**Accounting based risk management and the capital asset pricing model: An empirical comparison**

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**Accounting based risk management and the capital asset pricing model: An empirical comparison[[1]](#endnote-1)**

***Abstract***

*Accounting based risk management (ABRM) is a theoretically consistent and practical tool for calculating the cost of capital from underlying financial ratios. The paper uses a sample of ABRM generated discount factors to examine the resulting pattern of risk adjusted returns. These are compared to the pattern based on CAPM generated returns. In view of the debates about the validity of the CAPM, alternative empirical models, the nature and scale of the equity risk premium, and the importance of discount rates in capital budgeting and asset valuation, the comparative characteristics of ABRM rates offer a potentially useful alternative. The results suggest that although average discount rates are comparable, their cross sectional distributions are dissimilar, so that investors in an averagely risky firm are overcompensated for systematic risk when using CAPM discount rates. In other words, stock market CAPM discount factors overestimate risk arising from fixed costs in most firms.*

In a recent paper (Toms 2013a),[[2]](#endnote-2) a method of computing discount rates using underlying accounting data was outlined. This method of accounting based risk measurement (ABRM) offers a possible alternative to capital asset pricing model (CAPM) approaches. Unlike the CAPM approach, which takes stock market prices as its starting point, the ABRM approach builds up a discount rate from firms’ accounting and cost data. It is therefore possible that if managers were to perform calculations utilising their own cost data, rather than figures derived from stock markets, that the resulting cost of capital and associated business decisions might differ. Any such differences might be important, either because they might explain why the CAPM does not perform well in empirical tests,[[3]](#endnote-3) or because of the significance of these calculations for practitioners in terms of investment decision making and asset valuation, including intangible assets, such as goodwill. There is also a recognition among Australian regulators that equity beta estimates are statistically unreliable.[[4]](#endnote-4)

The purpose of this paper is to compare the discount rates that might be used in such contexts when using ABRM and CAPM. To do so, data was obtained using a questionnaire to obtain firm or business unit level inputs for the ABRM approach. Discount rates and risk adjustment factors are then calculated for both methods. The reasons for differences or similarities are then investigated, focusing on underlying cost behaviour in the sample firms.

The first section below reviews the differences between ABRM and CAPM. The strengths and weaknesses of each approach are discussed and the potential value of a comparable empirical test explained. The second section discusses the approach to the empirical test and the firm level questionnaire used to collect the data. The third section compares the costs of capital according to the two methods. It offers explanations in terms of differences in firm specific risk adjustment factors, underlying cost behaviour and differences in risk premia. The final section draws conclusions.

**ABRM and CAPM: An overview comparison**

The Sharpe (1964) and Lintner (1965) CAPM is still the one that financial managers use most often for assessing the risk of the cash flow from a project and for arriving at the appropriate discount rate to use in valuing the project (Graham and Harvey, 2001). The empirical anomalies of the CAPM are widely acknowledged. Several studies show that the model fails to adequately explain the cross sectional distribution of returns, and propose alternative, albeit under-theorised models. These are also less tractable from a practitioner point of view.[[5]](#endnote-5) So, although there is consequential uncertainty concerning the input numbers (the beta itself and the equity premium), the model nonetheless remains widely used. Researchers and financial decision makers have yet to endorse any alternative models.

The notion of operating gearing suggests that there may be suitable alternatives, if risk can be priced according to the degree of fixed cost and associated variability in residual cash flows. The literature on operating leverage shows that systematic risk arises because the firm is the subject of fixed claims but faces variable revenues (Huffman, 1983). If, by extension of Modigliani and Miller (1958), variance in total cash flow is a function of the presence of not just interest based, but *all* fixed charges, it would seem logical to expect operating gearing to account the more strongly for the firm’s systematic risk. The intuition of the ABRM approach is exactly the same as the adjustment of the cost of capital for the presence of fixed interest charges (Modigliani and Miller 1958, Hamada, 1972). Theoretical analyses use financial market data in conjunction with accounting data to develop operating gearing variables (Gahlon and Gentry, 1982, Huffman, 1983). Further analytical models (Lev, 1974, Gahlon and Gentry, 1982, Huffman, 1983 and Mandelker and Rhee, 1984) extend this relationship to include risk measures that depend jointly on underlying accounting and market numbers. Empirical studies using operating gearing have almost unanimously incorporated market numbers in their measures of operating gearing (for example, Hamada, 1972, Mandelker and Rhee, 1984, Huffman, 1989). Of the small number of studies that have examined the joint and complementary effects of operating and financial gearing, the quantitative impacts of differing categories of fixed costs on a systematic basis have been neglected.

An exception is Lord (1996) whose empirical study focuses on three sectors and ends with a call for further research in wider contexts. In response, this paper will develop an empirical test using United Kingdom evidence. Unlike Lord, who estimates operating leverage from published accounting numbers, the present study obtains these values from internal budget data using a questionnaire.[[6]](#endnote-6)

Such an approach provides the opportunity to integrate operating leverage into a formal risk pricing model using firm level forecast data. This is the objective of the ABRM approach as derived by Toms (2013a). ABRM has certain common features with CAPM. The following equations which summarise the input parameters of the two models have been set out to illustrate the common features and differences. The standard CAPM is set out in equation (1):

*Ri = Rf + βi [ERm – Rf] (1)*

Where:

*Ri* = Required rate of return for an individual firm

*Rf*  = Risk free rate

*ERm – Rf* = Difference between the expected return on the market and the risk free rate (the equity premium)

*βi* = The beta of security *i*

Input data for each of the right hand side parameters is obtained from current published economic interest rate data (*Rf),* long run historical averages for the equity premium(*ERm – Rf*)and from a 60 month regression of of the returns of security *i* on the returns on the market index(*βi*), usually obtained from *Datastream* or similar.

The alternative ABRM formulation is set out using a similar format in equation (2).

*Ri = Rf + γi [Eπm – Rf] (2)*

Where:

*Ri* = Required rate of return for an individual firm

*Rf* = Risk free rate

*Eπm*  = Expected average rate of profit for all firms, *m*.

*γi* = The rate of profit variability for firm *i*, relative to all firms, *m*.

As in the CAPM, equation (2) contains *Rf*, which as in the CAPM corresponds to bank base rates. The expected average profit *Eπm* is the forecasted return for all firms reflecting factor market conditions and collective expectations of yields from activities of average risk. The individual firm risk adjustment factor is denoted as γ (gamma) in (2), and reflects the relative variability of profit arising from the presence of fixed cost.[[7]](#endnote-7)

As with the CAPM, the alternative ABRM method is concerned only with diversifiable, or systematic, financial risk. Such fluctuations typically arise from cycles of economic activity connected to product and market characteristics. It is not therefore concerned with more general classes of risk, such as environmental, political and social risk, except and insofar as they can be priced by a capital market. Also, as in the CAPM, it is not concerned with other aspects of firm specific financial risk that investors can avoid using portfolio diversification. As illustrated in Toms (2013a), both utilise a risk free rate and a risk premium, albeit with differing data inputs and proxy assumptions. Modigliani and Miller (1958) have shown that the CAPM can be modified to reflect financial gearing. In like fashion, ABRM develops a CAPM modification based on operating gearing.

Based on these approaches, factoring asset turnover (Toms, 2013a), the underlying cash flows of the firm, and therefore its systematic business risk, form the starting point of the ABRM calculations. These involve and analysis of accounting data that is readily available from the management accounts, assuming suitable splits of total costs between variable and fixed costs can be made.

The effects of formalising the ABRM approach with reference to underlying costs give rise to an underlying basic contrast between ABRM and CAPM. Figure 4.1 shows the contrasts with the ABRM accounting based ‘bottom up’ methodology compared to the CAPM stock market based ‘top down’ approach. Although the two methods might simply appear the reverse of one another there is a very important difference. That is, the outcome of the ABRM approach is to compute a cost of equity without reference to stock market data. In the ABRM approach, operating gearing uses individual firm accounting data only and forms the basis for the estimation of the asset beta.

**Figure 4.1: Contrasting Captial Asset Pricing Model and Accounting Based Risk Measurement**

|  |  |
| --- | --- |
| **CAPM based approach** | **ABRM approach** |
| Compute cost of equity geared using stock market data | Cost of equity from underlying accounting data |
|  |  |
| Subtract effects of fixed borrowing charges | Add effects of fixed borrowing charges |
|  |  |
| Asset beta reflecting systematic business risk | Asset beta reflecting systematic business risk |
|  |  |
| Underlying cash flows | Underlying cash flows |

Although there are possible theoretical advantages associated with ABRM, important further questions concerns the likely properties of such measures in practice. These can be addressed by comparing the discount rates that would be used using normal CAPM estimation of beta with an alternative ABRM derived measure for the same firms. Because ABRM is calculated from accounting data, conclusions can be drawn from such a comparison about how well (or badly) CAPM estimates the risk associated with the underlying cash flows of the firm.

**Empirical survey methodology**

To perform this comparison, a survey was conducted of finance directors, financial controllers and divisional accountants.[[8]](#endnote-8) The objective was to obtain responses from individuals with responsibility for preparing financial forecasts at firm or business unit level and the questionnaire was designed to obtain forecast data for revenues, costs, profits and capital employed. Data were collected by individual cost category: bought in services and materials, labour and employment costs, depreciation charges, interest costs and taxation. Respondents were asked to provide forecast numbers for major categories of cost in the form of index numbers relative to current year sales revenue set to 100. In addition data was collected for forecasted price changes by revenue and cost category, together with background data including industry sector membership.[[9]](#endnote-9) A total of 95 replies (93 with full usable data) were received representing a response rate of 6.45%. In view of the high commercial sensitivity of the data requested, notwithstanding the careful steps taken to anonymise the data, the response rate was regarded as reasonable.[[10]](#endnote-10)

The survey responses were used to calculate an operating leverage measure for each firm, and by aggregating these, produce a benchmark average, enabling ABRM estimates of *γi.* using the approach in Toms 2013a.[[11]](#endnote-11) *Eπm* was estimated as the aggregate forecast rate of profit of all survey responses.[[12]](#endnote-12) Rf was estimated using bank base rates at the time of the survey for both ABRM and CAPMcalculations.

In the majority of cases, the respondents to the survey were employed by divisions, private companies or similar non-quoted business units. Therefore betas were estimated using *Datastream* betas averaged by industry, corresponding to the industry grouping identified by the questionnaire respondent. The use of industry benchmarks of quoted firms is a common approach to the problem of valuing private companies (see for example Arnold, 1998, pp.752-53; Brearley and Myers, 2003, p.226, Damodaran 1997, pp.804-5). For this purpose, the most detailed industry grouping code on Datastream (INDC6) was used. In cases where the number of quoted firms in INDC6 was fewer than 30, higher level groupings (INDC4 and INDC2) were used. The purpose was to calculate a meaningful average beta and standard deviation for each group. Using this approach an industry average beta could be calculated and a firm or business unit level beta was estimated using a simulated value.[[13]](#endnote-13) This generated an underlying sample that might correspond to a real data set of quoted companies, with the restriction that the recomputed averages for industry groupings would closely reflect the mean and standard deviations of quoted companies in each group and the global sample mean would only reflect the distribution of underlying returns across the industry groups.

**Analysis of results**

Comparative discount rates are shown in table 1. These are computed according to equations (2) and (1) using ABRM and CAPM inputs respectively. The results show thatthe cost of capital is over three percentage points lower when using ABRM compared to CAPM. In addition, of the 93 firms, 67 (72%), had lower costs of capital using ABRM than the CAPM equivalent. There are two reasons for this. First, as far as the aggregate difference between ABRM and CAPM is concerned the risk premium (*Eπm – Rf*) in ABRM is 6.55% and whereas the risk premium *(Rm – Rf)* in CAPM is 8%. As can be seen comparing equations (1) and (2), an important difference and hence a further reason for differences in costs of capital using the two methods is the different approach to the computation of the risk premium. ABRM uses the difference between the forecast rate of accounting profit and the risk free rate. There is an important theoretical reason for this. The purpose of ABRM is to determine how risk might be priced if financial market data is ignored, and instead only the risks associated with the firm’s transactions with underlying factor markets are included. It is clear for example that risk for a firm rises or falls depending on the specification of contracts with customers, suppliers and employees. Contract specification impacts on the variability of revenues and costs, and consequently profit. Collectively, a group of firms corresponds to a risky asset whose features resemble a portfolio of shares, according to the average variability of revenues, costs and profits. Unlike stock market risk measurement, the data sources in this case are from the firms’ internal cost, budgeting and forecast data collected from the questionnaires. In contrast, the CAPM uses only stock market inputs and ex post evaluations of share market index returns have produced differing estimates of the risk premium.[[14]](#endnote-14) Based on this literature, in the analysis thus far, a CAPM risk premium of 8% has been used, reflecting the high Brearley and Myers estimate which has become a common value in corporate finance texts (Arnold, 1998, p.709, Pike and Neale, 1999, p.293). One reason for this is that 8% has become synonymous with the ‘Ibbotson estimate,’ or the historic mean of excess returns earned by US equities since 1926 (Claus and Thomas, 2001).

Secondly, there is a difference between the comparable *γ*and*β* inputs into the models in equations (2) and (1). Table 3b shows the averages for each. Table 4.3 shows that the average *γ* is significantly lower than the average *β* across the sample. The differences between medians are greater indicating non-normality in the distribution of the *γ*ratios.[[15]](#endnote-15)

**Table 1: Comparative cost of capital, Accounting Based Risk Measurement and Capital Asset Pricing model**

1. **Discount factor estimates**

**ABRM CAPM**

Average 8.50% 11.68%

Median 5.34% 11.96%

Standard deviation† 6.19% 2.13%

1. **Risk adjustment factor estimates**

***γβ Difference***

Average 0.816 0.960 0.144\*

Median 0.439 0.996 0.557\*\*

Standard deviation 0.932 0.266

*Notes*: † CAPM estimates reflect only industry level variations; \*\* indicates statistical significance at the 5% threshold (p-value = 0.0101, using a non-parametric *Wilcoxon* two-tailed signed rank test); \* indicates significance at the 10% confidence threshold (p-value = 0.0747, using a two-tailed paired t-test).

*Sources*: Questionnaire data, *Datastream*

A particular feature is strong leftward skew, with a substantial proportion of firms having very low *γ* ratios, which has the effect of creating a median value significantly lower than the more approximately normal distribution implied when using betas. Figures 2 and 3 compare the underlying distributions of gamma and beta for the sample firms.

**Figure 2: Gamma distribution**



*Source*: Questionnaire data

**Figure 3: Beta distribution**

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*Sources*: Questionnaire data, *Datastream*

The patterns in figures 2 and 3 clearly show the non-normality in the distribution of the gamma ratio. The closer proximity of beta to a normal distribution is to be expected given the assumptions of the CAPM.[[16]](#endnote-16)A particular feature is the strong leftward skew in figure 2 which has the effect of creating a median value significantly lower the more approximately normal distribution implied when using betas.

An important reason for this is the underlying pattern of cost behaviour. The frequency distribution of variable cost as a percentage of total cost by firm is shown in figure 4. These are the estimates of the split of total cost into fixed and variable components using the information supplied in the 93 questionnaires.[[17]](#endnote-17) The figure shows the percentage of variable cost to total cost for each firm arranged into decile groups.

**Figure 4: Frequency distribution of variable cost**

*Sources*: Questionnaire data, *Datastream*

As figure 4 shows, the majority of firms are characterised by very high variable cost structures. Further details of the underlying cost estimates are shown in table 2. As the table shows the proportion of variable cost is high, representing 73.63% of the total. Using a similar approach based on national income data the long run variable cost percentage is 82.96% for services and 85.65% for manufacturing.[[18]](#endnote-18) Even factoring the possibility of error in the questionnaire returns, the average variable cost percentage does not appear to be an overestimate.

**Table 2: Cost analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **All firms** | | |  |  |
| Average variable cost | | | 73.63% |  |
| Average fixed cost | |  | 26.37% |  |
| Total |  |  | 100.00% |  |
|  |  |  | **Number** | **%** |
| Firms with above average variable cost | | | 67 | 72.04% |
| Firms with above average fixed cost | | | 26 | 27.96% |
| **Total firms** | |  | **93** | **100.00%** |
| Of which: |  |  |  |  |
| Firms with 100% variable cost | | | 33 | 35.48% |
| Firms with 100% fixed cost | | | 8 | 8.60% |
| Quintile splits of variable cost | | |  |  |
| 0%-20% |  |  | 11 | 11.83% |
| >20%-40% | |  | 5 | 5.38% |
| >40%-60% | |  | 7 | 7.53% |
| >60%-80% | |  | 7 | 7.53% |
| >80%-100% | |  | 63 | 67.74% |
|  |  |  | **93** | **100.00%** |

*Source*: Questionnaire data

What is striking about figure 4 and table 2 is the number and proportion of firms with high variable costs. Moreover, the average is dragged down by a cluster of firms with high or 100% fixed costs, and there are relatively few firms inhabiting the middle quintiles. In general about 2/3 of firms can be characterised as high variable cost and 1/3 as being high fixed cost, underpinned by bi-polar effects in the sample. Out of the 93 firms, the budget assumptions of 33 implied that all costs were variable.

In summary, because a majority of firms are characterised by high levels of variable cost, they have lower *γ*ratios and lower costs of capital than would be the case if CAPM were used. In other words if ABRM gives a truer indication of non-diversifiable systematic risk present in the underlying cash flows of firms than the distribution of stock market returns, then the CAPM method overstates the cost of capital for a substantial majority of firms. An important reason for this is the underlying pattern of cost behaviour.

Because CAPM is oblivious to this underlying distribution of firm level cash flows it does not replicate the skew in risk that seems to be present in reality. Practitioners relying on CAPM where they also know that their costs are highly variable might reduce their estimates accordingly. Theoretical modifications, which assume non-normality of risk adjustment factors, such as the mean-Gini CAPM (Shalit and Yitzhaki, 1984), would also appear to be well founded approaches.

**Conclusions**

The paper has contrasted the underlying theoretical assumptions for ABRM and CAPM. It then provided an empirical comparison of the costs of capital arising from the application of the two methods to the data for the sample firms. In around 2/3 of cases the ABRM method produces a lower cost of capital, such that on average the cost of capital is about three percentage points lower when using ABRM. The principle reason for this is the prevalence of variable cost in the cost structures of the majority of firms. Because the CAPM uses co-variances of stock returns, which are normally distributed, the CAPM makes assumptions about the cross-sectional characteristics of the distribution of underlying asset betas, which, as the evidence from the survey has shown, are non-normally distributed. In drawing this conclusion, the paper adds to the literature critical of the empirical performance of the CAPM and adds a further reason for its inaccuracy on the basis of the underlying accounting evidence collected in the survey.

The challenge to the CAPM is therefore a simple one. If underlying asset betas are skewed as a consequence of firm’s cost structures, why are the betas using stock price data not similarly skewed? A possible answer is that there are other components of non-diversifiable systematic risk that are picked up by CAPM betas but not picked up by ABRM cash flows. However, it is difficult to envisage what these sources of systematic risk might be.

Another possible answer arises from the underlying data for CAPM being not cash flows but stock market returns. Such returns are close to normality in their distribution due to the incidence of random events. Such events might be classified as firm specific or systematic. For example the appointment of a new director, which is firm specific event, or a rise in personal tax rates, which systematically affects consumer demand and hence profits and stock prices of many firms in some proportion. The CAPM is only concerned with pricing the latter type of event as the effects of the former can be removed by portfolio diversification. In the latter case the impact on firms depends on their cost structure. Firms with higher variable costs will be able to reduce their costs downwards in similar proportion whereas firms with more fixed cost will experience greater variability in their net returns. If the underlying cost structures are skewed towards variable costs, the cross section of expected returns in response to this type of event should be skewed in similar fashion.

There may be a further explanation here as to why, as first suggested by Fama and French, 1992) the CAPM provides a poor explanation of the cross section of stock market returns. In Fama and French (1992) and subsequent literature, discrepancies have been explained in terms of firm size, book to market and earnings to price ratios. However, there are no a priori theoretical reasons why these should work as explanatory factors. By similar virtue, analysts and financial market participants may be mis-pricing stocks because they are not factoring in the riskiness associated with underlying cash flows. The evidence above is suggestive of a high degree of flexibility in firm’s cost structures, reflecting perhaps the tendency towards the flexible firm in recent years (Toms and Salama, 2009). In contrast, ABRM offers a precise link between the fixity of underlying costs and the variability of net cash flows. ABRM offers a theoretical extension to the CAPM approach and offers a possible explanation for its empirical anomalies. The reasons for the differences arise from underlying cost structures and net cash flows rather than those identified in the prior finance literature (size, market to book and earnings to price ratios). Further tests of the Fama and French approach are therefore potentially useful, but using ABRM proxies.

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1. I am grateful to Tyrone Carlin for his encouraging comments and to two anonymous reviewers, and to the Institute of Chartered Accountants in Scotland for financial support. [↑](#endnote-ref-1)
2. ### Toms (2013a) builds on earlier research linking risk to asset valuation (Toms, 2010a) and alternatives to capital market based theories of asset valuation (Toms, 2010b, 2006).

   [↑](#endnote-ref-2)
3. For recent reviews of empirical tests and CAPM anomalies see Da, Re-Jin Guo, and Jagannathan (2012, pp.204-205) and Toms (2013a). [↑](#endnote-ref-3)
4. For example the Essential Services Commission. SFG Consulting, *The Equity Beta of an Energy Distribution Business*, Report for AGL, February 10, 2005 [↑](#endnote-ref-4)
5. For a summary, see Toms (2013a). [↑](#endnote-ref-5)
6. This approach allows forecast rather than historical data to be used so that the resulting discount rate is consistent with the risk implied in forecasted cash flows. [↑](#endnote-ref-6)
7. For numerical examples of the derivation of γ, including adjustments for asset turnover, see Toms (2013a) [↑](#endnote-ref-7)
8. These were selected from the membership list of the Institute of Chartered Accountants in Scotland. All those listing their occupation as financial director, financial controller, chief accountant or divisional accountant were selected, producing a list of 1714 names. Those located overseas were excluded, as the study uses UK benchmark metrics. The sample was thereby reduced to 1472 names to whom questionnaires were posted. [↑](#endnote-ref-8)
9. The surveys were completed in the summer of 2008 and respondents requested to use their forecasts for the coming financial year. The forecasts were therefore not affected by the loss of confidence inspired by the banking crisis of autumn 2008. [↑](#endnote-ref-9)
10. Response rates to questionnaires asking for similar information of chief financial officers have achieved response rates in the range of 5% (Brounen, de Jong and Koedijk, 2004) to 12% (Bancel and Mittoo, 2004, Trahan and Gitman (1995) and the response rate obtained by Graham and Harvey (2001) of 9% is perhaps typical of this kind of survey. Even so, an important difference is that in the present survey, budget data was requested in the form of numerical data whereas the previous studies obtained scaled qualitative responses from judgmental questions. [↑](#endnote-ref-10)
11. See Toms 2013a, Tables 3 and 4. [↑](#endnote-ref-11)
12. Asset turnover was assumed to be constant across all firms. In other words the effects of capital tied up were assumed to be the same for all firms and therefore relatively risk neutral. For an explanation of the potential effects of asset turnover on the calculations, see Toms (2013a). [↑](#endnote-ref-12)
13. To generate a simulated value, a normal random variable was used in conjunction with the mean and standard deviation for the *Datastream* INDC reference group, using the Excel worksheet function *NORMINV(rand(), mu , sigma).* [↑](#endnote-ref-13)
14. See Toms (2013a) for a summary. [↑](#endnote-ref-14)
15. The hypothesis of normality for gamma was rejected at the 1% confidence level but could not be rejected for beta (using a *Shapiro-Wilk* test for normality). [↑](#endnote-ref-15)
16. In the absence of stock market quotations, beta estimates for sample firmr and SBU’s have been computed assuming normal cross sectional distributions around the industry mean, which is consistent with the underlying assumtions of the CAPM (See Stapleton and Subrahmanyam, 1983). [↑](#endnote-ref-16)
17. Costs were estimated by first computing: DOL = % Change in Profit / % Change in Sales. Then solving for fixed costs in: DOL= (Profit + Fixed costs)/Profit. Variable Cost is Total Cost – Fixed Cost. [↑](#endnote-ref-17)
18. Calculated using 1984-2005 data from the Cambridge University Companies Database CD-ROM, *Datastream* and the Office for National Statistics*, Blue Book*) [↑](#endnote-ref-18)