
Answers

- 1 (a) The foreign exchange exposure of the dollar payment due in four months can be hedged using the following derivative products:

Forward rate offered by Pecunia Bank;
Exchange-traded futures contracts; and
Exchange-traded options contracts

Using the forward rate

Payment in Swiss Francs = US\$5,060,000/1.0677 = CHF4,739,159

Using futures contract

Since a dollar payment needs to be made in four months' time, CMC Co needs to hedge against Swiss Francs weakening. Hence, the company should go short and the six-month futures contract is undertaken. It is assumed that the basis differential will narrow in proportion to time.

Predicted futures rate = 1.0647 + [(1.0659 - 1.0647) x 1/3] = 1.0651

[Alternatively, can predict futures rate based on spot rate: 1.0635 + [(1.0659 - 1.0635) x 4/6] = 1.0651]

Expected payment = US\$5,060,000/1.0651 = CHF4,750,728

No. of contracts sold = CHF4,750,728/CHF125,000 = approx. 38 contracts

Using options contracts

Since a dollar payment needs to be made in four months' time, CMC Co needs to hedge against Swiss Francs weakening. Hence, the company should purchase six-month put options.

Exercise price US\$1.06/CHF1

Payment = US\$5,060,000/1.06 = CHF4,773,585

Buy 4,773,585/125,000 = 38.19 put contracts, say 38 contracts

CHF payment = CHF4,750,000

Premium payable = 38 x 125,000 x 0.0216 = US\$102,600

In CHF = 102,600/1.0635 = CHF96,474

Amount not hedged = US\$5,060,000 - (38 x 125,000 x 1.06) = US\$25,000

Use forward contracts to hedge this = US\$25,000/1.0677 = CHF23,415

Total payment = CHF4,750,000 + CHF96,474 + CHF23,415 = CHF4,869,889

Exercise price US\$1.07/CHF1

Payment = US\$5,060,000/1.07 = CHF4,728,972

Buy 4,728,972/125,000 = 37.83 put contracts, say 38 contracts (but this is an over-hedge)

CHF payment = CHF4,750,000

Premium payable = 38 x 125,000 x 0.0263 = US\$124,925

In CHF = 124,925/1.0635 = CHF117,466

Amount over-hedged = US\$5,060,000 - (38 x 125,000 x 1.07) = US\$22,500

Using forward contracts to show benefit of this = US\$22,500/1.0677 = CHF21,073

Total payment = CHF4,750,000 + CHF117,466 - CHF21,073 = CHF4,846,393

Advice

Forward contracts minimise the payment and option contracts would maximise the payment, with the payment arising from the futures contracts in between these two. With the option contracts, the exercise price of US\$1.07/CHF1 gives the lower cost. Although transaction costs are ignored, it should be noted that with exchange-traded futures contracts, margins are required and the contracts are marked-to-market daily.

It would therefore seem that the futures contracts and the option contract with an exercise price of US\$1.06/CHF1 should be rejected. The choice between forward contracts and the 1.07 options depends on CMC Co's attitude to risk. The forward rate is binding, whereas option contracts give the company the choice to let the option contract lapse if the CHF strengthens against the US\$. Observing the rates of inflation between the two countries and the exchange-traded derivatives this is likely to be the case, but it is not definite. Moreover, the option rates need to move in favour considerably before the option is beneficial to CMC Co, due to the high premium payable.

It would therefore seem that forward markets should be selected to minimise the amount of payment, but CMC Co should also bear in mind that the risk of default is higher with forward contracts compared with exchange-traded contracts.

(b)	CMC Co	Counterparty	Interest rate differential
Fixed rate	2.2%	3.8%	1.6%
Floating rate	Yield rate + 0.4%	Yield rate + 0.8%	0.4%

CMC Co has a comparative advantage in borrowing at the fixed rate and the counterparty has a comparative advantage in borrowing at the floating rate. Total possible benefit before Pecunia Bank's fee is 1.2%, which if shared equally results in a benefit of 0.6% each, for both CMC Co and the counterparty.

	CMC Co	Counterparty
CMC Co borrows at	2.2%	
Counterparty borrows at		Yield rate + 0.8%
Advantage	60 basis points	60 basis points
Net result	Yield rate – 0.2%	3.2%
SWAP		
Counterparty receives		Yield rate
CMC Co pays	Yield rate	
Counterparty pays		2.4%
CMC Co receives	2.4%	

After paying the 20 basis point fee, CMC Co will effectively pay interest at the yield curve rate and benefit by 40 basis points or 0.4%, and the counterparty will pay interest at 3.4% and benefit by 40 basis points or 0.4% as well.

[Note: Full marks will be given where the question is answered by estimating the arbitrage gain of 1.2% and deducting the fees of 0.4%, without constructing the above table]

- (c) Annuity factor, 4 years, 2% = 3.808
 Equal annual amounts repayable per year = CHF60,000,000/3.808 = CHF15,756,303

Macaulay duration
 $(15,756,303 \times 0.980 \times 1 \text{ year} +$
 $15,756,303 \times 0.961 \times 2 \text{ years} +$
 $15,756,303 \times 0.942 \times 3 \text{ years} +$
 $15,756,303 \times 0.924 \times 4 \text{ years}) / 60,000,000$
 = 2.47 years

Modified duration = $2.47 / 1.02 = 2.42$ years

The equation linking modified duration (D), and the relationship between the change in interest rates (Δi) and change in price or value of a bond or loan (ΔP) is given as follows:

$$\Delta P = [-D \times \Delta i \times P]$$

(P is the current value of a loan or bond and is a constant)

The size of the modified duration will determine how much the value of a bond or loan will change when there is a change in interest rates. A higher modified duration means that the fluctuations in the value of a bond or loan will be greater, hence the value of 2.42 means that the value of the loan or bond will change by 2.42 times the change in interest rates multiplied by the original value of the bond or loan.

The relationship is only an approximation because duration assumes that the relationship between the change in interest rates and the corresponding change in the value of the bond or loan is linear. In fact, the relationship between interest rates and bond price is in the form of a curve which is convex to the origin (i.e. non-linear). Therefore duration can only provide a reasonable estimation of the change in the value of a bond or loan due to changes in interest rates, when those interest rate changes are small.

(d) MEMORANDUM

From:

To: The Board of Directors, CMC Co

Date: xx/xx/xxxx

Subject: Discussion of the proposal to manage foreign exchange and interest rate exposures, and the proposal to move operations to four branches and consequential agency issues

This memo discusses the proposal of whether or not CMC Co should undertake the management of foreign exchange and interest rate exposure, and the agency issues resulting from the proposal to locate branches internationally and how these issues may be mitigated. Each proposal will be considered in turn.

(i) Proposal One: Management of foreign exchange and interest rate exposure

The non-executive directors are correct if CMC Co is in a situation where markets are perfect and efficient, where information is freely available and where securities are priced correctly. In this circumstance, risk management or hedging would not add value and if shareholders hold well diversified portfolios, unsystematic risk will be largely eliminated. The position against hedging states that in such cases companies would not increase shareholder value by hedging or eliminating risk because there will be no further reduction in unsystematic risk. Furthermore, the cost of reducing any systematic risk will equal or be greater than the benefit derived from such risk reduction. Shareholders would not gain from risk management or hedging; in fact, if the costs exceed the benefits, then hedging may result in a reduction in shareholder value.

Risk management or hedging may result in increasing corporate (and therefore shareholder) value if market imperfections exist, and in these situations, reducing the volatility of a company's earnings will result in higher cash inflows. Proponents of hedging cite three main situations where reduction in volatility or risk may increase cash flows –

in situations: where the rate of tax is increasing; where a firm could face significant financial distress costs due to high volatility in earnings; and where stable earnings increases certainty and the ability to plan for the future, thus resulting in stable investment policies by the firm.

Active hedging may also reduce agency costs. For example, unlike shareholders, managers and employees of the company may not hold diversified portfolios. Hedging allows the risks faced by managers and employees to be reduced. Additionally, hedging may allow managers to be less concerned about market movements which are not within their control and instead allow them to focus on business issues over which they can exercise control. This seems to be what the purchasing director is contending. On the other hand, the finance director seems to be more interested in increasing his personal benefits and not necessarily in increasing the value of CMC Co.

A consistent hedging strategy or policy may be used as a signalling tool to reduce the conflict of interest between bondholders and shareholders, and thus reduce restrictive covenants.

It is also suggested that until recently CMC Co had no intention of hedging and communicated this in its annual report. It is likely that shareholders will therefore have created their own risk management policies. A strategic change in the policy may have a negative impact on the shareholders and the clientele impact of this will need to be taken into account.

The case of whether to hedge or not is not clear cut and CMC Co should consider all the above factors and be clear about why it is intending to change its strategy before coming to a conclusion. Any intended change in policy should be communicated to the shareholders. Shareholders can also benefit from risk management because the risk profile of the company may change, resulting in a reduced cost of capital.

(ii) Proposal Two: International branches, agency issues and their mitigation

Principal-agent relationships can be observed within an organisation between different stakeholder groups. With the proposed branches located in different countries, the principal-agent relationship will be between the directors and senior management at CMC Co in Switzerland, and the managers of the individual branches. Agency issues can arise where the motivations of the branch managers, who are interested in the performance of their individual branches, diverge from the management at CMC Co headquarters, who are interested in the performance of the whole organisation.

These issues may arise because branch managers are not aware of, or appreciate the importance of, the key factors at corporate level. They may also arise because of differences in cultures and divergent backgrounds.

Mitigation mechanisms involve monitoring, compensation and communication policies. All of these mechanisms need to work in a complementary fashion in order to achieve goal congruence, much like the mechanisms in any principal-agent relationship.

Monitoring policies would involve ensuring that key aims and strategies are agreed between all parties before implementation, and results monitored to ensure adherence with the original agreements. Where there are differences, for example due to external factors, new targets need to be agreed. Where deviations are noticed, these should be communicated quickly.

Compensation packages should ensure that reward is based on achievement of organisational value and therefore there is every incentive for the branch managers to act in the best interests of the corporation as a whole.

Communication should be two-way, in that branch managers should be made fully aware of the organisational objectives, and any changes to these, and how the branch contributes to these, in order to ensure their acceptance of the objectives. Furthermore, the management at CMC Co headquarters should be fully aware of cultural and educational differences in the countries where the branches are to be set up and fully plan for how organisational objectives may nevertheless be achieved within these differences.

(Note: Credit will be given for alternative, relevant approaches to the calculations, comments and suggestions/recommendations)

2 (a) All figures are in \$ million

Year	0	1	2	3	4
Sales revenue (inflated, 8% p.a.)		24.87	42.69	61.81	36.92
Costs (inflated, 4% p.a.)		(14.37)	(23.75)	(33.12)	(19.05)
Incremental profit		10.50	18.94	28.69	17.87
Tax (W1)		(0.50)	(3.39)	(5.44)	(3.47)
Working capital (W2)	(4.97)	(3.57)	(3.82)	4.98	7.38
Investment/sale of machinery	(38.00)				4.00
Cash flows	(42.97)	6.43	11.73	28.23	25.78
Discount factors (12%, W3)	1	0.893	0.797	0.712	0.636
Present values	(42.97)	5.74	9.35	20.10	16.40

Base case net present value is approximately \$8.62 million.

W1 All figures are in \$ million

Year	0	1	2	3	4
Incremental profit		10.50	18.94	28.69	17.87
Capital allowances		8.00	2.00	1.50	0.50
Taxable profit		2.50	16.94	27.19	17.37
Tax (20%)		0.50	3.39	5.44	3.47

W2 All figures are in \$ million

Year	0	1	2	3	4
Working capital (20% of sales revenue)		4.97	8.54	12.36	7.38
Working capital required/(released)	4.97	3.57	3.82	(4.98)	(7.38)

W3 Lintu Co asset beta = $1.5 \times \$128m / (\$128m + \$31.96m \times 0.8)$ approx. = 1.25

All-equity financed discount rate = $2\% + 1.25 \times 8\% = 12\%$

Financing side effects

	\$'000
Issue costs $2/98 \times \$42,970,000$	(876.94)
Tax shield	
Annual tax relief = $(\$42,970,000 \times 60\% \times 0.015 \times 20\%)$ + $(\$42,970,000 \times 40\% \times 0.04 \times 20\%)$ = $77.35 + 137.50 = 214.85$	
The present value of the tax relief annuity = 214.85×3.63	779.91
Annual subsidy benefit	
$\$42,970,000 \times 60\% \times 0.025 \times 80\% = 515.64$	
The present value of the subsidy benefit annuity = 515.64×3.63	1,871.77
Total benefit of financing side effects	1,774.74

Financing the project entirely by debt would add just under \$1.78 million to the value of the project, or approximately, an additional 20% to the all-equity financed project.

The adjusted present value (APV) of the project is just under \$10.4 million and therefore it should be accepted.

Note: In calculating the present values of the tax shield and subsidy benefits, the annuity factor used is based on 4% to reflect the normal borrowing/default risk of the company.

Alternatively, 2% or 2.5% could be used depending on the assumptions made. Credit will be given where these are used to estimate the annuity factor, where the assumption is explained.

(b) Corrections made to the original net present value

The approach taken to exclude depreciation from the net present value computation is correct, but capital allowances need to be taken away from profit estimates before tax is calculated, reducing the profits on which tax is payable.

Interest is not normally included in the net present value calculations. Instead, it is normally imputed within the cost of capital or discount rate. In this case, it is included in the financing side effects.

Cash flows are inflated and the nominal rate based on Lintu Co's all-equity financed rate is used (see below). Where different cash flows are subject to different rates of inflation, applying a real rate to non-inflated amounts would not give an accurate answer.

The impact of the working capital requirement is included in the estimate as, although all the working capital is recovered at the end of the project, the flows of working capital are subject to different discount rates when their present values are calculated.

Approach taken

The value of the project is initially assessed considering only the business risk involved in undertaking the project. The discount rate used is based on Lintu Co's asset beta which measures only the business risk of that company. Since Lintu Co is in the same line of business as the project, it is deemed appropriate to use its discount rate, instead of 11% that Burung Co uses normally.

The impact of debt financing and the subsidy benefit are then considered. In this way, Burung Co can assess the value created from its investment activity and then the additional value created from the manner in which the project is financed.

Assumptions made

It is assumed that all figures used are accurate and any estimates made are reasonable. Burung Co may want to consider undertaking a sensitivity analysis to assess this.

It is assumed that the initial working capital required will form part of the funds borrowed but that the subsequent working capital requirements will be available from the funds generated by the project. The validity of this assumption needs to be assessed since the working capital requirements at the start of years 2 and 3 are substantial.

It is assumed that Lintu Co's asset beta and all-equity financed discount rate represent the business risk of the project. The validity of this assumption also needs to be assessed. For example, Lintu Co's entire business may not be similar to the project, and it may undertake other lines of business. In this case, the asset beta would need to be adjusted so that just the project's business risk is considered.

(Note: Credit will be given for alternative, relevant explanations)

- 3 (a) Vogel Co may have switched from a strategy of organic growth to one of growth by acquisition, if it was of the opinion that such a change would result in increasing the value for the shareholders.

Acquiring a company to gain access to new products, markets, technologies and expertise may be quicker and less costly. Horizontal acquisitions may help Vogel Co eliminate key competitors and enable it to take advantage of economies of scale. Vertical acquisitions may help Vogel Co to secure the supply chain and maximise returns from its value chain.

Organic growth may take a long time, can be expensive and may result in little competitive advantage being established due to the time taken. Also organic growth, especially into a new area, would need managers to gain knowledge and expertise of an area or function, which they not currently familiar with. Furthermore, in a saturated market, there may be little opportunity for organic growth.

(Note: Credit will be given for alternative relevant comments)

- (b) Vogel Co can take the following actions to reduce the risk that the acquisition of Tori Co fails to increase shareholder value.

Since Vogel Co has pursued an aggressive policy of acquisitions, it needs to determine whether or not this has been too aggressive and detailed assessments have been undertaken. Vogel Co should ensure that the valuation is based on reasonable input figures and that proper due diligence of the perceived benefits is undertaken prior to the offer being made. Often it is difficult to get an accurate picture of the target when looking at it from the outside. Vogel Co needs to ensure that it has sufficient data and information to enable a thorough and sufficient analysis to be undertaken.

The sources of synergy need to be properly assessed to ensure that they are achievable and what actions Vogel Co needs to undertake to ensure their achievement. This is especially so for the revenue-based synergies. An assessment of the impact of the acquisition on the risk of the combined company needs to be undertaken to ensure that the acquisition is not considered in isolation but as part of the whole company.

The Board of Directors of Vogel Co needs to ensure that there are good reasons to undertake the acquisition, and that the acquisition should result in an increase in value for the shareholders. Research studies into mergers and acquisitions have found that often companies are acquired not for the shareholders' benefit, but for the benefit or self-interest of the acquiring company's management. The non-executive directors should play a crucial role in ensuring that acquisitions are made to enhance the value for the shareholders. A post-completion audit may help to identify the reasons behind why so many of Vogel Co's acquisitions have failed to create value. Once these reasons have been identified, strategies need to be put in place to prevent their repetition in future acquisitions.

Procedures need to be established to ensure that the acquisition is not overpaid. Vogel Co should determine the maximum premium it is willing to pay and not go beyond that figure. Research indicates that often too much is paid to acquire a company and the resultant synergy benefits are not sufficient to cover the premium paid. Often this is the result of the management of the acquiring company wanting to complete the deal at any cost, because not completing the deal may be perceived as damaging to both their own, and their company's, reputation. The acquiring company's management may also want to show that the costs related to undertaking due diligence and initial negotiation have not been wasted. Vogel Co and its management need to guard against this and maybe formal procedures need to be established which allow managers to step back without loss of personal reputation.

Vogel Co needs to ensure that it has proper procedures in place to integrate the staff and systems of the target company effectively, and also to recognise that such integration takes time. Vogel Co may decide instead to give the target company a large degree of autonomy and thus make integration less necessary; however, this may result in a reduction in synergy benefits. Vogel Co should also have strategies which allow it sufficient flexibility when undertaking integration so that it is able to respond to changing circumstances or respond to inaccurate information prior to the acquisition. Vogel Co should also be mindful that its own and the acquired company's staff and management need to integrate and ensure a good working relationship between them.

(Note: The above answer covers more areas than would be needed to achieve full marks for the part. Credit will be given for alternative relevant comments)

- (c) **Approach taken**

The maximum premium payable is equal to the maximum additional benefit created from the acquisition of Tori Co, with no increase in value for the shareholders of Vogel Co (although the shareholders of Vogel Co would probably not approve of the acquisition if they do not gain from it).

The additional benefit can be estimated as the sum of the cash gained (or lost) from selling the assets of Department C, spinning off Department B and integrating Department A, less the sum of the values of Vogel Co and Tori Co as separate companies.

Estimation

Cash gained from selling the assets of Department C = $(20\% \times \$98.2\text{m}) + (20\% \times \$46.5\text{m} \times 0.9) - (\$20.2 + \$3\text{m}) = \$19.64\text{m} + \$8.37\text{m} - \$23.2\text{m} = \$4.81\text{m}$

Value created from spinning off Department B into Ndege Co

Free cash flow of Ndege Co	\$ million
Current share of PBDIT ($0.4 \times \$37.4\text{m}$)	14.96
Less: attributable to Department C (10%)	(1.50)
Less: tax allowable depreciation ($0.4 \times 98.2 \times 0.10$)	(3.93)
Profits before tax	9.53
Tax (20%)	(1.91)
Free cash flows	7.62

Value of Ndege Co =

Present value of cash flow in year 1: $\$7.62\text{m} \times 1.2 \times 1.1^{-1} = \8.31m

Add: present value of cash flows from year 2 onwards:

$(\$9.14\text{m} \times 1.052)/(0.1 - 0.052) \times 1.1^{-1} = \182.11m

Less debt = \$40m

Value to shareholders of Ndege Co = \$150.42m

Vogel Co's current value = $\$3 \times 380\text{m} = \$1,140\text{m}$

Vogel Co, profit after tax = $\$158.2\text{m} \times 0.8 = \126.56m

Vogel Co, PE ratio before acquisition = $\$1,140.0\text{m}/\$126.56\text{m} = 9.01$ say 9

Vogel Co, PE ratio after acquisition = $9 \times 1.15 = 10.35$

Tori Co, PE ratio before acquisition = $9 \times 1.25 = 11.25$

Tori Co's current value = $11.25 \times (\$23.0 \times 0.8) = \207.0m

Value created from combined company

$(\$126.56\text{m} + 0.5 \times \$23.0\text{m} \times 0.8 + \$7\text{m}) \times 10.35 = \$1,477.57$

Maximum premium = $(\$1,477.57\text{m} + \$150.42\text{m} + \$4.81\text{m}) - (\$1,140\text{m} + \$207.0\text{m}) = \285.80m

Assumptions

Based on the calculations given above, it is estimated that the value created will be 64.9% or \$285.80m.

However, Vogel Co needs to assess whether the numbers it has used in the calculations and the assumptions it has made are reasonable. For example, Ndege Co's future cash flows seem to be growing without any additional investment in assets and Vogel Co needs to establish whether or not this is reasonable. It also needs to establish how the increase in its PE ratio was determined after acquisition. Perhaps sensitivity analysis would be useful to show the impact on value changes, if these figures are changed. Given its poor record in generating value previously, Vogel Co needs to pay particular attention to these figures.

- 4 (a) With conventional investment decisions, it is assumed that once a decision is made, it has to be taken immediately and carried to its conclusion. These decisions are normally made through conventional assessments using methods such as net present value. Assessing projects through option pricing may aid the investment decision making process.

Where there is uncertainty with regard to the investment decision and where a company has flexibility in its decision making, valuing projects using options can be particularly useful. For example, situations may exist where a company does not have to make a decision on a now-or-never basis, or where it can abandon a decision, which has been made, at some future point, or where it has an opportunity for further expansion as a result of the original decision. In such situations, using option pricing formulae, which incorporate the uncertainty surrounding a project and the time before a decision has to be made, can determine a value attached to this flexibility. This value can be added to the conventional net present value computation to give a more accurate assessment of the project's value.

In the situation which Faoilean Co is considering, the initial exploration rights may give it the opportunity to delay the decision of whether to undertake the extraction of oil and gas to a later date. In that time, using previous knowledge and experience, it can estimate the quantity of oil and gas which is present more accurately. It can also use its knowledge to assess the variability of the likely quantity. Faoilean Co may be able to negotiate a longer time scale with the government of Ireland for undertaking the initial exploration, before it needs to make a final decision on whether and how much to extract.

Furthermore, Faoilean Co can explore the possibilities of it exiting the extraction project, once started, if it is proving not to be beneficial, or if world prices of oil and gas have moved against it. It could, for example, negotiate a get-out clause which gives it the right to sell the project back to the government at a later date at a pre-agreed price. Alternatively, it could build facilities in such a way that it can redeploy them to other activities, or scale the production up or down more easily and at less cost. These options give the company the opportunity to step out of a project at a future date, if uncertainties today become negative outcomes in the future.

Finally, Faoilean Co can explore whether or not applying for the rights to undertake this exploration project could give it priority in terms of future projects, perhaps due to the new knowledge or technologies it builds during the current project. These

opportunities would allow it to gain competitive advantage over rivals, which, in turn, could provide it with greater opportunities in the future, but which are uncertain at present.

Faoilean Co can incorporate these uncertainties and the time before the various decisions need to be made into the option formulae to determine the additional value of the project, on top of the initial net present value calculation.

The option price formula used with investment decisions is based on the Black-Scholes Option Pricing (BSOP) model. The BSOP model makes a number of assumptions as follows:

- The underlying asset operates in perfect markets and therefore the movement of market prices cannot be predicted;
- The BSOP model uses the risk-free rate of interest. It is assumed that this is known and remains constant, which may not be the case where the time it takes for the option to expire may be long;
- The BSOP model assumes that volatility can be assessed and stays constant throughout the life of the project; again with long-term projects these assumptions may not be valid;
- The BSOP model assumes that the underlying asset can be traded freely. This is probably not accurate where the underlying asset is an investment project.

These assumptions mean that the value based around the BSOP model is indicative and not definitive.

(Note: Credit will be given for alternative relevant comments)

- (b)** Equity can be regarded as purchasing a call option by the equity holders on the value of a company, because they will possess a residual claim on the assets of the company. In this case, the face value of debt is equivalent to the exercise price, and the repayment term of debt as the time to expiry of the option.

If at expiry, the value of the company is greater than the face value of debt, then the option is in-the-money, otherwise if the value of the firm is less than the face value of debt, then the option is out-of-the-money and equity is worthless.

For example, say V is the market value of the assets in a company, E is the market value of equity, and F is the face value of debt, then,

If at expiry $V > F$ (option is in-the-money), then the option has intrinsic value to the equity holders and $E = V - F$;
 Otherwise if $F > V$ (option is out-of-the-money), then the option has no intrinsic value and no value for the equity holders, and $E = 0$.

Prior to expiry of the debt, the call option (value to holders of equity) will also have a time value attached to it. The BSOP model can be used to assess the value of the option to the equity holders, the value of equity, which can consist of both time value and intrinsic value if the option is in-the-money, or just time value if the option is out-of-the-money.

Within the BSOP model, $N(d_1)$, the delta value, shows how the value of equity changes when the value of the company's assets change. $N(d_2)$ depicts the probability that the call option will be in-the-money (i.e. have intrinsic value for the equity holders).

Debt can be regarded as the debt holders writing a put option on the company's assets, where the premium is the receipt of interest when it falls due and the capital redemption. If $N(d_2)$ depicts the probability that the call option is in-the-money, then $1 - N(d_2)$ depicts the probability of default.

Therefore the BSOP model and options are useful in determining the value of equity and default risk.

Option pricing can be used to explain why companies facing severe financial distress can still have positive equity values. A company facing severe financial distress would presumably be one where the equity holders' call option is well out-of-the-money and therefore has no intrinsic value. However, as long as the debt on the option is not at expiry, then that call option will still have a time value attached to it. Therefore, the positive equity value reflects the time value of the option, even where the option is out-of-the-money, and this will diminish as the debt comes closer to expiry. The time value indicates that even though the option is currently out-of-the-money, there is a possibility that due to the volatility of asset values, by the time the debt reaches maturity, the company will no longer face financial distress and will be able to meet its debt obligations.

(Note: Credit will be given for alternative relevant comments)

- (c)** According to the BSOP model, the value of an option is dependent on five variables: the value of the underlying asset, the exercise price, the risk-free rate of interest, the implied volatility of the underlying asset, and the time to expiry of the option. These five variables are input into the BSOP formula, in order to compute the value of a call option (the value of an equivalent put option can be computed by the BSOP model and put-call parity relationship). The different risk factors determine the impact on the option value of the changes in the five variables.

The 'vega' determines the sensitivity of an option's value to a change in the implied volatility of the underlying asset. Implied volatility is what the market is implying the volatility of the underlying asset will be in the future, based on the price changes in an option. The option price may change independently of whether or not the underlying asset's value changes, due to new information being presented to the markets. Implied volatility is the result of this independent movement in the option's value, and this determines the 'vega'. The 'vega' only impacts the time value of an option and as the 'vega' increases, so will the value of the option.

(Note: Credit will be given for alternative relevant comments)

**Professional Level – Options Module, Paper P4
Advanced Financial Management**

June 2014 Marking Scheme

		<i>Marks</i>
1	(a) Calculation of payment using the forward rate	1
	Going short on futures and purchasing put options	2
	Predicted futures rate based on basis reduction	1
	Futures: Expected payment and number of contracts	2
	Options calculation using either 1·06 or 1·07 rate	3
	Options calculation using the second rate (or explanation)	2
	Advice (1 to 2 marks per point)	4–5
		<hr style="width: 100%;"/>
	Max	15
		<hr style="width: 100%;"/>
(b)	Comparative advantage and recognition of benefit as a result	2
	Initial decision to borrow fixed by CMC Co and floating by counterparty	1
	Swap impact	2
	Net benefit after bank charges	1
		<hr style="width: 100%;"/>
	6	
	<hr style="width: 100%;"/>	
(c)	Calculation of annual annuity amount	1
	Calculation of Macaulay duration	2
	Calculation of modified duration	1
	Explanation	3
		<hr style="width: 100%;"/>
	7	
	<hr style="width: 100%;"/>	
(d) (i)	2–3 marks per point	9
		<hr style="width: 100%;"/>
(ii)	Discussion of the agency issues	3–4
	Discussion of mitigation strategies and policies	4–6
		<hr style="width: 100%;"/>
	9	
	<hr style="width: 100%;"/>	
	Max	9
	<hr style="width: 100%;"/>	
Professional marks		
	Memorandum format	1
	Structure and presentation of the memorandum	3
		<hr style="width: 100%;"/>
		4
	Total	50
	<hr style="width: 100%;"/>	
2	(a) Inflated incremental profit	2
	Taxation	2
	Working capital	2
	Estimate of discount rate	2
	Net present value	1
	Issue costs	1
	Tax shield benefit	2
	Subsidy benefit	1
	Adjusted present value and conclusion	2
		<hr style="width: 100%;"/>
		15
		<hr style="width: 100%;"/>
	(b)	Corrections made
Approach taken		2–3
Assumptions made		3–4
		<hr style="width: 100%;"/>
	Max	10
	<hr style="width: 100%;"/>	
	Total	25
	<hr style="width: 100%;"/>	

		<i>Marks</i>
3	(a) 1–2 marks per point	Max <u>4</u>
	(b) 2–3 marks per point	Max <u>7</u>
	(c) Cash gained from sales of Department C assets	1
	Calculation of free cash flows for Ndege Co	2
	Calculation of present values of Ndege Co cash flows and value	2
	Vogel Co PE ratios before and after acquisition	2
	Tori Co PE ratio and value	1
	Value created from combining Department A with Vogel Co	1
	Maximum premium payable	1
	Approach taken	1–2
	Assumptions made	2–3
		Max <u>14</u>
	Total	<u>25</u>
4	(a) Discussion of the idea of using options in making the project investment decision	7–8
	Explanation of the assumptions	3–4
		Max <u>11</u>
	(b) Discussion of using options to value equity	4–5
	Discussion of using options to assess default risk	2–3
	Discussion of financial distress and time value of an option	2–3
		Max <u>9</u>
	(c) Explanation of why option values are determined by different risk factors	2–3
	Explanation of what determines 'vega'	2–3
		Max <u>5</u>
	Total	<u>25</u>