Corporate Risk Analysis

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Investors worldwide have experienced substantial financial loss over the last year or so. This paper discusses issues of risk and its impact when considering future investment. We illustrate how risk can be scrutinized and understood in terms of making better investments.

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1 Background

Strategy @Risk has developed a radical and new approach to the way risk is assessed and measured when considering current and future investment. A key part of our activity in this sensitive arena has been the development of a series of financial models that facilitate understanding and measurement of risk set against a variety of operating scenarios.

Our purpose in this paper is to show that every item written into a firm's profit and loss account and its balance sheet is a stochastic variable with a probability distribution derived from probability distributions for each factor of production. Using this approach we are able to derive a probability distribution for any measure used in valuing companies and in evaluating strategic investment decisions. Indeed, using this evaluation approach we are able to calculate expected gain, loss and probability when investing in a company where the capitalized value (price) is known.

1.1 Business Environment

Oft said but no less true, market places change and evolve constantly. An example is the increasing level of commercial globalization sometimes prompting massive change over short time-scales driven by technological advances, politics, consumer confidence, competition, terrorism, customer expectations and an increasing plethora of once unconsidered factors. Investment strategies deemed viable only six months ago could appear inadequate for a rapidly changing environment.

There are four truisms to which we subscribe in the course of strategy formulation encompassing analysis, evaluation and final implementation. They are:

- Today's constant is *change.*
- Today's variable is *speed* of change.
- Time frames for strategies to deliver profit have shrunk.
- Tomorrow's success results from *constancy* in strategic analysis and evaluation.

Changes in markets can be both spectacular and rapid. *In extremis* they polarize toward huge opportunities or alternatively pose dire threats. Whether change is incremental or cataclysmic, strategies initiated, rigorously evaluated, adopted and implemented in timely fashion can, on occasions, dictate a quantum change in organisational fortunes - one way or another.

A strategic approach concerns itself with identifying the ideal future state of an organisation. Firms then need to adopt and employ tactical processes, measures and resources that will enable that future corporate state to be attained. The key words here are *strategic* and *processes.* Investment needs to be considered initially in terms of *doing the right things* and *doing things right* – the processes referred to earlier. Investment therefore needs to be considered and evaluated in the context of a firm's activities or processes. This is a crucial activity as, rigorously undertaken, it will rank processes in terms of the economic profit they contribute. Understanding this in detail will impact upon all future strategic considerations.

Whether emergent or prescriptive, reactive or proactive, top down or bottom up – however strategies are envisioned or given birth, developing and evaluating strategic options and the processes associated with them requires apposite research and detailed analysis before final selection and commitment.

1.2 An Approach to Risk

Where is the value? Strategy @Risk's primary task from the outset is to establish the economic profit of the firm. We identify organisational value drivers - processes, ranking them according to the economic profit that they contribute and forecast their development.

In concert with this activity we determine important strategy parameters including debt, equity, depreciation and investments. We establish a risk free interest rate for use within our evaluation programme and establish a complete record of income, expenditure and investments looking both at history and more importantly forecasts. Further key steps include development of risk profiles for income, expenditure and investment, determining probability distributions for each criterion. This is the basis for Strategy @Risk simulations.

1.3 Simulations

Strategy @Risk's simulation model is designed to mimic the *real world*, enabling realistic market behaviour to be studied, evaluated and risk based decisions made concerning investment. To be of value, a clearly defined purpose is the single most important ingredient for a successful modelling study. The Strategy @Risk models have been evolved to focus on how an organization can maximize shareholder value without being an optimisation model. The art of financial simulation is knowing what to include and what to cut out; the model itself acts as the *knife* making logical decisions in this respect. The usefulness of our models lies in the simplification of reality, putting it into a form that can be easily understood.

A truism: any model is only as good as its assumptions.

Adequately representing the economic system is usually not a problem; the economic environment can be portrayed with whatever detail and accuracy is needed to suit a particular modelling purpose. Simulation models can easily be developed to include feedback effects, non-linearities, and dynamics; they are not rigidly determined in their structure by mathematical limitations as is the case in optimisation. Indeed, one of the main uses of simulation is to identify how feedback, non-linearity, and delays interact to produce troubling dynamics that persistently resist a solution.

Of course we recognise that many relationships and parameters in models, whether based on soft or hard variables, are imprecise and uncertain to some degree. We therefore perform risk analysis to consider how conclusions might alter if other plausible assumptions are introduced. Risk analysis should not be restricted to uncertainty in a particular parameter's value; we also consider the sensitivity of conclusions to alternative structural assumptions.

In the exercise shown later in this paper, this is achieved through 'Monte Carlo' simulations - recalculating (250 – 1000 runs) the model with new observations from production factor's probability distributions.

Our financial model uses expected values and their probability distributions then calculates comprehensive financial statements for each year of forecast. The model solves all of the implicit equations necessary to make detailed calculations at every stage of the process.

Many investors and shareholders have experienced the consequences of risk. Information concerning levels of risk involved in an investment is a precious asset. Most investment advisors tend to focus on general descriptions about what they believe to be the relevant risk factors associated with a particular investment. Rarely do these descriptions reflect an accurate evaluation and quantification of risk when an investment prospect is being presented to a client. The gap between a client investor's need for

quantifiable, risk based information and the frequent lack of measurable and relevant risk information provided by advisors can and does influence investment decisions with the potential for some obvious downsides. A failure to invest in an opportunity and reap the benefits and, conversely, investing in a total *'dog'* where loss is the outcome.

2 Corporate Risk Analysis

In the following pages we illustrate how Strategy @Risk computer based financial modelling can undertake detailed analysis of a company for the purpose of valuation whilst employing strategic simulations in order to maximize shareholder value and understand the levels of associated risk involved.

The clear purpose of this exercise is to establish a firm's level of economic profit. This key measure is used for valuation purposes and in determining if the firm is actually earning money i.e. creating value over and above the opportunity cost of capital invested.

Risk is exposure to uncertainty and there is an obvious need to understand the level of risk associated with a particular course of action. Even small changes in operational data or the framework in which the company operates can impact significantly on levels of risk and economic profit.

2.1 Sensitivity Analysis

Sensitivity analysis is very useful in identifying critical factors and their impact on the value of the company's equity. In Figure 1 are shown typical examples of the 10 most significant factors. Not surprisingly the results indicate that the number of units sold is the most important factor in determining a company's value. A 5% increase in sales increases the value by 24.8%. Alternatively a 5% percent increase in cost of raw materials decreases the value by 19.1%. The better the model is specified the better individual factors or processes can be assessed and levels of uncertainty taken into account.

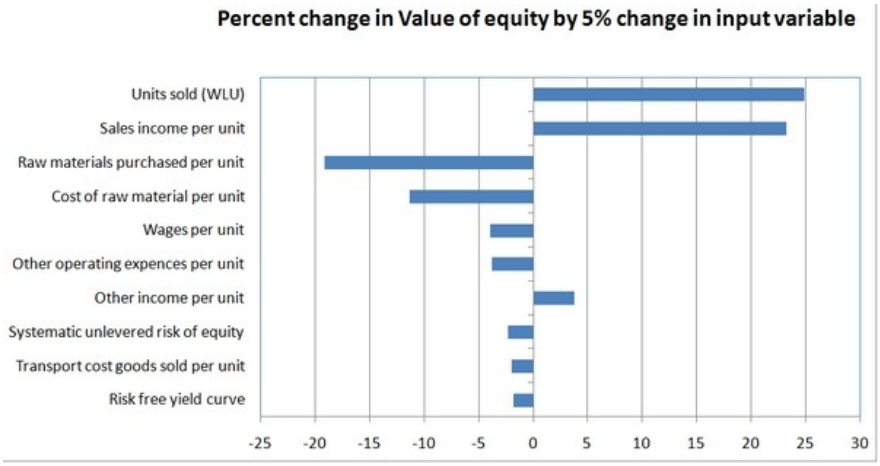

Figure 1 The 10 Most Significant Factors Related to Change in the Company's Value of Equity

For every significant variable (e.g. demand, currency exchange, interest rates, prices, etc.) we need to forecast their most likely value **and** its expected variance in the future. Historical observation and understanding of factors that have determined past variance adds important data to this approach.

2.2 Operational Data and their Probability Distribution

To facilitate estimation of future probability distributions for the key variables e.g. volume, price, costs and investments etc., we ask managers to predict expected variance. In other words to "guess" what percent the variable can be less than the most likely value, and how many percent it can be higher. This exercise aims at establishing the low and high 5% probability limits for the variable, as illustrated in Figure 2.

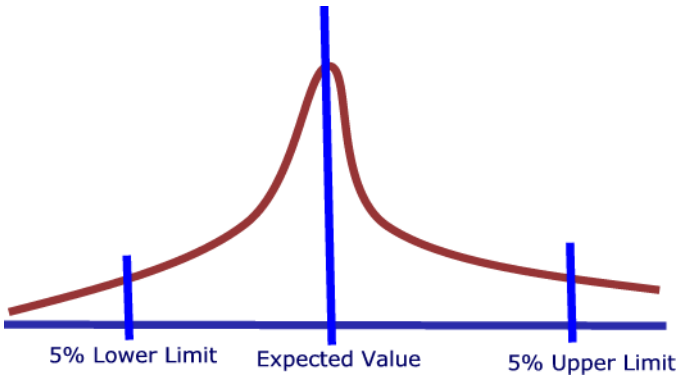

Figure 2 Expected Value and 5% Upper / Lower limits

Volumes, prices, costs and investments are expected to behave differently depending upon the industry sector in which the company operates. Normally we would expect volume, prices and most other costs to be skewed i.e. having a tail either to the left or right:

Uniformly distributed (e.g. the market is not yet clearly defined):

Other costs, being normally distributed have a typical bell shape:

Investments are expected to have a triangular distribution since there are obvious limits to their cost:

2.3 The Yield Curve

To be able to compute net present values (NPV) of future cash flows and the cost of debt and equity, we use observations from the risk free yield curve to estimate forward short and long-term risk free interest rates – shown in Figure 3.

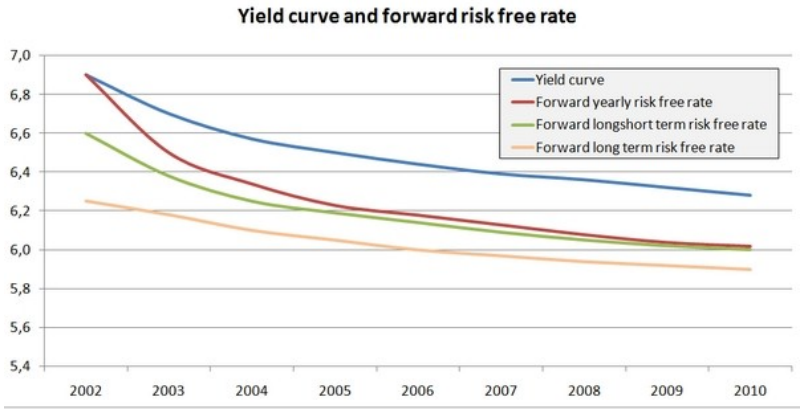

Figure 3 Yield Curve and Calculated Forward Risk Free Rates

2.4 Cost of Debt and Equity

The cost of equity is calculated from risk free rates, expected market risk premium and unlevered *beta.* Levered *beta* is calculated for each period based on leverage in that period. Often in valuation analysis debt-equity ratios are fixed throughout a forecast period. In the real world this is simply not possible so debt-equity ratios in the following example varies with calculated values of debt and equity, solving for the Weighted Average Cost of Capital (WACC) and the company value as a implicit simultaneous equation.

Based on estimated future risk free interest rates, market risk premiums, unlevered *beta*, the liquidity premium and tax regime, the cost of equity can be calculated for every period as illustrated in Figure 4. The cost of debt - long and short term - is calculated in the same way using the expected lender's margin on the calculated future risk free rates for the selected length of debt.

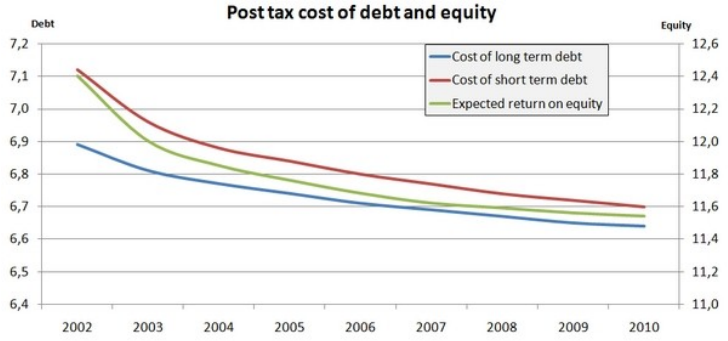

Figure 4 Post Tax Costs of Debt and Equity

2.5 Units Sold

Creation of a credible sales forecast needs extensive quantitative and qualitative research. The upper and lower limits of forecast sales need to be based both on appropriate research and any variance experienced historically.

Expected sales are forecast in Figure 5. Vertical bars in the graph indicate the approximate 90% confidence interval for sales in each year. As the graph indicates these intervals increase with the length of the forecast. This is partially due to the fact that uncertainty increases the further we look into the future and because the company

currently enjoys a very high return and expects aggressive competition to develop in future.

We have estimated the probability distribution for the number of units sold to be skewed (log normal) with a long upper right tail. The lower 5% limit is assumed to be 10% of expected value and the upper 5% limit to be 15% of expected value. These limits will increase to 24% and 29% respectively in year 2009.

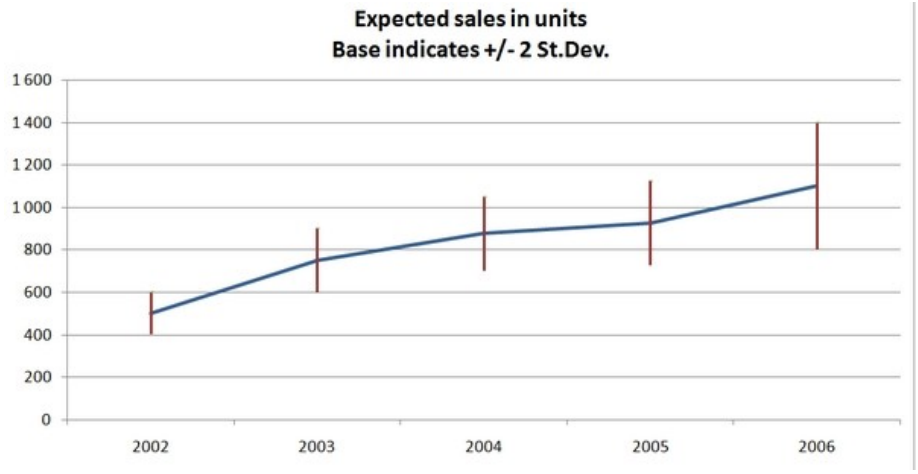

Figure 5 Expected Sales and Variance in Sales in the Forecast Period

With these forecasts, sales in year 2003 have a deterministic value of 750 units. When taking into consideration the uncertainty given by the estimated probability distribution, the expected value is 759 units, with a standard deviation of 68. Figure 6 shows there is a probability that the number of units sold might be as few as 561 or as many as 980.

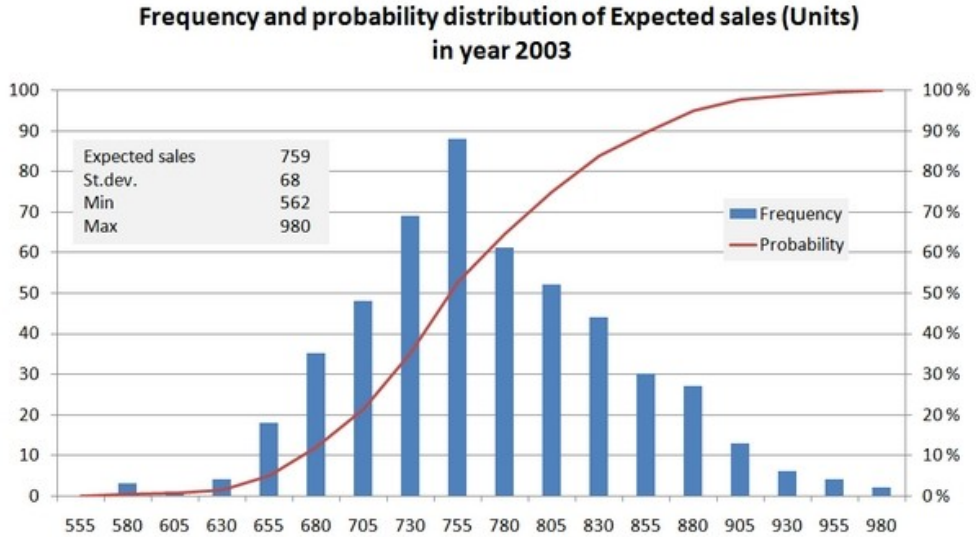

Figure 6 Frequency and Cumulative Probability Distribution of Expected Sales (Units) in Year 2003

2.6 Price per Unit

The expected price per unit sold is 1.650. The sales department assesses the probable price to have a skewed distribution with a longer left tail. The company also believes that future market development will see an average increase of 1.5 % per year in product price. The frequency and probability distribution for the expected price generated by 250 simulation runs is as shown for year 2002 in Figure 7.

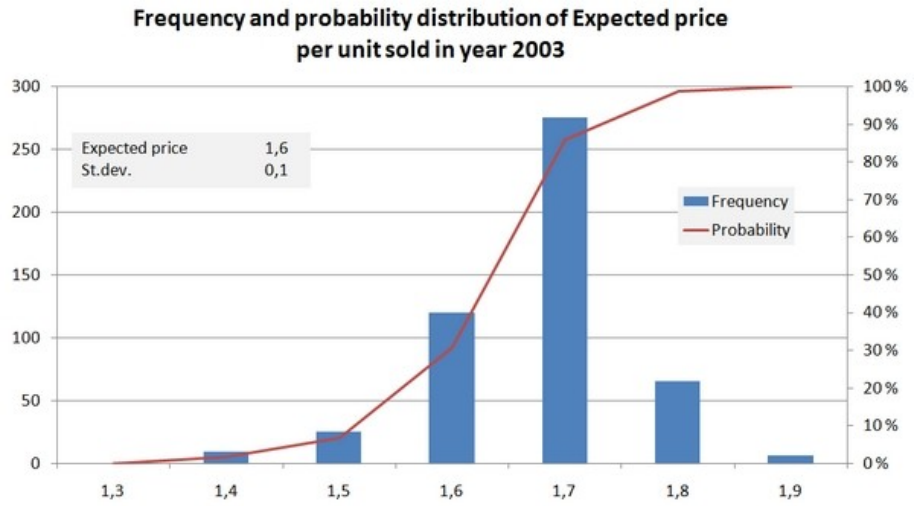

Figure 7 Frequency and Cumulative Probability Distribution for Price per unit sold in Year 2002

3 The Analysis

The Strategy @Risk simulation model provides all necessary information for development of a complete Profit and Loss Account as shown below in Table 1. In this framework all items whether from the profit and loss account or from the balance sheet **will** have individual probability distributions. These distributions are generated by the combination of distributions from factors of production that define the item. The figures in the tables are expected values.

Variance will increase as we move down the items in the profit and loss account. The message is that even if there is a low variance in the input variables (sales, prices, costs etc.) metrics like NOPLAT, Free Cash Flow and Economic Profit will have a much higher variance.

3.1 Forecast Profit and Loss

PROFIT & LOSS ACCOUNT	2002	2003	2004	2005	2006
1 Sales	825	1 256	1 487	1 553	1 926
2 Other Operating Income	125	191	228	239	298
i Total Operating Income	950	1 447	1 715	1 792	2 224
3 Changes in Stocks	-73	-96	-229	-37	117
4 Raw Materials etc.	470	732	950	831	965
5 Payroll and Related Cost	138	205	263	256	276
6 Depreciation of Assets	30	20	28	35	41
7 Write-down of Assets	227	340	437	452	499
ii Total Operating Expenses	791	1 202	1 448	1 537	1 898
iii Operating Profit (Loss)	159	245	267	255	327
iv Financial Items Net	-2	-4	-1	-7	-12
v Profit Before Tax	156	242	265	248	315
20 Tax (Cur.+Def.)	44	68	74	67	84
vi Profit (loss) for the period	112	174	192	182	231

Table 1 Profit and Loss Account

3.2 Total Operating Income

Each sale of a product produces an additional expected income of 250. However, it is not a fixed value but assumed to be a skewed distributed with a long left tail. Combining the distributions for sales and other income we can generate the probability distribution for total operating income (**Figure 8**):

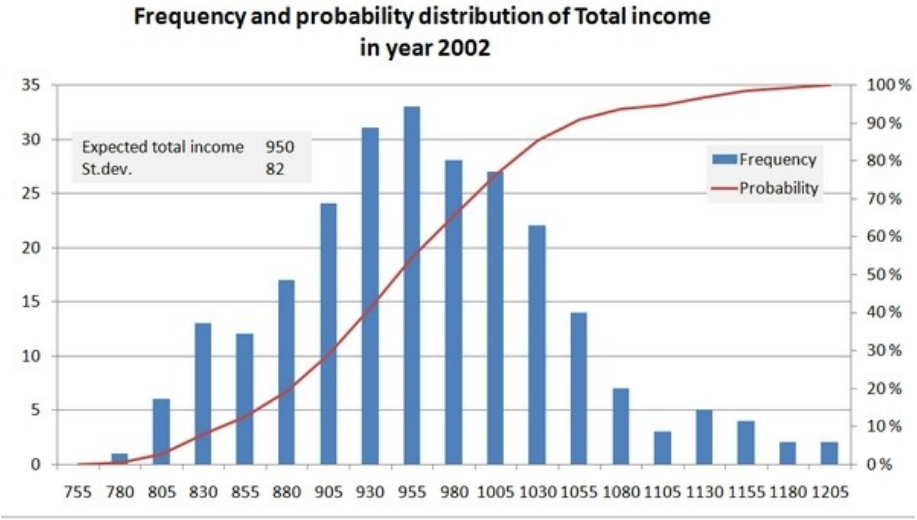

Figure 8 Frequency and Cumulative Probability Distribution for Total Operating Income in Year 2002

From the probability curve in Figure 8 we see the 90% confidence interval for total operating income as [830-1105] with an expected value of 950. The probability distribution is therefore slightly skewed to the right indicating a possible upside in sales.

3.3 Total Operating Expenses

All costs, variable or fixed, have their own probability distributions. Every run in the simulation generates an observation from each of the cost distributions creating a probability distribution for expected total operating expenses (Figure 9):

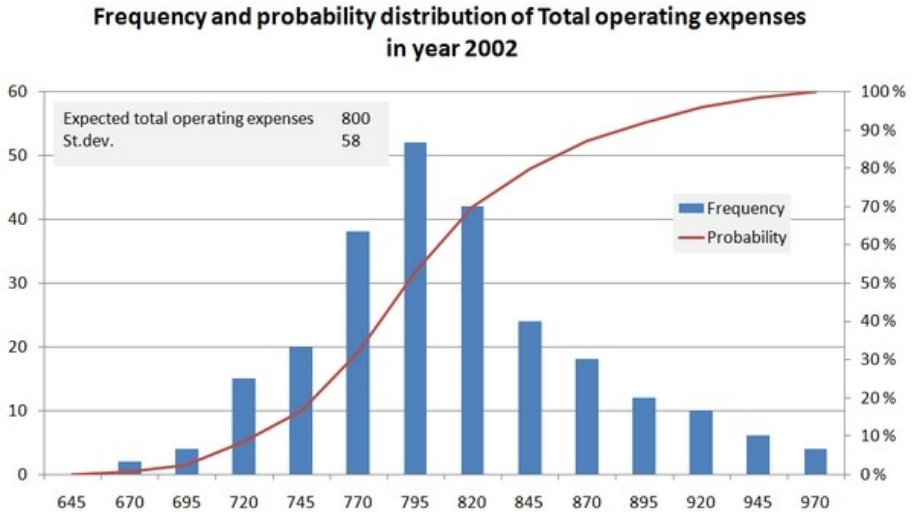

Figure 9 Frequency and Cumulative Probability Distribution for Expected Total Operating Expenses in Year 2002

This also includes depreciation/amortization of fixed assets and taking into account changes in stock of raw materials and finished goods. The distribution is slightly skewed to the right indicating possible cost well above expected value.

3.4 Earnings before Interest and Taxes (EBITA)

The distribution for EBITA is a purely derived distribution – consisting of observations of the differences between operating income and operating expenses (Figure 10):

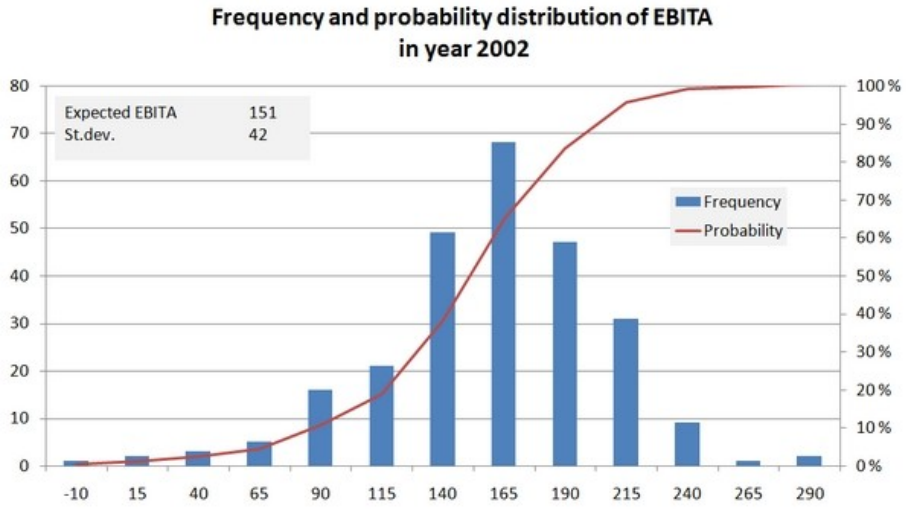

Figure 10 Frequency and Cumulative Probability Distribution for EBIT in Year 2002

Here distribution is slightly skewed to the left indicating a possibility for low and even negative values for EBITA.

3.5 Profit Before Tax

Based on the company's strategy reflected in the parameter values, EBITA, financial cost and income generated from the company's cash flow we find the probability distribution for profit before tax (Figure 11):

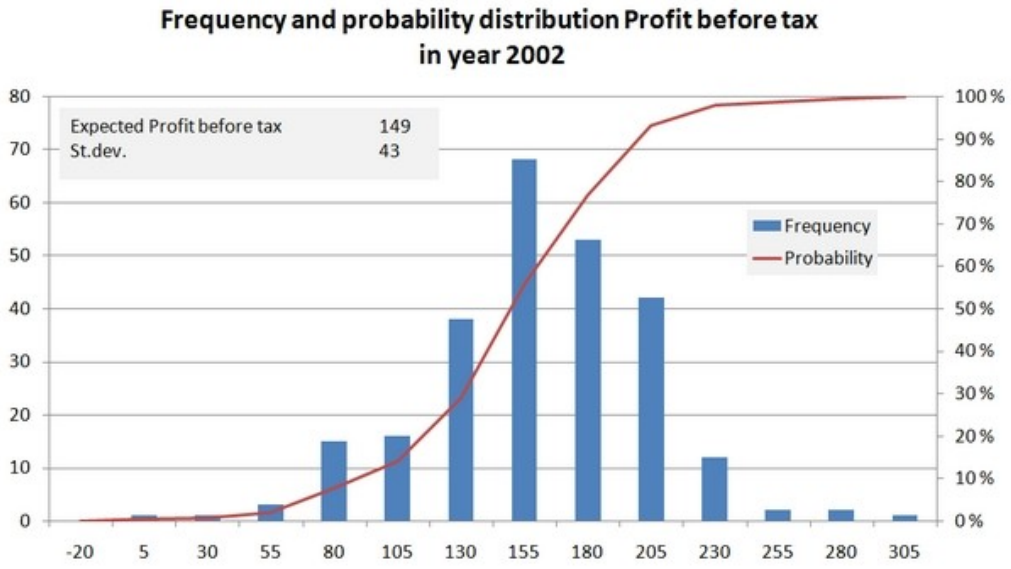

Figure 11 Frequency and Cumulative Probability Distribution for Expected Profit before Tax in Year 2002

The probability distribution has a relatively large standard deviation but it can be shown that more than 90% of the observations will be in the interval [0, 298]. As is evident in this case the probability of a loss is small.

3.5 NOPLAT Calculations

The most important metric for evaluating a company or a strategy is NOPLAT (Table 2). It is the starting point for calculating economic profit and free cash flow. Accordingly, the various probability distributions are instrumental in generating the distribution for both economic profit and free cash flow, and for the value of the company.

NOPLAT CALCULATION	2002	2003	2004	2005	2006
EBITDA	159	245	267	255	327
Taxes on EBITDA	-45	-69	-74	-69	-87
Changes in Deferred Tax	1	1	0	-2	-4
NOPLAT	115	178	193	185	236

TAXES ON EBITDA	2002	2003	2004	2005	2006
Tax on Profit (Current and Deferr	44	68	74	67	84
Tax Shield on Interest Expenses	2	2	2	3	6
Tax on Interest Income	-1	-1	-1	-1	-2
Tax on Non-Operating Income	0	0	0	0	-1
Taxes on EBITDA	45	69	74	69	87

Table 2 Expected Values of Net Operating Profit Less Adjusted Taxes.

Not unexpectedly NOPLAT show a high variance with approximate 90% of the observations between 50 and 154. Thus we anticipate only 5% of the observations will be less than 50 and that only 5% will be greater than 154.

With more simulation runs the frequency distributions will become increasingly smoothed and closer to symmetric, but still slightly skewed to the left (

Figure 12).

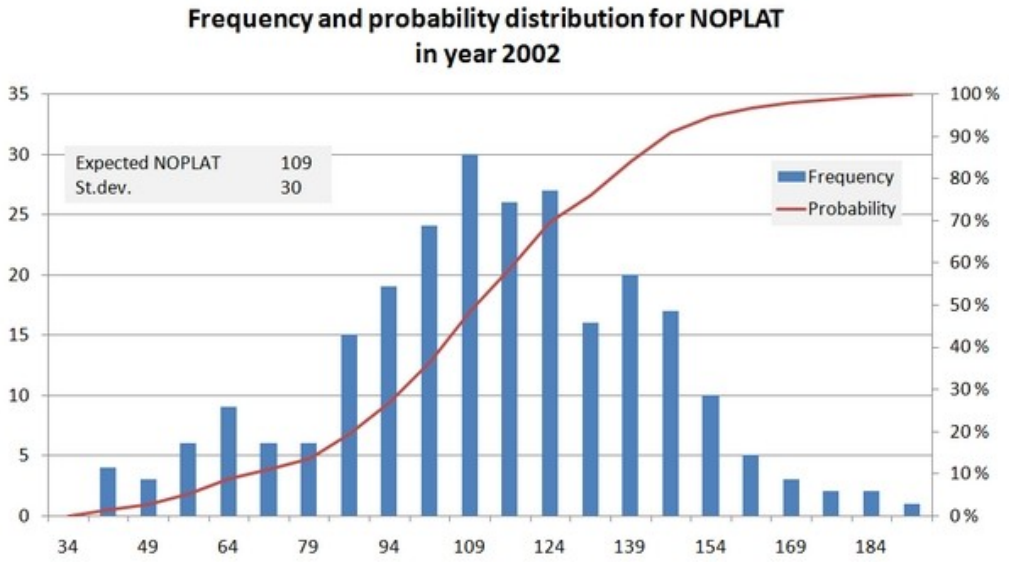

Figure 12 Frequency and Cumulative Probability Distribution for NOPLAT in Year 2002

3.6 Forecast Balance Sheet

From the opening balance and subsequent transactions generated by company operations we are able to produce a balance sheet for the forecast period shown below in Table 3.

As for the P&L account, each item is stochastic with a probability distribution. The figures given are expected values for the main items.

ASSETS	2002	2003	2004	2005	2006
A.i. Total Intangible Fixed Asset	0	27	30	45	44
A.ii. Total Tangible Fixed Assets	158	166	164	154	148
A.iii. Total Financial Fixed Assets	0	0	0	0	0
A. Total Fixed Assets	158	193	194	199	191
B.i. Goods (Inventory)	171	267	496	533	416
B.ii. Total Receivables	147	224	268	279	344
B.iii Total Financial Current Asse	0	0	0	0	0
B.iv. Cash at End of Period	56	73	83	81	173
B. Total Current Assets	374	564	847	893	933
Total Assets	532	757	1 041	1 091	1 124

EQUITY AND LIABILITIES	2002	2003	2004	2005	2006
C.i. Total Paid-in Capital	200	327	507	507	507
C.ii. Total Retained Earnings	0	0	0	0	0
C. Equity	200	327	507	507	507
D.i. Total Provisions	1	2	2	1	0
D.ii. Long-term Liabilities	111	89	139	216	164
D.iii Total Current Liabilities	219	339	393	368	454
D. Total Liabilities	332	430	535	585	617
Liability and Equity	532	757	1 041	1 091	1 124

Table 3 Balance Sheet

4 Economic Profit[1]

A performance measurement and incentive system that closely aligns the interests of shareholders and managers is economic profit. Most valuation approaches use some variation of economic profit to measure value created:

Economic Profit = (ROIC - WACC)*Capital

ROIC = Return On Invested Capital
WACC = Weighted Average Cost of Capital
Capital = Assets Relevant to Operations

There are three basic ways to improve economic profit values:

- Increasing earnings (NOPLAT)
- Reducing the operating capital
- Reducing the cost of capital (WACC)

A company's economic profit will indicate to investors how competitive it is compared to alternative investments with similar risk. If economic profit is less than zero the company is clearly destroying value. If economic profit is greater than zero the company is creating value over and above its opportunity cost of capital and investors will have a clear indication that investment in the firm is probably a good strategy.

International management guru, Peter Drucker, authored a Harvard Business Review article stating[2]: *"Until a business returns a profit that is greater than its cost of capital, it operates at a loss. Never mind that it pays taxes as if it had a genuine profit. The enterprise still returns less to the economy than it devours in resources… Until then it does not create wealth; it destroys it."*

Analyzing historical performance enables the investor to see if a company has generated economic profit or not. We now examine the probability distributions for ROIC, WACC, operating capital and for economic profit before we end up with the probability distribution for the value of the company.

4.1 Operating Capital

The Company's opening balance and forecast balance sheet states the required assets to run the company's activities. These assets – fixed and current will in the forecast period change, partly due to the company's investments and acquisition plans, and partly due to the working capital necessary to run the day-to-day operations. Production and sales, stocks, debtor and creditor turnover rate and the minimum cash level set the minimum level of working capital (Table 4):

[1] All following calculations are in the model also done for free cash flow and free cash flow valuation. In this case however we find economic profit to be the appropriate measure even if both give the same value for the Company.

[2] Source: Drucker, Peter F., "The Information Executives Truly Need," Harvard Business Review, Volume 73, Number 1, pp 54 - 62

INVESTED OPERATING CAPITAL CALCULATION	2002	2003	2004	2005	2006
Minimum Cash Level	56	73	83	81	102
Inventories and Accounts Receivables	318	491	764	812	760
Operating Current Assets	374	564	847	893	862
Excess Marketable Securities	0	0	0	0	71
Current Assets	374	564	847	893	933
Operating Current Assets	374	564	847	893	862
Non-Interest Bearing Current Liabilities	-219	-339	-393	-368	-454
Net Working Capital	155	225	454	525	409
Net Property. Plant and Equipment	158	166	164	154	148
Other Operating Fixed Assets	0	27	30	45	40
Operating Fixed Assets	158	193	194	199	188
Operating Assets	312	418	648	723	597

Table 4 Invested Operating Capital

Based on the selected strategy, the simulation model calculates necessary capital to run the company's operation. Capital infusion is partly equity and partly debt, depending on the selected minimum debt-equity ratio (see paragraph 7). The expected values and the probability distribution (cumulative) are then as shown in **Figure 13**

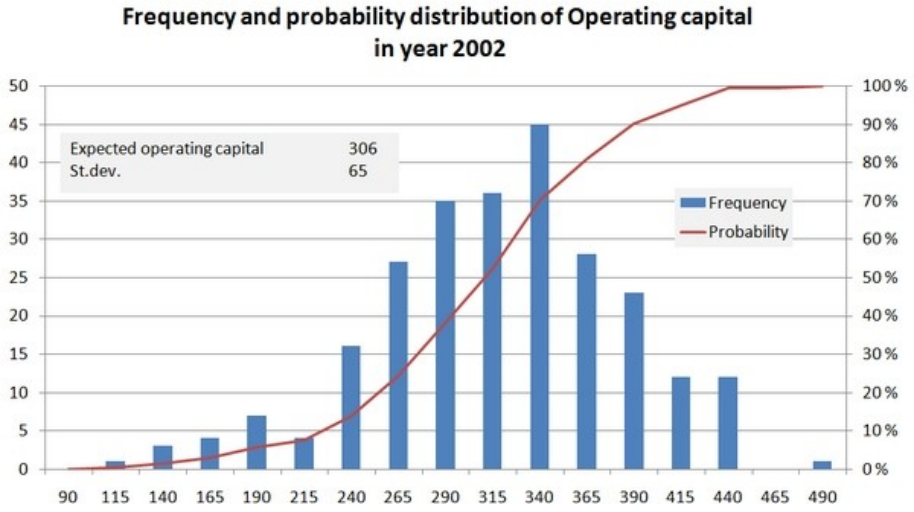

Figure 13 Frequency and Cumulative Probability Distribution of Operating Capital in Year 2002

In this calculation goodwill has been included in the operating capital. In most cases however goodwill and goodwill amortization should be excluded.

The level of operating capital has a relatively high variance with 90% of the observed values between 170 and 415. This is caused largely by the fact that production lead times in some instances, lead to excessive stocks together with creditor turnover rate at almost twice debtor turnover rate, leading to a high level of operating current assets.

4.2 Return on Invested Capital (ROIC)

The return on invested capital (ROIC) is the single most important value driver. It is defined as 100*(NOPLAT/Operating Capital) and is determined by the operating margin and the capital turnover rate (Figure 14):

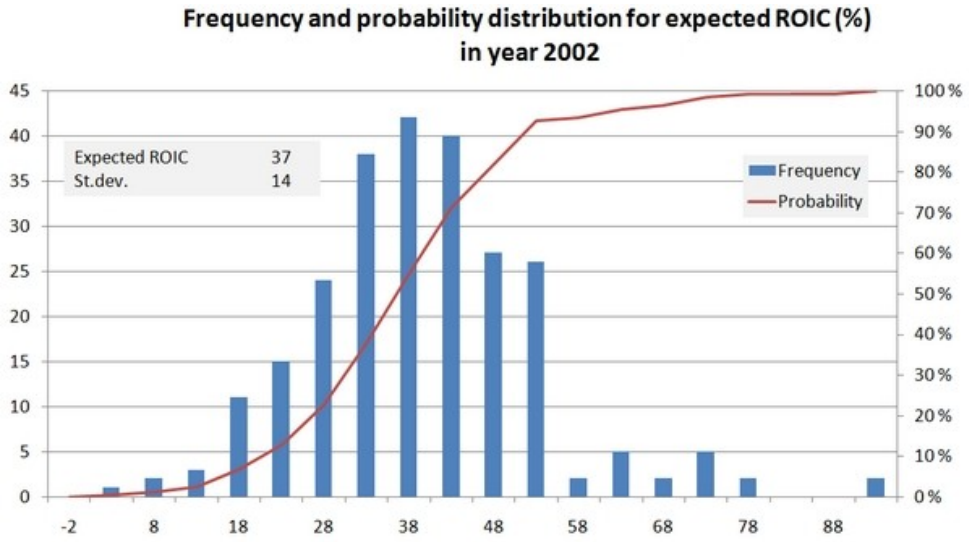

Figure 14 Frequency and Cumulative Probability Distribution for the Expected ROIC in Year 2002

Distribution above is skewed to the right and variance is high, however 60% of observations are in the interval 33% to 43%. Variance is caused by the relatively large variance both in NOPLAT and operating capital.

4.3 Weighted Average Cost of Capital (WACC)

The final variable in calculating economic profit is the Weighted Average Cost of Capital (WACC), shown in (Figure 15):

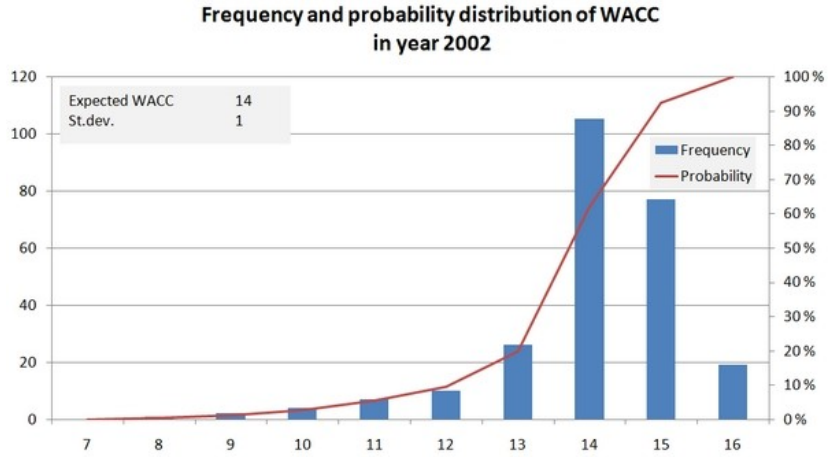

Figure 15 Frequency and Cumulative Probability Distribution for the expected WACC in Year 2002

Given the level of operating capital, the selected minimum debt-equity ratio together with the selected long/short term loan period, the Strategy @Risk model calculates WACC for each period. In this context the WACC rate will be a stochastic variable with a long left tail. The left tail consists of those situations where new capital is debt financed. The principle part of the distribution consists of situations where both debt and equity are needed.

Traditional financial spreadsheet models fail to provide a solution that solves all of the implicit equations that occur when calculating WACC correctly[3] for every period in the

[3] For a more detailed discussion please see "Valuation, Measuring and Manage the Value of Companies, Third Edition. McKinsey & Company, Inc. Tom Copeland, Tim Koller, Jack Murrin" Pages 203 and 204.

forecast. Strategy @Risk employs software especially developed for financial simulations and for solving these kinds of complex problems.

4.4 (ROIC – WACC) Spread

As much as individual values of ROIC and WACC and their probability distributions are interesting, **it is the difference between them that matters.**

It is the difference that determines whether a company is creating or destroying value. If (ROIC – WACC) is positive: value is being created. If it is negative: value is being destroyed. To create value for the shareholders is necessary that profit before tax is positive, but not sufficient. The economic profit has to be positive for that to happen. Investments and strategies have to be evaluated and finally selected based upon the economic profit generated. In Figure 16 the observed (ROIC- WACC) values are calculated for our example.

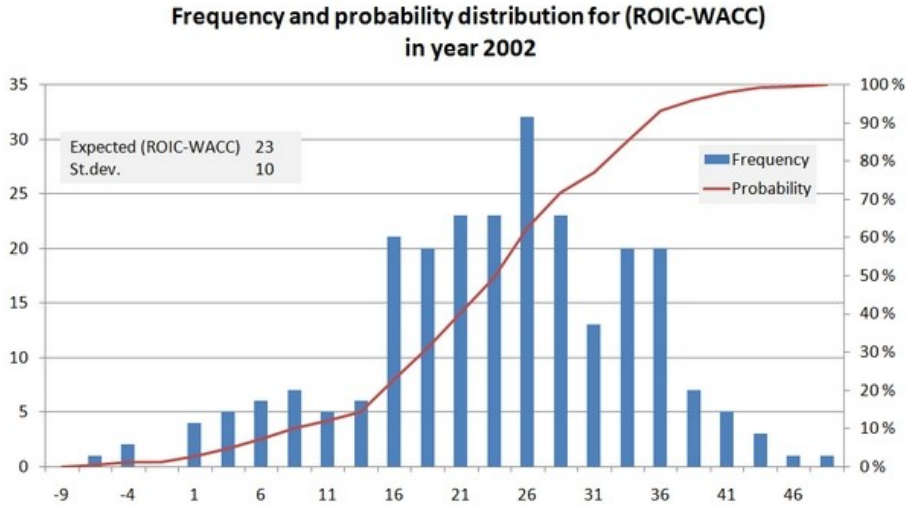

Figure 16 Frequency and Cumulative Probability Distribution of (ROIC – WACC) Spread in Year 2002

Figure 16 shows values for (ROIC – WACC) spread from minus 13 to 54 indicating a large range of spread possibilities. However, most of the observations are in the interval 14 to 36; however, negative values have also occurred.

In the example in Figure 16, the company is earning a healthy economic profit in the forecast period. It will not however last. Profits at this level will inevitably draw competition to the firm's market and over time reducing future operating profits - see paragraph 5.2.

4.5 Economic Profit Calculation

Based on the definition above, the company's economic profit can be calculated for every period and its probability distribution established.

ECONOMIC PROFIT CALCULATION	2002	2003	2004	2005	2006
ROIC (%)	38,5	56,8	46,1	28,5	32,6
WACC (%)	14,0	12,4	12,4	13,2	12,8
ROIC-WACC Spread	24,5	44,4	33,7	15,3	19,8
Invested Capital	289,0	312,4	417,8	648,0	723,1
ROIC-WACC Spread	24,5	44,4	33,7	15,3	19,8
Economic Profit	70,8	138,7	140,8	99,1	143,2

Table 5 Economic Profit Calculations

Table 5 gives expected values of economic profit for the first five years of the forecast period. The economic profit increases from 73 in year 2003 to 141 in year 2004. In year 2005 operating capital increases sharply, causing a fall in economic profit. From year 2005 profit is established at a lower level than in the first three-year period.

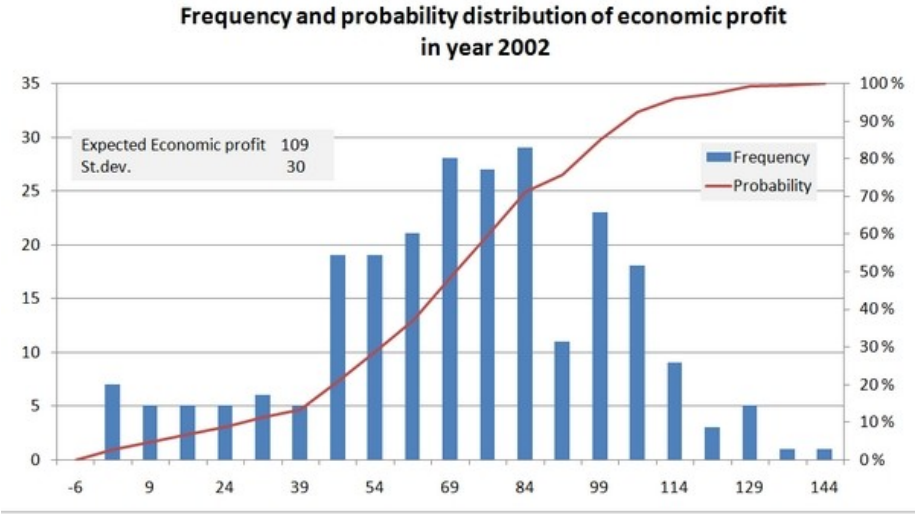

Figure 17 Frequency and Cumulative Probability Distribution of Economic Profit in Year 2002

Figure 17 gives the probability distribution for expected economic profit in year 2002. The variance is relatively large and distribution skewed to the left. However, almost 80% of observations are in the interval 46 to 106.

5 Valuation

Nobel Laureate in Economics: Milton Friedman, has stated:"The only concept / theory which has gained universal acceptance by economists is that the value of an asset is determined by the expected benefits it will generate".

The value of a company consists of three distinct parts:

1. Invested capital at beginning of forecast (not for free cash flow valuation)
2. Present value of economic profit (free cash flow) during the forecast period
3. Present value of economic profit (free cash flow) period after forecast period - continuing value.

Calculations differ between free cash flow and economic profit valuation but the principles remain the same. Both methods for calculating continuing value depend heavily upon the chosen growth rate of NOPLAT in the continuing value calculation. We have chosen to illustrate the impact of differing assumptions on the company's value of equity as shown in Figure 19.

In Table 6 the value of the company and its equity has been estimated using the economic profit method. The continuing value adds, in this case, no uncertainty to calculations since the parameters NOPLAT, WACC, ROIC and growth rate in NOPLAT are fixed.

The reasons for this are that after the forecast period the company has reached a steady state of operations with expected values set for these parameters. By letting the Strategy @Risk model forecast these parameter values, as a part of a simulation, continuing value would be stochastic with its own probability distribution.

ECONOMIC PROFIT VALUATION	2002	2003	2004	2005	2006
Invested Capital (start of Period)	298	312	418	648	723
Excess Marketable Securities	0	0	0	0	71
Capital Charge	42	39	52	85	93
NPV of Forecasted Economic Profit	703	708	640	565	525
Continuing Value of Economic Profit	834	938	1 054	1 193	1 346
Value of Entity By Economic Profit	1 876	1 996	2 163	2 491	2 756
Value of Debt	-307	-303	-291	-278	-245
Value of Equity By Economic Profit	**1 569**	**1 693**	**1 872**	**2 213**	**2 511**

Table 6 Economic Profit Valuation

Table 6 shows a value for the company's equity at 1,569 for year 2002 increasing to 2,511 in year 2006.

The value consists of the invested capital at beginning of period, excess marketable securities – cash above necessary level, capital charge for the first period – the value is calculated for the end of period, net present value of economic profit and the continuing value.

The value of equity is the value of entity less the value of debt. In Table 6 the calculation is repeated every year. The value of the entity (equity) increases in the forecast period as the level of operations and thus invested capital increases.

5.1 The Probability Distribution for the Value of Equity

The simulation creates the frequency and probability distributions shown in Figure 18. They give the company's value of equity in year 2002 and can be calculated every year in the forecast period. We can use the information contained in Figure 18 to calculate the risk of investing in the company for different levels of the company's market capitalization.

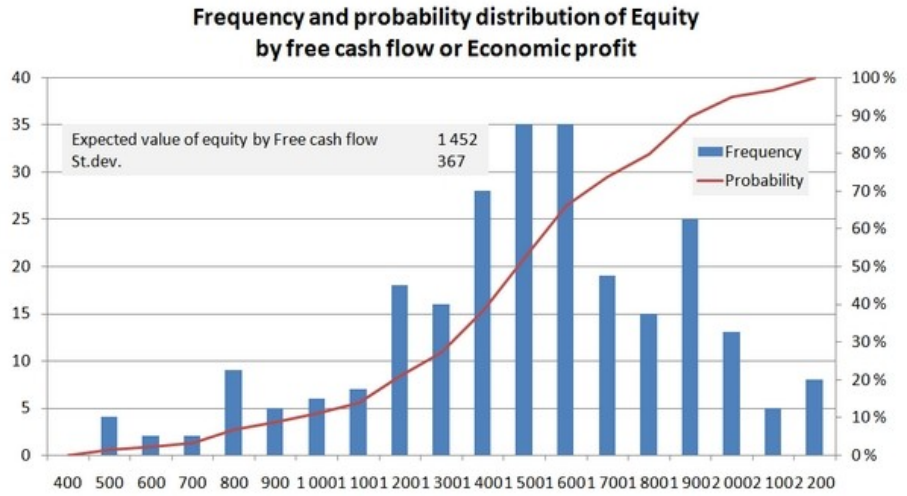

Figure 18 Frequency and Cumulative Probability Distribution of Equity by Economic Profit.

The expected value of the company is 1.452 read from the intersection between probability curve and a line drawn from the 50% probability point on the 2nd Y-axis.

The calculations in Table 6 present a deterministic value of the company's equity at 1,569. Taking probability distribution into account we obtain a value of 1.452. The difference between the two reflects the risk involved. There is obviously a downside in the company's operations not covered by the deterministic approach.

The shape of the cumulative probability curve gives information about "risk" involved in setting a fixed value for the company. The steeper the curve the easier it is to establish the value, conversely the flatter the curve the more difficult it is to establish a value.

5.2 Continuing Value Calculations

The continuing value represents the value of the company after the explicit forecast period. There are several approaches to estimate this value. The one used here is accordance with the free cash flow valuation to ensure reliable and consistent valuation.

Since we have fixed the parameters value for continuing value calculations, one useful way of accounting for uncertainty in continuing value is to calculate it for differing levels of growth in NOPLAT.

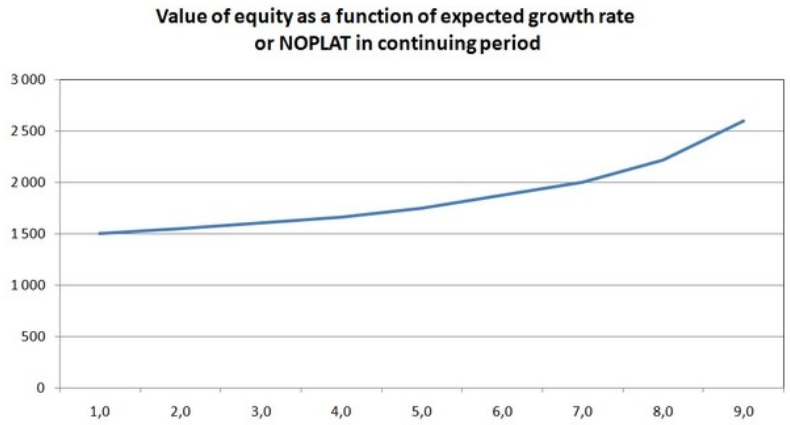

Figure 19 Value of Equity as Function of the Growth Rate in NOPLAT

Figure 19 gives the value of the company's equity for different values of growth in NOPLAT in the continuing value calculations. As the growth rate approaches WACC the value increases sharply. In our calculations the growth rate has been set to 2% accepting the fact that the company will experience much lower growth in the future.

Undertaking a sensitivity analysis in this way, investors can correct values in line with their own views about the future.

6 The Probability Distribution for Gain and Loss

The shape of the probability curve provides concise information concerning uncertainty in calculating expected values of equity. Uncertainty is reduced the steeper the probability curve, whereas the flatter the curve so uncertainty is more evident. Figure 20 depicts the value of this type of information enabling calculation of expected gains or losses from investments in a company for differing levels of market capitalization.

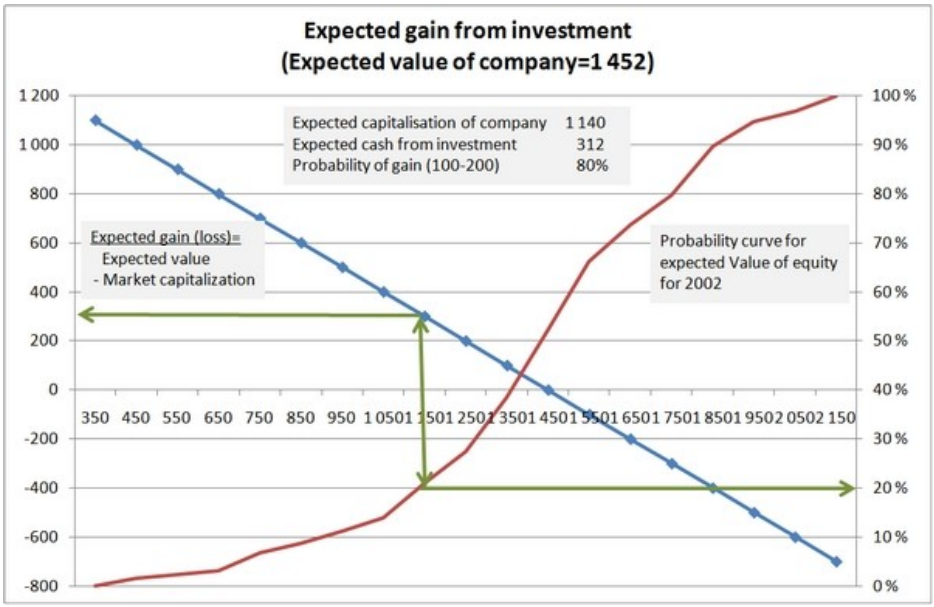

Figure 20 Expected Gain from Investment

We have calculated expected Gain or Loss as the difference between expected values of equity and the market capitalization; the 'S' curve in the graph shows this. The X-axis gives different levels of market capitalization; the 1st Y-axis (left) gives the expected gain (loss) and the 2nd y-axis the probability. Drawing a line from the 50% probability point to the probability curve and down to the X-axis point to the position where the expected gain (loss) is zero. At this point there is a 50/50 chance of realising or losing money through investing in the company capitalized at 1,452.00, which is exactly the expected value of the company's equity.

To the left of this point is the investment area. The green lines indicate a situation where the company is capitalized at 1,140 indicating an expected gain of 312 with a probability of 80% (100%-20%).

Figure 21 below describes a situation where a company is capitalized above the expected value.

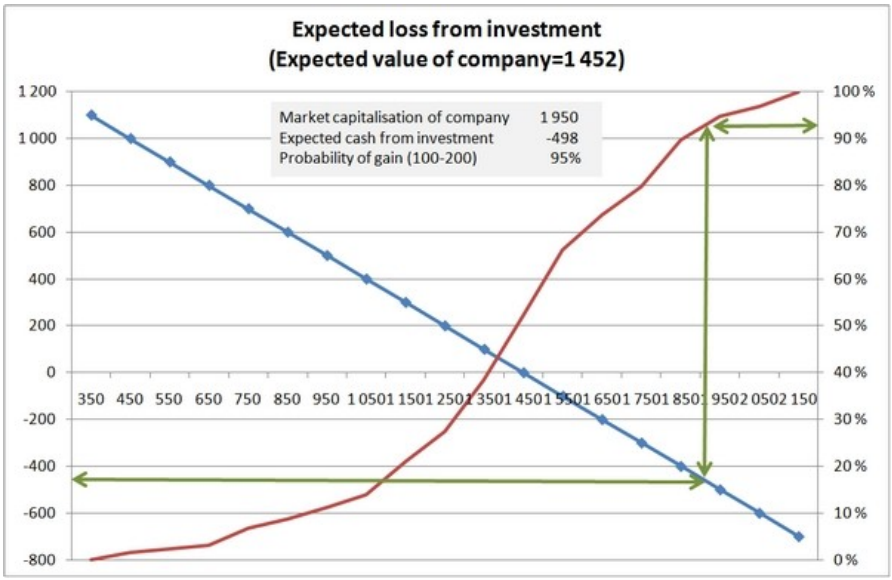

Figure 21 Expected Losses from Investment

To the right is the speculative area where an industrial investor, with perhaps synergistic possibilities, could reasonably argue a valid case when paying a price higher than expected value. The red line in figure 21 indicates a situation where the company is capitalized at 1,960 – giving a loss of 498 with 96% probability.

To a financial investor it is obviously the left part – the investment area – that is of interest. It is this area that expected gain is higher than expected loss.

7 Capital Requirements

Contained within the risk an investor faces is the valuation of the company. Other risk associated areas include the company's future capital requirement and how or if they can be financed. In Figure 22 we have calculated all necessary future capital requirements based on the selected debt-equity ratio and repayments plans for debt. The expected total capital requirement in the forecast period is 684 with a standard deviation of 296. In this case the probability distribution is skewed to the right.

The risk inherent in production, sales and growth of company operations will require increased capital in the forecast period. Expected equity requirements during the forecast period are 432 but it might be as high as 1,515 or a low as 124. Expected debt will be 251 with a standard deviation of 131.

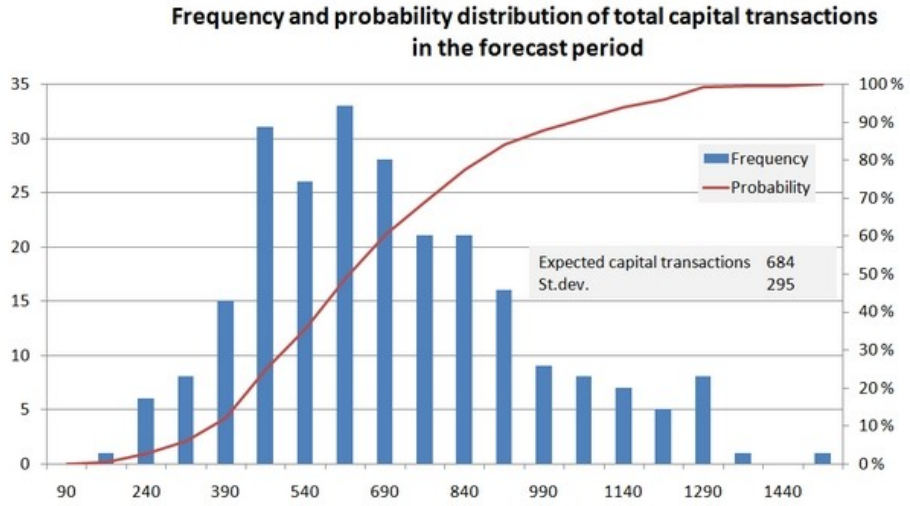

Figure 22 Capital Requirements in the Forecast Period

Cases with high capital requirements correspond with cases with low ROIC, low or negative (ROIC-WACC) spread and thus lower or possibly negative economic profit. In these instances additional financing for operations might be difficult and there is a risk that the company will have to reduce its level of operations thereby reducing the value of the company substantially.

If it is shown that the need for capital is high it will add risk to company operations. The question to be answered is: 'can the company finance its operations at the level needed and when it is needed?' Investors should note carefully the probability distribution for future capital requirements and evaluate in detail the probability of financing both equity and debt. The company should have established contingency plans and strategies developed to meet possible adverse situations where the need for capital is high and possibilities of financing low.

8 Theatre of Risk

Decisions require information. Whilst there is a good deal of qualitative and anecdotal information available in markets, ideally it needs to be considered in conjunction with reliable quantitative data. There's nothing controversial in such an approach and few critics would disagree.

Decisions are most often about alternatives. In the context of real life theatre it is about whether to change from an existing stage for a new, alternative stage setting that may offer, within an acceptable time frame, increased pecuniary advantage. Maintaining the *status quo* may be an option, particularly if we are fearful of the risks associated with change or if we are unable to satisfy ourselves as to the level of risk associated with proposed change.

We are all familiar with risk in our everyday lives and we often make instinctive judgements in this area and manage to survive on the whole. It's easy, we have habit born out of rote and in other areas we have significant control over our actions and know instinctively the consequential risks associated with them.

On a wider world stage, the rate of economic and social change is influencing market activity with increasing rapidity creating in its wake a need for concise, timely and accurately focused decisions that will maximise audience value. The problem with the world stage is that there are too many influences for us to be in control and too much out there is outside of rote learning. If maximising audience value is policy then we are

bound to focus our efforts making well founded decisions and this brings in its train plots and strategies to be evaluated and implemented that will directly affect our impact upon markets – and market impact upon our value - quickly.

Those same strategies are the sum of usually a number of acts or processes, strategy cannot be divorced from processes, and processes usually require investment across a spectrum of macro and micro activity before they can be made to work both effectively and efficiently.

So, the plot unfolds as the evil competition assumes unprecedented levels of aggression, backstage, legislation moves the goal posts to favour decreased tariffs on imports and the handsome technology has made a quantum step forward as far as production opportunities are concerned – do we go on?

You bet. The show must go on, it's policy. Anyway, the alternatives are a lingering and very public stage death.

Primary and secondary researches have hogged centre stage, we have a measure of external threats and opportunities, and we now know our areas of strength and where we are weak. We need now to play to an oft-sceptical audience gaining their involvement, getting them to invest in our proposed new act ensuring that the show has a long run with record box-office receipts.

Act Two

Now, dressed to kill in my investor's hat I look down from an ivory tower before turning again to the script. The scene before me is comprehensive, the merchant bank has excelled with the brochure and now seeks its pound of flesh, and the offer looks enticing at first reading. Audiences will be interested in this I conclude.

But, my stage musing is interrupted by growing disquiet as I read again. The company of players appears to be proposing a radical re-engineering of most of the current script; a radical diversion from tried and trusted theatre. Have tastes changed so much? Instinct tells me this is a high-risk strategy. As Impresario, I have a duty to my clients and need to look more closely at alternative scenes and lines. I cannot fault the scene setting or the story's logic but experience has taught me that productions like this are to be avoided, the risk is too great.

In the interval I ask 'What is so forbidding, what can we do to lighten the moment?' Instinctively I want to support this production, its new, exciting, *avant garde* even, and this is what causes me to falter. My emotions are indulged; I find difficulty being rational. Supporting a new genre of production, if successful on a world stage, would make a huge difference to this now struggling company of players.

In the Green Room later, I see the source of my inhibitions. Theatre has always been risky but this production sets new standards as far as risk is concerned. I need to gauge how risky compared with alternatives, say a new safe and sure production of 'Cinderella' or 'The Mouse Trap'.

Beyond theatre

An important issue for most people when considering investment is that of risk and the opportunity cost of investing in 'A' as opposed to 'B' or 'C'? Earlier in this document we have emphasised the importance of establishing a firm's economic profit providing as it does measure of company valuation. Accurate valuation of the company is important in measuring risk attached to investment. It also needs to be firmly borne in mind that valuation of a company's assets is determined by the expected benefits that they will generate over some time period.

The other key area of risk concern is that related to future capital requirements. There is usually inherent risk in growth of company operations across functional areas. High capital requirements set against low or negative economic profit may actually constrain operations and development adding risk to investing.

The Strategy @Risk financial model enables these and other risk factors to be measured and presented when considering strategic options. The quantitative assessment delivered by Strategy @Risk in conjunction with other qualitative considerations makes strategic decision making and options evaluation a fact not fiction.