachian pipeline, but it has requested that the firm initiate discussions with one shipper regarding its Michigan Crude Pipeline. The rates for this asset are currently set by the Michigan regulator.

Source: 10-K for year ended December 31, 2004.

New Jersey Resources (NJR) This firm distributes natural gas in New Jersey and provides access to competing gas marketers. It also provides unregulated wholesale energy services in states from the Gulf Coast and Mid-Continent to New England, and Canada.

- *New Jersey* (New Jersey Board of Public Utilities). The last traditional base rate case was held in January 1994. A PGA clause was approved on January 6, 2003.

Source: 10-K for year ended September 30, 2005.

NICOR Inc. (GAS) This firm distributes natural gas to customers in Illinois and provides access to competing gas marketers.

- *Illinois* (Illinois Commerce Commission). Base rates have not changed since 1996, but the firm filed for a rate increase on November 4, 2004. The cost of natural gas purchased for customers is fully charged to customers without markup. The regulator annually reviews the company's natural gas purchasing practices for prudence, and may disallow the pass-through of costs considered imprudent.

Source: 10-K for year ended December 31, 2004.

Northwest Natural Gas (NWN) This firm's principal business is distributing natural gas in Oregon and Washington. The firm does not face competition from rival gas marketers. PGA clauses are in place in both states.

- *Oregon* (Public Utility Commission of Oregon). The firm filed requests for general rate cases in 1998 and November 2002. These were the only two such requests since 1989. Since 1999, an earnings sharing mechanism has been added to the annual review of the PGA clause: the firm retains all of its earnings up to a threshold level 300 basis points above its authorized return on equity, while one-third of any earnings above that level are refunded to customers. The excess earnings threshold is subject to adjustment up or down each year depending on movements in interest rates.
- *Washington* (Washington Utilities and Transportation Commission). As part of the settlement of its request for a general rate case filed on January 21, 2000, the firm agreed not to file for another general rate increase in Washington before June 1, 2002. (However, some provision for interim rate relief was allowed.) The most recent request for a general rate case was filed in November 2003.
- *Interstate storage* (FERC). A cost and revenue review was required within three years following FERC's original storage service rate authorization.

Source: 10-K for year ended December 31, 2004; various press releases from Northwest Natural Gas and its regulators.

Penn Octane Corp (POCC) This firm purchases, transports, and sells liquefied petroleum gas primarily in northeast Mexico.

Source: 10-K for year ended July 31, 2004.

Peoples Energy (PGL) This firm is a vertically integrated natural gas distributor in Chicago and northeastern Illinois. Since 2002, it also delivers gas sold by gas marketers. The gas distribution business accounts for 65% of the firm's revenue. Other activities include oil and gas production and power generation.

- *Illinois* (Illinois Commerce Commission). Delivery rates were last reviewed in 1994. Fuel charges include a PGA clause, with prices changing monthly, but subject to an annual prudence review.

Source: 10-K for year ended September 30, 2005.

Piedmont Natural Gas (PNY) This firm distributes natural gas in North Carolina, South Carolina and Tennessee. PGA clauses are in place in all states.

- *North Carolina* (North Carolina Utilities Commission). At the time of filing for a base rate increase on March 28, 2002, the most recent rate review had occurred two years earlier, in March 2000.
- *South Carolina* (Public Service Commission of South Carolina). At the time of filing for a base rate increase on May 3, 2002, the most recent rate review had occurred seven years earlier, in May 1995.
- *Tennessee* (Tennessee Regulatory Authority). At the time of filing for a base rate increase on December 30, 1999, the most recent rate review had occurred three and a half years earlier.

Source: 10-K for year ended October 31, 2004; various press releases from Piedmont Natural Gas.

RGC Resources Inc (RGCO) This firm distributes and sells natural gas in Virginia and West Virginia and does not provide gas marketers with access to its network. PGA clauses are in place in both states.

- *Virginia* (Virginia State Corporation Commission). Higher base rates were requested in September 2004 and September 2005.
- *West Virginia* (West Virginia Public Service Commission). Base rate increases were requested in January 2004 and January 2005.
- *Interstate pipeline* (FERC).

Source: 10-K for year ended September 30, 2005.

SEMCO Energy (SEN) This vertically integrated firm distributes natural gas in Michigan and Alaska and provides access to gas marketers. PGA clauses are in place in both states.

- *Alaska* (Regulatory Commission of Alaska). Base rates were reviewed in 1986. The firm was ordered to reduce its prices in August 2002 and the regulator has ordered another base rate review in 2008.
- *Michigan* (Michigan Public Service Commission). The firm requested price reviews in November 2002 and December 2004.
- *Battle Creek* (Battle Creek City Commission). Base rates were changed on February 15, 2005; they had been at their current levels since 1995. A PGA clause has been reintroduced, to become effective on April 1, 2005; gas prices had been fixed for the previous three years.

Source: 10-K for year ended December 31, 2004; various press releases from SEMCO Energy.

South Jersey Industries Inc. (SJI) This firm distributes natural gas to customers in New Jersey and, since unbundling in January 2000, provides access to competing gas marketers.

- *New Jersey* (New Jersey Board of Public Utilities). The firm was granted rate relief in January 1997 and a base rate increase was granted on July 7, 2004. A PGA clause is in place.

Source: 10-K for year ended December 31, 2004.

Southern Union (SUG) This firm distributes natural gas in Missouri, Pennsylvania, Rhode Island, and Massachusetts. It is also engaged in the interstate transportation and storage of natural gas. PGA clauses are in place.

- *Massachusetts* (Massachusetts Department of Telecommunications and Energy). Before its acquisition by Southern Union in 2000, Fall River Gas Company filed for base rate reviews in 1981, 1983, 1991, and 1996.
- *Missouri* (Missouri Public Service Commission). The firm filed for a base rate review on November 4, 2003. At that time, it had most recently filed for a base rate review on November 7, 2000.
- *Pennsylvania* (Pennsylvania Public Utility Commission). The firm filed for a base rate review on March 1, 1998. As part of the settlement, the firm agreed not to file for another rate increase before February 29, 2000. It subsequently filed for a base rate review on April 3, 2000. The market was opened to competition from gas marketers in 2000.
- *Rhode Island* (Rhode Island Public Utilities Commission). The firm filed for a base rate review on November 1, 2001. At that time, base rates had not been increased for six years. The review introduced an earnings sharing scheme, whereby the firm shares incremental earnings with customers when the return on equity of the division's Rhode Island operations exceeds 11.25%.
- *Interstate pipelines* (FERC). Unbundled since 1992.

Source: 10-K for year ended December 31, 2004; company press releases; orders from regulators.

Southwest Gas (SWX) This firm purchases, transports, and distributes natural gas in Arizona, Nevada, and California. PGA clauses are in place.

- *Arizona* (Arizona Corporation Commission). The firm filed a request for a rate review in December 2004. At that time, the most recent general rate increase had occurred in November 2001.
- *California* (California Public Utilities Commission). Rate cases are typically held every three years.
- *Nevada* (Public Utilities Commission of Nevada). The firm filed for a general rate review in March 2004. It was the first such request for three years.
- *Interstate pipelines* (FERC). The last general rate increase was in January 1997.

Source: 10-K for year ended December 31, 2004; Southwest Gas website.⁵⁶

Star Gas Partners L.P. (SGU) This firm is a home heating oil distributor and services provider. Its prices are not regulated.

Source: 10-K for year ended September 30, 2005.

Streicher Mobile Fueling (FUEL) This firm provides petroleum product distribution services, transportation logistics and emergency response services to the trucking, construction, utility, energy, chemical, and government services industries. Its prices are not regulated.

Source: 10-K for year ended June 30, 2005.

Suburban Propane Partners (SPH) This firm markets and distributes propane, fuel oil and other refined fuels nationwide. It is also a marketer of natural gas and electricity in deregulated markets in New York and Pennsylvania. It is not subject to price regulation.

Source: 10-K for year ended September 24, 2005.

UGI Corp. (UGI) This firm distributes natural gas and electricity in Pennsylvania and provides access to competing gas marketers. Other business units distribute propane in the US, Canada, and Europe; generate electricity; market natural gas directly to commercial and industrial customers in Pennsylvania, New Jersey, Delaware, Maryland, Virginia, New York, Ohio, North Carolina, and Washington DC; and market fuel oil, electricity, and LPG to commercial and industrial customers in Pennsylvania, New Jersey and Maryland.

- *Pennsylvania* (Pennsylvania Public Utility Commission). The most recent general base rate increase for the gas distribution business unit became effective in 1995. The most recent general base rate increase for the electricity distribution business unit became effective in 1996.
- *Electricity transmission facilities* (FERC).

Source: 10-K for year ended September 30, 2005.

WGL Holdings Inc. (WGL) This firm is a vertically-integrated supplier of natural gas, and energy-related products and services in Maryland, Virginia, and Washington DC. The firm also distributes gas for competing marketers. PGA clauses are in place.

- *Maryland* (Public Service Commission of Maryland). The firm's proposal to implement an incentive based rate plan was rejected by the regulator on October 19, 2000, forcing the firm to continue charging the base rates that had been in effect since December 1994. New rates were subsequently approved in October, 2003, and are still in place in 2006.
- *Virginia* (State Corporation Commission of Virginia). The firm requested rate reviews on June 14, 2002 and January 27, 2004.

Since December 18, 2003, an annual 'earnings test' is performed. If the firm earns in excess of its allowed return on equity, it must increase the depreciation expense for the amount of the actual earnings in excess of the earnings produced by the 10.50% allowed return on equity. These annual earnings tests will be performed until the \$28 million difference between the accumulated reserve for depreciation recorded on the firm's books and the theoretical reserve derived by the regulator is eliminated.

⁵⁶<http://southwestgas.com/residential/howto/gasratesset.php>, accessed on March 12, 2006.

- *Washington DC* (Public Service Commission of the District of Columbia). The most recent request for a rate review was filed on February 7, 2003. The previous request, in June 2001, was the first general rate case filed by the firm in over seven years.
- *Underground natural gas storage facility* (FERC).

Source: 10-K for year ended September 30, 2005; company press releases.