Finance and Investment Conference 2003

Session G1 - An actuarial framework for the selection of ordinary shares
Speaker: Malcolm Burford

Malcolm Burford was due to speak at the conference, but his session had to be cancelled due to the SARS crisis in Toronto. Malcolm had already prepared a paper for the conference, and this is attached. He also prepared the Forward below:

Forward:-

"One significant development in the actuarial profession during the last 30 years has been the evolution of the availability of massive computational power by means of the personal computer. While change may indeed have evolved to the point of wholesale replacement for some actuarial activities; it also provides opportunity for the wholesale placement of others.

The paper describes a role that actuaries might play in equity investment research. This amounts to exploring ' value ' by using the massive calculation power of modern personal computers. It is a role that would not have been envisioned before modern computational devices were developed, due to the practical limitations of the day.

It is the view of the author, that actuaries who wish to develop a career in investment research, might be advised not to attempt to mimic the work and skills of the legions of very capable investment analysts that are already active, but rather to specialize in the quantitative determination of ' value ' through long term modeling of cash inflows along the lines proposed in the paper."

Developing applicable skills and specializing so, actuaries may make a significant if not central contribution in the equity investment decision process.

The author hopes the model described in the paper will become an actuarial standard. With ideas fixed as to the input parameters, timely actuarial debate can follow as to input, as well as methods to improve the same.

Malcolm Burford

1 *An Actuarial Framework for the Selection of Ordinary Shares*

By M. E. BURFORD *

ABSTRACT

The paper briefly explores the role of the securities analyst in the investment industry and the special skills that are generally considered valuable in that role. An analysis of the problem of determining "value" for ordinary shares shows the problem is generally at least as much an actuarial/statistical problem as a business problem. Hence actuarial modeling can make a contribution.

A model (John Hemsted 1962), which provides an estimation process for the prospective income stream of ordinary shares is proposed for actuarial use. Discussion includes an illustration of it's possible application using modern computer spreadsheets. The model develops "investment returns" (yields) that can be compared to those available in the bond market.

There is a discussion as to how input might be formulated for this model and in particular driven from industrial scenario analysis. Hence, a change in the prospects for an industry can be translated immediately into pricing effects on constituent companies. Simulation possibilities are discussed briefly.

Considering the value of ordinary shares as derived from their future "payables" to shareholders, as per the model, provides another dimension to explore "market risk" and in particular the risk of adverse price movement associated with changing interest rates. Some thoughts are offered on this.

1. INTRODUCTION

1.1.1 Actuaries, looking at the advertisements in an actuarial magazine for investment work, might be forgiven if they supposed actuarial fellowship excessive for the job. Generally investment jobs advertised in those pages require only partial qualification. They might conclude their training and perspective contributed little and was perhaps even inappropriate certainly for actually making investment decisions.

1.1.2 Indeed actuaries involved with the capital markets are usually found performing duties that are not directly related to the selection of ordinary shares. More likely actuaries will be found involved with performance measurement and/or advising pension fund trustees as to the merits of individual investment managers. Certainly, selecting shares is a demonstrably risky business. It is at odds with the surety that has come to be associated with an actuarial certificate. Further, there is intense competition from others, who do not have an actuarial background and who genuinely believe themselves to be at least if not better qualified for the role of selecting ordinary shares. So *why* bother ?

1.1.3 That is a question that this paper does *not* address. What this paper does explore is *how* actuaries, with their traditional training in life insurance and pension fund liability evaluation techniques, can apply that training to the problem of ordinary share selection.

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2 *An Actuarial Framework for the Selection of Ordinary Shares*

2. SOME APPROACHES TO ORDINARY SHARE EVALUATION

2.1 *Rationale of Purchaser*

2.1.1 While a seller of ordinary shares can be motivated by numerous reasons, a purchaser is generally motivated by a single purpose. He buys with the expectation that the shares will provide a satisfactory *investment return*, (i.e. to make money). Generally, most of the financial reward from holding ordinary shares occurs in consequence of a change to market price. The market price of the shares will only register an improvement at a future date if other investors are persuaded to pay more. However, they are unlikely to do this unless they too perceive that they will in turn obtain a satisfactory *investment return* by holding the shares. It follows that a rational investor should investigate for as far in the future as possible the prospective monetary rewards associated with holding the security. The long term prospects will ultimately determine future market prices.

2.1.2 The emphasis in equity investment analysis (at least as practiced in North America) is generally to focus upon corporate prospects. Often the distinction between corporate prospects and shareholder prospects is not explicit; there being only an implicit notion that corporate prospects will eventually transform into prospects for the shareholders themselves. However, rational investors might be more concerned with directly assessing what and when they, as shareholders, will likely get rather than what their company can/will get.

2.2 *Break Up Value and Related Assessment Skills*

2.2.1 Nevertheless, in a semi-rational world, corporate prospects rather than shareholder prospects are often important drivers of stock market prices. Particularly worthy of note is the approach to securities analysis which focuses upon establishing the net *break up value* of a corporation's shares. Presumably, this is related to what the net assets of the discontinued company would fetch in an open auction. This approach is particularly common in the analysis and assessment of resource companies.

2.2.2 For instance, in the North American oil and gas industry, *break up value* is an important consideration. This is particularly true for junior exploration companies. The same can be said also of junior mining exploration companies. *Geologists and others* with special skills related to estimating 'in ground' reserves are surely more appropriate than actuaries when it comes to establishing the worth of such companies using this method.

2.2.3 More generally, for corporations not necessarily involved in resource industries *accounting skills* also feature as an important skill for estimating *break up value*. Corporate accounts involve all sorts of accounting conventions and concepts. Interpreting them often amounts to an art with conclusions significantly affecting inferences as to *break up value*.

2.3 *Cash Flow and Related Assessment Skills*

2.3.1 Another important driver in stock evaluation is the internal *cash flow* that a company develops from operations ignoring depreciation and/or depletion. Dealing with *cash flow* has the distinct advantage of avoiding the effect of the various accounting conventions that might be employed to charge for on going wear and tear of capital assets. Accordingly, the equity value of a company might be obtained by estimating future *cash flow* year by year and discounting it to produce a present value. The producing assets of the company are consumed in this hypothetical process and so, in theory, the company eventually ceases to exist.

2.3.2 Generally, the time horizon for such cash flow analysis covers relatively few years. Estimating the *cash flows* often necessitates a thorough in-depth investigation of the company. MBA's and/or a*ccountants* probably have more appropriate skills to perform this kind of analysis than an actuary, especially if such experts have gained a familiarity with the company after years of following its operations.

2.3.3 *Cash flow* analysis is focused upon a hypothetical process that is generally not contemplated by the company. Also the process fails to identify when and what the investor gets by way of return. It focuses solely on the company. Further the corporation's ability to earn abnormal returns on reinvested capital is not explored. This may be a very important characteristic of a company which lends much to the rating the stock market affords it.

2.4 *Assigning Multiples and Related Assessment Skills*

2.4.1 Investment research, often offered to the investing public, will involve explicit estimates for a couple of years (usually earnings per share). The valuation is then completed by presuming an appropriate *multiple* (e.g. a P/E multiple, if the estimates are earnings per share) and multiplying the quantity estimated by the presumed *multiple*. Hence a prospective price of the share is obtained.

2.4.2 All sorts of people perform this kind of analysis. The assumption of a *multiple* has the effect of camouflaging the long term nature of the valuation problem that is implicit in that process. Actuarial skills are not needed.

2.5 *Actuarial Forte*

2.5.1 So what contribution can actuaries specifically make ? At first sight prospects seem grim. Geologists, accountants, MBA's and personalities with a following, all seem to possess special skills generally judged as more appropriate to for valuing ordinary shares than what actuaries can offer. However, deeper considerations suggest an actuary's plight is not so desperate.

2.5.2 One important theoretical valuation model described in security analysis literature is the *dividend discount model*. This modeling approach attempts to identify what future money will actually flow through to the investor by way of dividends etc. Dividends are discounted back to the present at some assumed rate of interest (*investment return*) to determine a present value. An important aspect of the model is that it deals directly with funds flowing through to the investor rather than focusing upon the internal characteristics of the corporation. Philosophically, it takes the "valuation bull by the horns".

2.5.3 **Table I** illustrates, the *percentage of present value* associated with the years remaining after various time horizons (10, 20 and 30 years) for a growing dividend stream. We might call these *"Percentages of Residual Value"*. For illustration purposes various rates of annual dividend growth are assumed (0, 2, 4, 6 and 8 per cent). Under each of these growth assumptions a perpetual stream of dividends is discounted at annual rates of 9, 11, and finally 13 per cent; rates which might perhaps be used to value ordinary shares.

Table I - Percentages of Residual Present Value For A Perpetual Cash Flow Stream Growing At Various Compound Rates

	Discount 9 %					**Discount 11 %**					**Discount 13 %**				
	Growth %					**Growth %**					**Growth %**				
	0	**2**	**4**	**6**	**8**	**0**	**2**	**4**	**6**	**8**	**0**	**2**	**4**	**6**	**8**
Year															
10	*42*	*51*	*63*	*76*	*91*	*35*	*43*	*52*	*63*	*76*	*29*	*36*	*44*	*53*	*64*
20	18	*27*	*39*	*57*	*83*	*12*	*18*	*27*	*40*	*58*	*9*	*13*	*19*	*28*	*40*
30	*8*	*12*	*24*	*43*	*76*	*4*	*8*	*14*	*25*	*44*	*3*	*5*	*8*	*15*	*26*

2.5.4 **Table II** below illustrates similar values under less severe growth assumptions. Here the growth is presumed to continue only for 10 years and then there is no further growth in the payment stream. Equity investment is a risky business. Such an arbitrary cut off of future growth prospects at say year 10 introduces an element of conservatism which is probably appropriate for modeling purposes.

Table II - Percentages of Residual Present Value For A Perpetual Cash Flow Stream With Compound Growth Restricted To Only The First 10 Years

	Discount 9 %					**Discount 11 %**					**Discount 13 %**				
	Growth %					**Growth %**					**Growth %**				
	0	**2**	**4**	**6**	**8**	**0**	**2**	**4**	**6**	**8**	**0**	**2**	**4**	**6**	**8**
Year															
10	*42*	*45*	*47*	*49*	*52*	*35*	*38*	*40*	*42*	*44*	*29*	*32*	*34*	*36*	*38*
20	18	*19*	*20*	*21*	*22*	*12*	*13*	*14*	*15*	*16*	*9*	*9*	*10*	*11*	*11*
30	*8*	*8*	*8*	*9*	*9*	*4*	*5*	*5*	*5*	*6*	*3*	*3*	*3*	*3*	*3*

2.5.5 Scrutiny of the tables illustrates that for *most* combinations of growth and discount, significant present value (perhaps even more than 50 per cent) remains after all three time horizons. Indeed, for both models, *at least* 30 years seems necessary to generally bring the percentages down to the range of single digits. Therein is illustrated the essence of the valuation problem, once the philosophical attitude is adopted of valuing prospective shareholder entitlements. *Justification for value comes from potential prospects many years ahead in the future. This is an essential point of this paper.*

2.5.6 Perhaps this is why there is generally so little published investment research into equities that focuses upon the essentials of the valuation problem as described. It is more convenient to focus solely upon near term essentials To be fair, there are few investors who are prepared to tax themselves with considerations which encompass periods of 30 years or more. The market for investment research tends to supply what buyers want.

2.5.7 *The problem of dealing with such long term essentials leans less on accounting or business administration analysis and more upon statistical and actuarial aptitude the further ahead in the future the estimates are made.* Perhaps there is a "catch 22" here for actuaries who wish to become securities analysts. Investment research tends to be concentrated on "near term" aspects, because there is limited actuarial presence in the industry. Because investment research tends to be concentrated on the "near term" there is little perceived need for actuarial skills.

3. DESIRABLE CHARACTERISTICS OF AN ACTUARIAL MODEL

3.1. *Simplicity*

3.1.1 Beethoven's 9th Symphony was composed by a man who at the time was deaf. In as much as Beethoven must surely have heard the music in his head so it is with experienced actuaries when they apply their mathematical modeling concepts. The mathematical model is merely a tool for the purpose of pursuing thought. The *simpler* the modeling the greater the ease with which an actuary can carry it around in his head and use it to think. *Added complexity should earn it's keep in spades.*

3.2 *Completeness*

3.2.1 While simplicity is very desirable for the actuarial modeling of ordinary shares, the analysis should nevertheless encompass all of the 'critical' factors that in general theoretically affect the market value of a share. Debates in an actuary's mind as to appropriate value, then focus automatically upon the essentials of the valuation problem rather than other extraneous argument, which perhaps has the effect of confusing the issue.

3.2.2 However, a model is by definition a simplification of reality. In consequence, there must be something of a balancing act between including that which is deemed necessary for *completeness* and model *simplicity.* While adding additional "levers" to a model in an attempt to more precisely mimic reality will not necessarily produce better results, an actuary should be conscious of the model's limitations.

3.3 *Capitalizing Upon Existing Skills*

3.3.1 Actuaries have lots of experience valuing the liabilities of pension funds and insurance company liabilities. If the model can draw upon this experience so much the better. Why not capitalize on the knowledge and experience already familiar to actuaries?

3.4 *Using Historical Experience*

3.4.1 Actuaries are used to drawing inferences from past experience. It seems reasonable therefore that a modeling process covering a projection over say 30 years should, at least, start with an analysis of recent corporate experience and as the estimates move forward in time draw inferences from larger data sets.

3.5. *Focus upon Relative Valuation*

3.5.1 Hopefully actuaries are realists. No matter how elaborate and well considered the input to a model purporting to value ordinary shares, the actual realization will probably fall far from the mark, leading to significant "estimation error". However, in security analysis absolute evaluation, while desirable, is not the only useful form of evaluation. Relative valuation is also useful. Ideally a modeling approach should lend itself to relative valuation between individual companies.

3.5.2 An added bonus occurs if the approach also lends itself to relative valuation between industries and also different sectors of the capital markets. For example, it is often useful to compare equities and the fixed income markets. This suggests measuring value in terms of yield or "*investment return*" using North American equity jargon.

3.6 *Flexibility To Mimic Market Reality*

3.6.1 Large percentage swings in the value of life insurance liabilities or pension fund liabilities tend to occur relatively rarely between periodic actuarial examinations. The actuarial bases used in the calculations are rarely subject to significant or constant change. On the other hand, capital markets are something else. Rapid and significant change is the rule more than the exception. Consequently, it is natural for actuaries familiar with working with liabilities to be rather intimidated by the relatively large percentage swings in "value" they calculate when modeling ordinary shares.

3.6.2 Further the stock market is a constant nagging critic. An actuary involved in these activities must endure the reality of day to day stock market pricing. Wide variance is implicit in the valuation problem. Large discrepancies when comparisons to stock market prices are made should be anticipated.

An Actuarial Framework for the Selection of Ordinary Shares

4. PROPOSED MODELING PROCESS

4.1 *Origin*

4.1.1 In his 1962 paper[1] to the Actuarial Students Society the late John Hemsted outlined a method of effectively projecting in a very simplified way corporate accounts forward in time year by year using an iterative method. The process can be performed at the per share level. All that is needed for this operation is a starting *book value* per share and a yearly series of estimates for future *returns on equity* and *dividend pay out ratios*.

4.2. *Projecting Forward*

4.2.1 The iterative process can be described thus :-

Let

t take zero and positive integers values

B_t be the equity per share at the end of period t

E_t be the earnings per share during period t

D_t be the dividends per share paid (assumed at end of) period t

ROE_t be the return on initial equity generated during period t

PO_t be the percentage of earnings paid out as dividends during period t (i.e. payout ratio).

Then

$$E_t = B_{(t-1)} \times ROE_t \quad \text{..... Equation (1)}$$

$$D_t = E_t \times PO_t \quad \text{..... Equation (2)}$$

and

$$B_t = B_{(t-1)} + E_t - D_t \quad \text{..... Equation (3)}$$

4.2.2 Thus it follows that given an initial B_0 to start the process off and future yearly estimates of ROE_t and PO_t a series of yearly dividends develops. The process can be continued for as long as the yearly estimates of ROE_t and PO_t exist.

4.3 *Developing Present Value*

4.3.1 The present value of the income stream V_k can be now developed simply by discounting the dividends to the present at an *investment return rate* "k" viz. :-

$$V_k = \sum_{t=1}^{t=\text{infinity}} D_t / (1+k)^t \quad \text{..... Equation (4)}$$

4.4 *Sale At Book Value*

4.4.1 As illustrated in Section 2 a relatively small amount of present value develops in years subsequent to 30 under most realistic circumstances for valuing shares. An alternative to dealing with the added complexity of an infinite dividend stream might be to simply assume a sale of the security at book value at that time viz. :-.

$$PV_k = \sum_{t=1}^{t=30} D_t / (1+k)^t + B_{30} / (1+k)^{30} \qquad \text{..... Equation (5)}$$

where PV_k is the present value discounting at rate k assuming a sale.

4.4.2 Cutting the dividend stream off at say year 30 is convenient for spread sheet work. It avoids the necessity of formulating explicit assumptions regarding growth in perpetuity. Any difference between book value and the sale price is unlikely to effect present value significantly. The sale is contemplated far in the future and discounting will minimize the difference. Further, since the shares of successful enterprises tend to trade above their book values the process will generally introduce an element of prudence. What is important is to fix a standard for the actuary to make comparisons.

4.5 *Spread Sheet Concept*

4.5.1 **Table III** illustrates the calculations developing the income stream in spread sheet format. It is probably a good idea to hold such a concept in mind when deliberating about the worth of a share.

4.5.2 In the illustration, using per share values, past observations of book, earnings, and dividends are input and used to develop a past record of ROE (return on equity) and PO (payout ratio). Past experience is then used to help formulate estimates of ROE and PO in the future. These in turn are used to develop consistent future estimates of book, earnings and dividends.

Table III Illustration Of The Development of An Income Stream Using Prospective Estimates Of ROE and PO

COMPANY XYZ

Past Experience

	Developed			Input		
YEAR	PO	ROE		BOOK	EARN	DIV
1994				5.13	0.47	
1995	19.61%	29.82%		7.02	1.53	0.30
1996	35.00%	14.25%		8.51	1.00	0.35
1997	18.18%	6.46%	< < <	8.96	0.55	0.10
1998	12.99%	8.59%		9.63	0.77	0.10
1999	11.24%	9.24%		9.41	0.89	0.10
2000	8.93%	11.90%		10.43	1.12	0.10
2001	8.16%	14.09%		11.78	1.47	0.12

v

Future Estimated v

	Input			Developed		
YEAR	PO	ROE		BOOK	EARN	DIV
2002	**8.00%**	**16.50%**		13.57	1.94	**0.16**
2003	**9.00%**	**16.50%**		15.61	2.24	**0.20**
2004	**14.00%**	**9.00%**		16.81	1.40	**0.20**
2005	**10.00%**	**13.00%**		18.78	2.19	**0.22**
2006	**10.00%**	**15.50%**		21.40	2.91	**0.29**
2007	**10.00%**	**11.00%**		23.52	2.35	**0.24**
2008	**10.00%**	**13.00%**		26.27	3.06	**0.31**
2009	**10.00%**	**15.50%**	> > >	29.94	4.07	**0.41**
2010	**10.00%**	**11.00%**		32.90	3.29	**0.33**
2011	**10.00%**	**13.00%**		36.75	4.28	**0.43**
2012	**10.00%**	**15.50%**		41.87	5.70	**0.57**
"	"	"		"	"	"
"	"	"		"	"	"
"	"	"		"	"	"
2030	**40.00%**	**11.00%**		149.58	14.35	**5.74**
2031	**40.00%**	**11.00%**		**159.45**	16.45	**6.58**

Income Stream Developed

4.6 *Modeling The Accounts*

4.6.1 In **Table III** the accounts of the corporation have been simplified as far as possible. Both debt and preferred share capital (capital senior to equity capital) are excluded from the proposed model. Only 'book value per share' remains to represent the balance sheet each year. 'Earnings per share' likewise represent the income statement while 'dividends per share' are an item drawn from a statement of cash flows.

4.6.2 Certainly, a similar model could be developed which extends the capital base to include debt and preferred shares. Perhaps instead of projecting forward using *return on equity* an alternative process using return on total capital might be employed. All other things being equal, the greater the amount of capital senior to equity used by a company the greater the *return on equity* that should evolve from such modeling and the greater the growth of the company.

4.6.3 Whether the additional complexity enhances the projection process is questionable. There will be a tendency for large corporations to keep balance sheet ratios (e.g. debt to equity) relatively constant over long periods of time; lending support to the notion that observed past levels of ROE will continue into the future. If there is reason to suppose that debt levels will change and it will influence future earning prospects, the effect can always be accommodated in the proposed model with a subjective adjustment to the estimates of future ROE.

4.6.4 Nevertheless, if a corporation appears to be taking on additional debt and therefore accepting more business risk perhaps it is time to reconsider the *investment return* required.

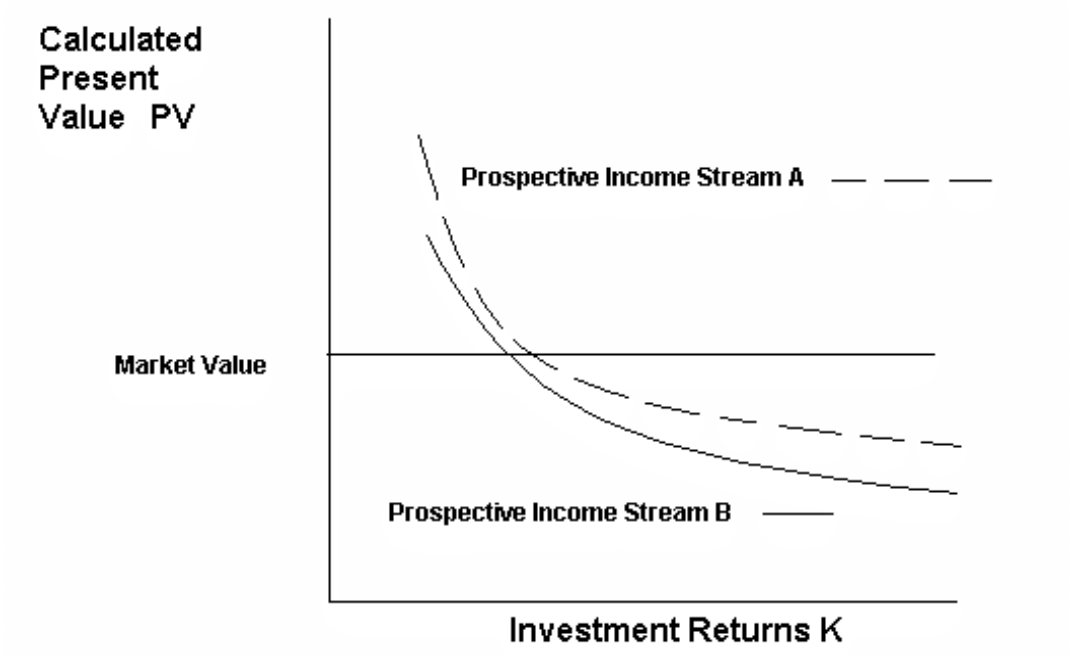
5. WITH DIFFERENT INVESTMENT RETURNS

5.1 *Effect of Changing Investment Return*

5.1.1 **Diagram I** illustrates the effect of changing the rate of discounting on present value. Here there are two possible income streams A and B, each developed through the modeling process. They are discounted to the present at various *investment returns* 'k'.

5.1.2 It is useful to conceptualize the results of modeling like this. Various income streams spanning assumptions with which the actuary might feel comfortable can be graphed together and so relative effects and sensitivity to changing assumptions explored over a whole range of *investment returns*.

Diagram I - Discounted Present Values At Various Rates



6. RUBBISH IN - RUBBISH OUT, CONSIDERATIONS ABOUT INPUT

6.1 *Thinking With The Model*

6.1.1 Having a theoretical frame work is one thing. Developing useful results from it is another. Investment people can sometimes be somewhat naive regarding inputs into a model like that described. Perhaps there is a tendency to be engrossed with the modeling process itself. Virtually any result can be achieved given sufficiently skewed input. There is an art and a skill to formulating input for the model if it is to be usefully applied.

6.1.2 It has been the author's experience that frequent use and familiarity with the model applied to a wide range of circumstances leads to a "feel" for what is appropriate for the stock market at any particular time. The relationships between the input numbers become almost as important as the absolute values of the numbers themselves. In a way an analyst has to perform a role as an arbitrator and define for his own purposes what the stock market is implying about the distant future in order to develop values consistent with current market prices. Within such a framework abnormalities often appear. *The essence of the usefulness of the approach is that it provides additional insight to that generally applied by most persons involved with the selection of securities in the capital markets. Usually investors focus on more immediate factors in their deliberations.*

6.2 *About Return On Equity*

6.2.1 Estimating *return on equity*, spanning many years into the future, becomes less of a business problem and more of a statistical/actuarial problem the further into the future forecasts are made. In itself that may have something to do with the attitude many investment professionals adopt towards this kind of work, proclaiming it "impossible". Those who make that claim are often well trained in business management. Perhaps it is because of this very orientation, that they may have a tendency to argue that share appraisal should also revolve around those skills.

6.2.2 It is useful to conceptualize *return on equity* as *a price*. That is to think of *return on equity* as being a price for equity capital in much the same way that interest rates generally represent the price of borrowed money.

6.2.3 Prices are determined by supply and demand. Thus, for example, interest rates are determined by the supply and demand for borrowed money. Similarly over long periods it might be reasonably argued *return on equity* will be determined by the supply and demand for equity capital. Thus if a company demonstrates that it can consistently earn a higher *return on equity* than its industrial peers it seems reasonable to assume that competition will arise. Other companies will be attracted into the field or learn to apply similar industrial techniques. Whence more equity capital is attracted and employed in the field. Prices for the products or services are reduced in consequence of the greater supply causing r*eturns earned on equity* to move down towards the averages. Conversely, one might argue that if a company earns less on equity than average returns, it will eventually have an opportunity to increase them (provided it survives). Competition will tend to leave the field. Indeed, the company itself might change its activities, in time slanting them towards more profitable ventures.

6.2.4 The rationale of 6.2.3 applies not only to companies but also to industries and indeed whole economies when treated in aggregate.

6.2.5 Previous considerations suggest that as estimates of *return on equity* are made further into the future they should be trended ultimately towards averages. Perhaps at first the trending might be towards industrial averages and then later towards averages for the economy as a whole.

6.3 *Inputs For "Return on Equity" i.e. ROE*

6.3.1 If one projects the future from past experience, one might be well advised to understand the underlying reasons that caused the past to be what it was. These might change. This is particularly true when using past data to predict future values of *return on equity.* An intelligent use of past data for projection purposes involves an investigation (or at least a familiarly) with the business or economic conditions that gave rise to that data in the first place, both at the corporate level and when the data is aggregated as in industrial analysis.

6.3.2 After having emphasized the need for such prior intelligent analysis, it might be said that one of the main clues an actuary will have as regards what to expect from a company will be it's track record. Deliberations might start by investigating what *return on equity* has been for say the last ten years.

6.3.3 If the investment community can provided earnings estimates for say the first two years of the projection into the future these might be translated into *return on equity* estimates and used in the model. One needs all the help one can get. Presumably such earnings estimates were developed from a thorough in-depth examination of the business by the securities analyst.

6.3.4 After projecting the first two years the actuary might review the track record of the company and perhaps consider say the last ten years. This should give some insight as to what to expect as per *return on equity* before trending estimates first into industrial averages and then averages for the economy as a whole.

6.3.5 While it would be exceedingly useful to know what the long term averages will actually turn out to be for as much as 30 years in the future being precise is not essential for *comparative analysis*. Being reasonable and estimating as well as possible probably suffices for that purpose.

6.3.6 Nevertheless, there is tremendous scope for research here. Records of *return on equity* experienced for various industries and for the economy as a whole would be very useful to someone modeling this way. An analysis of historical patterns in response to the economic and industrial factors of their day would likewise be very useful. Such investment research is rare if ever to be found.

6.3.7 It should be remembered that modeling will probably incorporate explorations using different *investment returns* (i.e. k) in the calculations. This variable has enormous effect on the end result. The absolute values of the *ROE* estimates (and the long term industrial averages to which they are trended), are not so important as their *relationship* to the *investment return*s used in discounting. There is an aspect of balancing between these two variables with the net result guiding deliberations as to the worth of a share.

6.3.8 Various corporate specific, industrial specific, and economic specific factors can be worked into the projections. For example, perhaps there is an onerous long term contract that will eventually expire leading to higher corporate profitability thereafter. As another example, an actuary may have some notions as to where the overall economy is currently situated in a business cycle or perhaps a particular industrial cycle important to corporate operations. Such cycles can be followed with the future estimates of *ROE* following the prospective ups and downs, diminishing in magnitude as time advances, there being less surety as regards estimating cycle incidence. Finally, the estimates can be smoothed into the overall averages.

6.3.9 Cycles in commodity prices are particularly important for corporations actively engaged in resource activities. For the UK, North Sea oil exploration and the importance of crude oil prices comes to mind. For Australia, perhaps the price of metals, such as copper, comes to mind as an example.

6.4 *Inputs For "Payout Ratio" i.e. PO*

6.4.1 Future estimates of the *payout ratio* are needed to establish a dividend stream from the earnings. (If no dividends are paid the *investment return* is generated solely from a prospective sale at the end of the estimation period). While still an important input, certainly to be estimated as carefully as possible, the estimates tend to be less critical than the ROE estimates previously discussed. This is because *payout ratio* assumptions are not so much concerned with identifying the overall *amount* of money that will be received. They are more concerned with *when* moneys are paid. If earnings are not immediately paid out to shareholders by way of dividends, they are reinvested by the corporation. Thereby they increase shareholders' equity. This should provide for additional future earnings and corporate growth.

6.4.2 Once having set a precedent with a dividend policy, corporate management is unlikely to risk incurring the wrath of shareholders by reducing the monetary amount of the dividend unless there is a very good reason. Thus with ROE estimates varying year by year with resulting similar effect on earnings, one can formulate *payout ratio* estimates so as to keep dividends expanding along with the general trend of earnings but at the same time in such a way so that the monetary amount of the resulting dividend is at least equal the previous year's dividend.

6.4.3 An important consideration when estimating dividend *payout ratios* is an understanding of the corporation's likely need for additional equity capital as the years pass. A company is unlikely to pay out much if it will need the funds for active expansion.

6.4.4 Superficially, at least, it seems reasonable to assume that if a company is growing relatively quickly and earning extraordinary high *returns on equity* it makes sense both with regard for the best long term interests of shareholders and those of the company itself, to retain as much earnings as possible. The funds can be ploughed back into the business and so generate higher returns for shareholders than they could probably achieve by directly investing the funds themselves. Likewise if a company is only able to earn a low return on it's equity, in theory, it should pay out the earnings so that shareholders can earn better returns elsewhere. In practice, tax considerations, and even more likely, the personal ambitions of management often thwart the application of this rationale.

6.4.5 Unless there is good reason to suppose otherwise, it seems reasonable to trend estimates of dividend *payout ratio* towards first industrial and then overall economic averages as forecast years advance, and the company grows. A generous dividend policy becomes increasingly important as companies grow should they wish to continue to attract larger investors such as institutional shareholders, for example.

6.5 *Input For Investment Return i.e. k*

6.5.1 As illustrated in **Diagram I** one of the most important variables in assessing stock market prices using this model is the long term *investment return* offered to a prospective buyer. Such rates of return can be compared with rates available in the fixed income market. Thus with this approach, the equity market can be considered to be an extension of the fixed income market.

6.5.2 Obviously an equity vehicle carries much more business risk than a corporate debenture, even of the same enterprise. An equity owner needs compensation in the form of additional *investment return* for the added risk associated with equity. There are no absolutes. As with the corporate fixed income market where the various yield spreads between securities depend upon the perception of corporate prospects, so it is with the apparent *investment return* offered by the shares of different companies.

6.5.3 One aspect of the modeling process is that it provides insight into the effect of the overall level of interest rates on equity prices. In theory at least, when the long term trend in interest rates is up, perhaps in response to increasing inflation, it becomes more difficult for equities to rise (e.g. the 1970's in North America). Similarly, all things being equal, modestly decreasing interest rates provide a more benign long term investment environment for capital appreciation (e.g. the 1990's in North America).

6.5.4 **Diagram I** illustrates in broad terms the sensitivity of *value* to the general level of *investment return*. In theory, very low rates of *investment return* have the effect of significantly boosting equity values, other variables remaining unchanged. The author's experience has been that the stock market adjusts relatively slowly to significant declines in the general level of bond yields. It takes a while for a revision down in interest rates to register an effect on *investment returns* required for shares in the market. As 'they' say, the market has to climb a wall of worry. Certainly, if yields in the bond market reverse while the process is developing, the leverage displayed in **Diagram 1** can work in reverse. Severe losses can occur.

6.6 *Need For Adaptability to Meet Particular Circumstances*

6.6.1 Common sense must be applied all the way. Nothing is carved in stone. Perfection is never obtained, but practice helps movement towards it.

7. BACK TRACKING TO OBTAIN ROE RECORDS

7.1 *Recreation of Book Values and So Adjusted ROE (i.e. PR Records)*

7.1.1 Nothing is absolute. Accountants have a way of changing their practices. This can represent a problem when one is recording historical data from which to project forward. Hemsted[(1)] points out that it is possible to use Equation (3) in reverse.

That is : -

repeating $B_t = B_{(t-1)} + E_t - D_t$ ..... Equation (3)

implies $B_{(t-1)} = B_t - E_t + D_t$ ..... Equation (6)

whence $ROE_t = E_t / B_{(t-1)}$ ..... Equation (7)

(and of course) $PO_t = D_t / E_t$ ..... Equation (8)

7.1.2 Thus it is possible to recreate previously recorded book values per share given a historical per share record of earns and dividends. Such records of dividends and earnings tend to be readily available irrespective of yesteryears' accounting conventions. In as much as the theoretical book values so developed will be consistent with the published record of earnings and dividends and the most recent accounting convention giving rise to the most recent book value they also will be consistent. An actuary might feel more comfortable using ROEs developed from them rather than the original book values recorded yesteryear under different accounting conventions.

7.1.3 It is a mute point whether such a refinement has much merit. The record of earnings per share will also be a function of past accounting conventions. The process probably improves the data for projection purposes when there is reason to suppose that the record of historical earnings is more representative of the current accounting convention than the record of book values.

7.1.4 Nevertheless, Equation (6) is a useful device to keep in mind since it represents a practical way to quickly extend data backwards for the purpose of calculating ROEs when historical records of book value are not readily available but earnings and dividend records are.

8. THE GOODNESS OF BOOK EQUITY

8.1 *Good Book Values*

8.1.1 No doubt the point will be raised that book value is just a theoretical accounting concept and that statistics based on it will be fraught with error. Also, what someone may pay for a company may be well removed from book value. All that is quite true. However the absolute magnitude of the book value is not as important as the related earning power represented by the related ROE values.

8.1.2 Hopefully, a feel for future ROE values, as related to the particular characteristics of the underlying book values, can be acquired from a scrutiny of the recent past. For valuation purposes all that is really required is that estimates of future ROE are consistent with the book value developed under the most recent accounting conventions.

8.1.3 In the distant future, when for the sake of modeling simplicity, a sale at book value is contemplated, current day differences will reflect only a minor contribution to the overall book value at that time. Most of that future book value will be composed of retained earnings generated in the years ensuing from the current time. Further, the dollar amount of any current differences will be reduced by discounting from far in the future when the hypothetical sale takes place.

9. SCENARIO ANALYSIS AND INPUT

9.1 *Relative Valuation Within a Common Scenario*

9.1.1 A few trial runs with the model proposed in this paper should serve to convince most people that, while highly desirable, determining "absolute value" is intrinsically elusive. Section 3.5 suggests that realistically "relative valuation" of ordinary shares is probably more feasible, and so better suited for actuarial endeavor.

9.1.2 Broadly speaking, different companies active in the same industry will be subject to the influence of the same factors which affect profitability. Thus for example, if the price of crude oil doubled, it might be anticipated that companies engaged in the exploration and production of crude oil would do better in consequence. With this in mind, it seems that a reasonable way to go about using the model *relatively* is to fix an industrial scenario and make corporate projections within that context.

9.1.3 The personal computer and the availability of modern spread sheet software can be exploited to extend an individual's calculation abilities enormously and so the analytical powers of an actuary. In particular, with a little thought about automating the process, it is possible to set up a computer system with inter-linked spread sheets that effectively allows one to completely recalculate hundreds of corporate analyses with a few simple key strokes which specify a change to their common industrial scenario. Thereby one is able to explore the relative effect on constituent corporations as different industrial scenarios are explored.

9.2 *A Procedure For Developing and Quantifying Scenario Factors*

9.2.1 Initially, it is probably a good idea to just compile a list of the factors presumed to affect profitability (i.e. ROE). These should be grouped by the year that they are thought likely to initially start to be of influence.

9.2.2 Having established such a list the next step might be to try to assess subjectively the magnitude of the effect on ROE that the factors will produce and also the number of years it will be in effect. For instance, we might use a scale from "-5" (most pessimistic) to "+5" (most optimistic) to indicate the strength of a factor. Thus the numeric representation of a factor with a strength of "+3" acting for a period of 5 years might be denoted (3,5).

9.2.3 Suppose, for example, one had reason to believe that construction plans for many new nuclear reactors will be required in 1 year. Further, it is thought this will give rise to a huge increase in the demand for civil engineering services which will enhance the ROE of companies providing those services. Suppose that according to one's best estimate the ROE's of such companies will be positively affected, by "+3" on the scale and that the effect will likely last 5 years before competition develops, reducing the prices to normal levels. With the example, this "*skills shortage factor*" (i.e. Description A), expressed initially simply in words, might be assigned a numerically useful attribute "(3,5)". The factor with it's (3,5) attribute is associated with a year 1 year hence, when the factor first causes an influence on corporate earnings.

9.2.4 Continuing from the above example, suppose there is also reason to believe that interest rates will reach extremely high levels 4 years hence and remain there for an additional 3 years (i.e. Description B). This will have the effect of reducing all civil engineering activity and in particular affect the ROE's for companies engaged in those activities by "-2" on the scale.

9.2.5 **Table IV** shows how this process might be formulated on a spread sheet to arrive at an overall set of numeric scale values presumed to affect ROE in future years. The numbers are accumulated from the analysis of each of the descriptions (i.e. Description A and Description B). The factor with Description A subjectively assigned strength "3" starts in 2004. It runs until 2008. The factor with Description B was assigned a negative strength of "-2" . It starts in 2007 and runs until 2009. The "overall effect" on the corporate ROE's is obtained for each future year by adding the contributions from each factor for that year.

Table IV - Accumulating the Effects of Factors

SCENERIO - HYPOTHETICAL

As Of Jan 2003

	Overall Effect	2003	2004	2005	2006	2007	2008	Description of Factor
2003	0							
2004	3		3					(3,5)// Description A
2005	3		3					
2006	3		3					
2007	1		3			-2		(-2,3)// Description B
2008	1		3			-2		
2009	-2					-2		
2010	0							

9.2.6 It remains to translate the numbers representing "overall effect" into specific ROE estimates for companies with prospects that are related to the scenario that has been developed. One method of doing this might be to simply identify and record on each corporate spread sheet an "average ROE" and a "change in ROE"; the "change in ROE" being that change that would result typically from an effect of "+1" in the scale. Ideas for these estimates might come from a scrutiny of the corporation's past record.

9.2.7 Thus to illustrate using the above example, if :-

ROE_A be the average ROE selected for a company

ROE_C be the change effect on ROE for a 1 in the scale

We have the resulting values of ROE developed using Table IV viz. :-

2003	ROE_A
2004	$ROE_A + 3 \times ROE_C$
2005	$ROE_A + 3 \times ROE_C$
2006	$ROE_A + 3 \times ROE_C$
2007	$ROE_A + 1 \times ROE_C$
2008	$ROE_A + 1 \times ROE_C$
2009	$ROE_A - 2 \times ROE_C$
2010	ROE_A
	..... Etc.

9.2.8 Perhaps the process might start after say the first two years of the projection. Inspiration for ROE during the first two years might be fixed according to conventional wisdom as offered by investment dealers and their securities analysts. *The essential point is that the analyses of similar companies are being driven from a common perception of the more distant future.* While the future has been handled subjectively, at least there has been some thought about it.

9.2.9 Equity capital is risk capital. Things will probably not turn out as expected and indeed a company might even become insolvent. One way of subjectively incorporating the cost of such business risk is to add an element of prudence into future estimates. Thus the ROEs calculated in accordance with the above process might then be automatically reduced by a “prudence” factor. The net result of these automated procedures should be a smoothed progression into the averages at more distant times.

9.2.10 Automated estimates of PO can presumably be developed as a function of ROE year by year (with an algorithm incorporating the considerations described in Section 6.4). They too might be smoothed into averages the further into the future the estimates are made. However, because PO is probably not so critical as ROE to the final result, it remains questionable whether such a refinement is worth the weight in added complexity. Fixed values of PO may be suffice.

9.3 *Application*

9.3.1 The capital markets exist upon a river of new information. It is very convenient to have the ability to change instantaneously each corporate analysis according to new developments affecting industrial prospects.

9.3.2 Running all the individual corporate estimates from a single projection of industrial factors helps preserve consistency. If an actuary were to set about directly adjusting each corporate analysis in turn in response to new industrial circumstances, his thoughts as to what constitutes an appropriate projection would probably change during the days he might be involved in the task. Automation enhances the relative aspects of the modeling process.

9.3.3 Nevertheless, automation should not be allowed to result in projections becoming so unreasonable that the computer ceases to be a servant of human logic but rather the dictator of it.

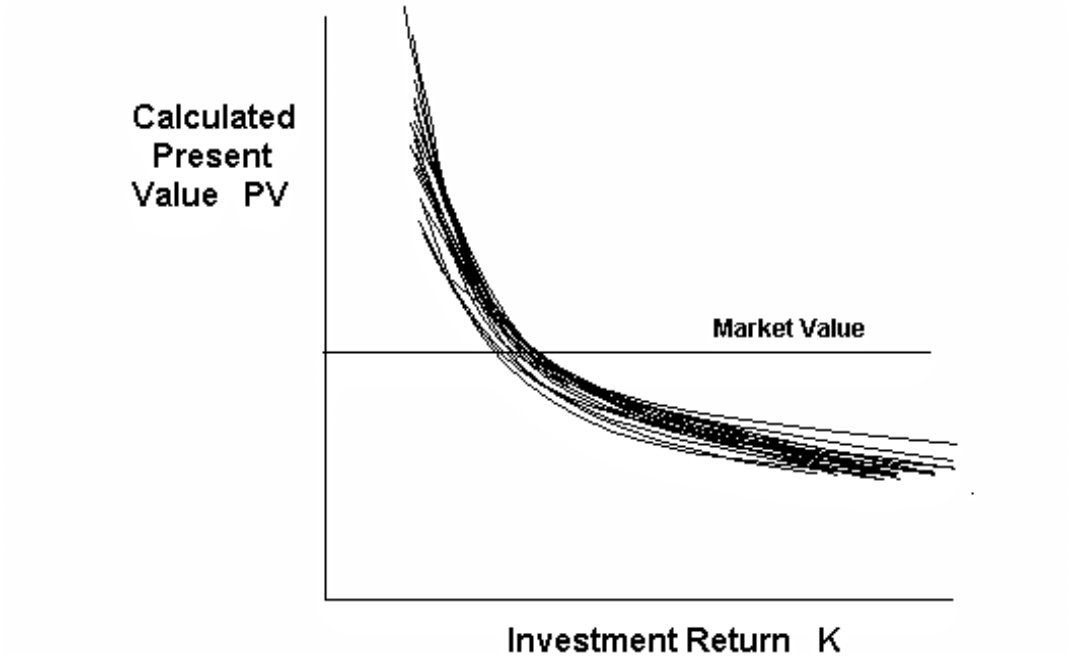
10. SIMULATION

Assessing The Effect of Estimation Error.

10.1.1 **Diagram I** illustrates the overwhelming effect on equity value that theoretically develops when the required *investment return* (rate of discount) changes. The effect is so dramatic that it is probably more convenient to conceptualize equity value in terms of such relationships rather than a single point estimate of value obtained after selecting a particular *investment return*.

10.1.2 Changing the set of assumptions of future *return on equity* (ROE) and the corresponding dividend *payout ratio*s (PO) will inevitability lead to a different relationship between *calculated present value* (PV) and *investment return* (k). Modern computing allows for almost limitless sets of assumptions to be formulated according to a probabilistic simulation process. Calculations can be performed for each set of simulated values of ROE and PO, to determine the respective relationship. **Diagram II** shows such relationships drawn together.

Diagram II - Shading The Likelihood Area For An Investment Return Relationship



10.1.3 Repeating the process over and over effectively shades an area. A interpretation of this is that the deeper the hue of the shading, the more probable the "true relationship", (which the simulation process is attempting to estimate), actually passes through the area. This approach, as briefly illustrated here, is certainly not precise. Nevertheless, from a pragmatic perspective it does provide a trader with some valuable insights as to where prices representing extraordinary value may be found.

10.1.4 Certainly the shading and relationships may justify a *wide* range of values for a particular equity, but then so is the trading range typical of share price. Wide ranges are implicit in the nature of the problem of determining share value. Even so, one would not wish to end up with a piece of paper that is completely black. The fact that an actuary is simulating estimates of future ROE and PO in no way removes the need to apply *reason* and constraint to the process, perhaps in compliance with the considerations described earlier in Section 6.3. and 6.4.

11. PERSPECTIVES OF RISK

11.1 *Market Risk and Business Risk*

11.1.1 Actuaries will probably hold a wider perspective of risk than most other investment people. Actuaries are more likely to be employed in a role which requires them to focus upon financial liabilities as well as financial assets. Their thoughts about risk are likely to relate to the possibility of adverse trends developing in the net balance between the assets and liabilities of a financial entity rather than focusing solely on assets.

11.1.2 On the other hand, securities portfolio managers may be in the unenviable position of having to demonstrate repeatedly their investment acumen, as measured by market value with prices constantly changing. Periods as short as three months are often used for this purpose. Performance will generally be measured against some stock market index. To the portfolio manager, risk is about collapsing prices for the shares in his portfolio. This is particularly true, if a collapse does not simultaneously register in the broader stock market.

11.1.3 Risk within this context has featured as a major topic in investment circles during the last thirty years or so. "Beta factors" have been developed. The beta factor of a share is supposed to measure the extent to which its price reflects shifts in the overall level of the stock market. A share with a high beta factor is regarded as being more risky than one with a low beta factor because its price swings, responding to changes of the overall level of the stock market, will be more volatile. This risk, which is closely associated with the fickle moods of the stock market, might be called "*market risk*". It is less related to the specifics of an individual corporation's business prospects (or lack of), which we might call "*business risk*".

11.2 *Measuring Market Risk*

11.2.1 Beta factors are calculated retrospectively from past observations regarding how a particular share price varied in response to the shifts in the overall level of the stock market. Unfortunately, they are often used as absolutes in the investment industry. In fact, they are just statistical estimates. Like all statistical estimates they are subject to *statistical error* in their estimation.

11.2.2 Indeed, when they are used for predicting the characteristics of future price behavior there is also an implicit assumption that the corporation's attributes remain constant. Observations used to calculate beta are drawn from a certain past time period and then the resulting beta applied to make inferences about behavior in another future time period.

11.2.3 With such limitations in mind, it seems reasonable that an exploration of "*market risk*" might incorporate an investigation of the factor(s) that *cause* share prices to move in the way they do relative to stock market swings.

11.2.4 Human psychology and the propensity for emotional translation of stock market moves probably feature as an element of *market risk*. For instance, it is interesting to note that many of the shares of large U.S. investment houses tend to have high betas. The immediate prospects for profitability of these corporations will be highly correlated to the performance of the overall stock market. Such short term considerations probably contribute to the observed price behavior of their shares.

11.2.5 Another element of *market risk* is probably related to changes in the overall level of interest rates. The perception that economic conditions are changing can have a significant and immediate effect on interest rates available in the capital markets. One cannot ignore market conditions. It seems reasonable to suppose that the *investment return*s required by investors in shares will also change.

11.2.6 The values developed by the model described in this paper are very sensitive to changes in *investment return*. Indeed it is seems plausible to suppose that *much* of the short term volatility in share prices, which is of such great interest to portfolio managers; the general investing public; and those who calculate beta factors; is actually caused by shifts in the overall level of interest rates and the consequential effect on required equity *investment returns*.

11.2.7 It follows that an alternative approach to beta for measuring *market risk* might be drawn from considerations concerning the effect that changing interest rates have upon the present value of the prospective income stream of a share. While not incorporating some of the more fickle aspects of volatility, such as mentioned in 11.2.4 for example, the notion that *market risk* is something largely caused by shifts in interest rates is nevertheless enticing. A strong theoretical argument can be made in its favour.

11.2.8 Nevertheless, for the sake of precision why not define *discount rate risk* as the component of *market risk* that is caused solely by changes that occur in *investment return*? It may well be that there is so little left over after removing this component that for practical purposes the two types of risk are the same. An investigation into this aspect might be the subject of another paper.

12. DISCOUNT RATE RISK

12.1 *Risk Implicit In The Structure of Income*

12.1.1 Viewing equity value within the context of a discounted income stream leads to an interesting observation concerning volatility. It is apparent that the more distant in time the income is discounted the greater will be the effect on present value in response to changing rates of discounting. Therefore, it seems reasonable to suppose that at least some price volatility has to do with the incidence in time that income from the share is received. The more distant in time the income, the greater the effect on share price and so volatility and *discount rate risk*.

12.1.2 Accordingly it is proposed that generally "growth" company shares, with an implied promise to pay out proportionally larger amounts at distant times, following rapid growth, are inherently more risky than "income" shares, paying out dividends sooner. Putting aside *business risk* (and the possibility that the growth may never even occur), the characteristics of a share's income stream itself provide some insight into *discount rate risk* and so probably *market risk* (and so betas too).

12.2 *Possibility of Developing a Prospective Measure of Risk*

12.2.1 Given the existence of explicit estimates of income to be delivered by various equities (perhaps developed by an investment research department) there appears to be the possibility of creating a measure of *discount rate risk* using this information. This may or may not serve to replace betas for measuring *market risk*. The essential aspect of such a measure is that it characterizes income streams by increasing as does the volatility of their present value in response to varying discount rates.

12.3 *Some Thoughts About Duration*

12.3.1 One thought along these lines is to borrow the concept of *duration* from bond traders and apply it to the income streams that have been modeled. For the purpose on hand, consider *duration* to be the weighted arithmetic average of the various time intervals when payments are received. The weight assigned to each time interval is the 'proportion' of the 'total present value' that the related payment represents after discounting. Equation (9) describes this mathematically viz. :-

Let $a_1, a_2, \ldots\ldots\ldots a_n$ be amounts paid at times $t1, t2, \ldots\ldots\ldots tn$ Series A

If D be the "*duration*" of Series A for an interest rate i

Then with $v = 1/(1+ i)$

$$D = (t1.a_1v^{t1} + t2.a_2v^{t2} + \ldots + tn.a_nv^{tn})/(a_1v^{t1} + a_2v^{t2} + \ldots\ldots + a_nv^{tn}) \quad \text{.... Equation (9)}$$

12.3.2 *Duration* will increase as proportionally more of the total present value is drawn from payments received at more distant times. The further in the future money is paid, the greater the change in present value (i.e. the greater the volatility) for changing discount rates. Therefore it seems reasonable to tentatively suppose that duration might suit as a measure for *discount rate risk*. An exploration of that idea might be the subject of another paper, but a few observations seem to be in order now.

12.3.3 First, note the approach lends itself directly to comparisons with similar numbers calculated for fixed income securities. The idea is familiar to participants in those markets.

12.3.4 Next, once the income stream for a share has been established, the approach is relatively simple. Values are easily calculated from the income stream. There is no need to get into least squares statistical techniques, as for example with the estimation of beta factors. There is no direct dependence upon past data, again as with betas. Also, such a measure of risk is consistent with the estimates of future income that have been modeled.

12.3.5 The rate used in discounting when calculating *duration* might vary from share to share, and in particular be that rate which equates 'present value' to 'market value' (bond traders will probably use the yield to maturity). Alternatively, the discount rate might be fixed at some average level reflecting the market conditions of the day. The former may more closely reflect stock market reality. However, it introduces an additional element influencing comparisons of income stream volatility for this measure, namely *the discount rate* itself.

12.3.6 Within this context, it is worth noting that Homer and Leibowitz[2] illustrate for 30 year bonds that volatility, if representing the effect of the same percentage yield change, will increase as the yield increases. *Duration* operates contrariwise. It will decrease as the discount rate increases implying less volatility not more. This is because there is relatively less present value weighting the more distant time intervals. It seems therefore that there may be some advantage to keeping the discount rate used in Equation (9) fixed for the purpose on hand.

12.3.7 It may be useful for informal contemplation to affix such a parameter as *duration* to the income streams of ordinary shares and it may be pleasant to muse over the prospect of replacing beta. However, for most practical purposes there does not appear to be any advantage in proceeding this way over simply exploring *discount rate risk* directly using the massive calculation power of modern computers.

12.4 *Volatility Measured Directly As Model Price Change*

12.4.1 A more direct way to measure volatility is to simply calculate the percentage change resulting to the modeled *present value* of each security in turn when applying a fixed percentage change to the *investment return* (yield) equating the modeled income stream to market price. Homer and Leibowitz[2] point to evidence that supports their proposition that in real life percentage yield changes rather than basis point changes represent a sounder standard for measuring changes in bond market yields, and so the related effect on bond prices. They explore the effect on the price of various bonds for a $33^{1}/3$ per cent change in yield. *The same can be done for equities,* once *the estimated income stream has been modeled and is available.*

12.4.2 The previous considerations suggest that the problem addressed by Modern Portfolio Theory of minimizing *market risk* for a given expected *investment return* of a portfolio of shares may well translate into the problem of identifying a set of shares which together minimize the volatility of a portfolio of securities as calculated in 12.4.1 for a given level of expected *investment return* for the portfolio as a whole. Indeed with a little imagination and a few more assumptions clients might be shown demonstrations of what various increases in interest rates are likely to do to the market value of their portfolios.

12.5 *Year by Year Cash Analysis*

12.5.1 An actuary will probably want to move beyond this line of thinking to incorporate a set of liabilities into the rationale he applies. With explicit estimates of cash flows developed by equities an actuary is one step nearer to describing the future income stream of an entire portfolio of assets. With a similar estimated stream of cash outflows related to the liabilities of a financial institution he is better able to engage in deliberations concerning the year by year flow of cash. In the author's humble opinion conclusions drawn from this sort of analysis are what the actuarial certificate should be about.

13. SOME PRACTICAL POINTS FOR STOCK PICKERS

13.1 *Courage of One's Convictions*

13.1.1 Firstly, judging from investment research literature the long term modeling approach described in this paper is generally not pursued by the vast majority of stock market participants. They tend to be more focused upon more immediate aspects that they feel are likely to affect share prices. Indeed, it is the author's opinion that in North America (at least) equity investors seem to behave as if they are almost blind to significant events occurring beyond a two year time horizon, even when those events can be predicted with a high degree of certainly. (Similarly it is the author's observation that investors' seem to act as if they are unable to remember more than two years of past experience). Therefore an actuary involved with this kind of work needs to have enough courage to stay the course of his convictions. This can be testing when it seems the whole stock market is crying foul. Other people may simply not see what he does.

13.2 *Importance of Industrial Analysis*

13.2.1 Corporations come and go. However, it seems self evident, that industries tend to be a more permanent feature of the economic landscape. Reaching out far into the distant future is probably best accomplished through industrial analysis rather than focusing too much upon individual companies. Most of the investment research purporting to service the needs of financial institutions centres upon corporate analysis rather than long term industrial analysis. In the author's view, this is unfortunate.

13.2.2 Ideally an investor would want to be positioned ready to take advantage of a quantum jump in the overall level of an industry's profitability. Not only are the regular equity returns available but also additional returns as the stock market begins to afford the industry higher growth prospects and starts to price shares accordingly. Probably the most important qualities needed by an actuary for identifying such opportunities are an inquiring open mind and also the ability to develop original ideas with regards to the future, particularly as it relates to the developing world economy.

14. CONCLUSION

14.1 *Efficient Allocation of Investment Capital*

14.1.1 Effective decision making in the capital markets is immensely important to the sound functioning of an economy. Without it economies can face ruin (e.g. the twentieth century social experiment with communism). If actuaries do not involve themselves in these activities others will. Further, these others will not hesitate to use actuarial techniques when it suits their purpose.

14.2 *Actuaries Should Do Their Own Thing.*

14.2.1 In theory at least, determining "values" for equities is at least as much an actuarial/statistical problem as a business problem. Actuaries seeking a career as securities analysts would be wise not to attempt to mimic the work and skills of the legions of very capable investment analysts that are readily available, but rather to draw upon their own unique background and skills with it's forte related to the probabilistic determination and valuation of long term cash flows. The paper suggests a simple framework that actuaries might adopt to accomplish this aim.

14.3 *Precision Not Feasible But Actuarial Contribution Still Very Worthwhile*

14.3.1 Much of the precision, refinement and surety with which actuaries may be familiar when performing their duties as related to the estimation of the value of liabilities is simply not intrinsic to the problem of valuing equities. The errors to be expected with equities are comparatively huge, both with regards input and the eventual end result. Model inputs are often made subjectively, being little more than educated guesses. This takes some getting used to by actuaries !

14.3.2 Nevertheless, the approach described is a rational extension of actuarial principles. At least, from an actuarial perspective it deals with the essential issues of the valuation problem. Proceeding so, stimulates those who would perform these type of calculations to reduce to a minimum the subjective element and deal intelligently with the residual. Thereby insights can often be gained to which may be missed by many in the investment community.

14.4 *The Author's Hope*

14.4.1 Probably the most important characteristic for success in doing this kind of analysis is to have an active, creative and critical imagination. One needs to follow closely economic events and the development of the world's economy. It should be fun and a consuming passion with every day being a professional development day. If the paper inspires a few young actuaries accordingly it will have served it's purpose.

14.4.2 Also, it is the author's hope that actuaries will be motivated to continue to develop the theory and carry the ideas forward (hopefully without forfeiting too much simplicity). The field is wide open.

14.4.3 Development of investment theory for equities during the last 30 years or so has mostly evolved outside of the actuarial profession. In consequence, many of the ideas commonplace in financial circles are not directly applicable to the actuarial discipline. Particularly in view of recent questions that have been raised concerning the Capital Asset Pricing Model (CAPM) by Richard Fitzherbert[3] there may be something of an onus on actuaries to come up with something else which is more immediately applicable to their purposes.

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