EXAMINATION

April 2006

Certificate in Practical Financial Economics

EXAMINERS' REPORT

Introduction

The attached subject report has been written by the Principal Examiner with the aim of helping candidates. The questions and comments are based around Core Reading as the interpretation of the syllabus to which the examiners are working. They have however given credit for any alternative approach or interpretation which they consider to be reasonable.

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Chairman of the Board of Examiners

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Comments

Individual comments are shown after each question.

1 Two historical features that can't be explained by CAPM are how:

- Small companies have outperformed large companies.
- Value stocks (is high book value to market value stocks) have outperformed growth stocks (i.e. low book:market ratio stocks).

Fama & French attempted to explain this using a 3-factor model, looking like:

Expected return =
Risk Free + $b_{\text{market}}\, r_{\text{market factor}} + b_{\text{size}}\, r_{\text{size factor}} + b_{\text{book-to-market}}\, r_{\text{book-to-market factor}}$

Where the *r*'s are risk premia, i.e.:

- return on market index less risk free
- return on small stocks less returns on large stocks
- return on high BtoMs les return on low BtoMs

And the *b*'s are stock-specific sensitivities to each factor.

Comments on question 1: *This was simple bookwork and generally well answered.*

2 (i) (a) **Mental accounting** — people show a tendency to separate related events and find it difficult to aggregate events. Thus rather than netting out all gains and losses, people set up a series of mental accounts and view individual decisions as relating to one or another of these accounts.

(b) **Recency effect** — if presented with a series of options, a bias is sometimes seen for the final option. The gap in time between presentation of the option and the decision may influence the decision.

(c) **Myopic loss aversion** — research shows that investors are less risk-averse when faced with a multi-period series of "gambles" and the frequency of choice/length of reporting period will also be influential. Investing for a long period is seen as a "repeated gamble" that investors are willing to take but the individual gamble of investing in equities — for example — over a one-year period seems too high to risk.

(d) **Framing** — the way a choice is presented or a question is asked can have an enormous impact of the answer given e.g. "are you happy to back your mortgage with an equity product given the fact that the stock market can drop 40% (or more) in any one year?".

(e) **Confirmation bias** — People tend to look for evidence that confirms their point of view (and tend to dismiss evidence that does not justify it).

(ii) Albert's view is an example of "*myopic loss aversion*". Equities have performed better than bonds over longer periods and as long as he is ahead Albert will prefer to continue to gamble.

Brian's view is an example of "*anchoring and adjustment*". It is extremely difficult to value stocks from scratch so investors nearly always price a stock relative to the latest available market information (the anchor) and then adjusting for how they think their own views may differ from the market as a whole.

Colin's view could be an example of either "*regret aversion*" or "status quo bias". Although many investors were predicting the bursting of the dot-com bubble, they were perhaps rationally reluctant to sell as they could not be sure when the boom would end.

Dennis' view is an example of "*mental accounting*". Overall he is ahead on the year but he feels disproportionately badly about the loss on his equity portfolio.

Comments on question 2: *This was another well-answered bookwork question.*

3 (i) Collectively defined benefit pension funds are the most important investors in equities and gilts. In the UK equity market they own about 35% of all shares (by market value).

Defined benefit pension fund liabilities are long term and their investment strategy will reflect this e.g. with a bias for longer dated bonds and equities rather than cash and short dated bonds.

(ii) Whenever a Company borrows it creates an option because the borrower is not compelled to repay the debt. A shortfall in a pension scheme is equivalent to borrowing as the company is expected to make up the shortfall before the funds are needed (for paying benefits etc).

If the assets of the Company are worth less than the shortfall in the pension scheme the Company could default on payment of the shortfall (and default on payments of other debt) and the pension fund (along with other bondholders) is likely to be entitled to take over the Company's assets.

An alterative way of looking at this is that when a pension fund has a shortfall, the fund has acquired the Company at that time and the shareholders have obtained an option to buy back the Company by paying off the shortfall. In effect the shareholders have purchased a call option on the assets of the Company.

If the value of the Company's assets goes up, the shareholders will wish to exercise the option/their right to buy the Company's assets at the "exercise price" of the pension fund shortfall. If, however, the value of the assets goes down, the shareholders will not wish to exercise the option.

(iii) **Equity arguments:**

- equities are expected to return more than bonds
- market timing or accounting implications or market reaction or switching costs
- nature of liabilities means cannot match exactly with bonds
- peer pressure and regret aversion (behavioural finance points)

Bond arguments:

- tax efficiency of holding bonds in the fund
- liability matching
- financial significance of fund to company may mean volatility of equities is too risky
- lower dealing costs or market timing or agency costs/transparency

Indifference arguments:

- whatever the pension funds holds, the shareholder can reverse the position outside of the fund (MM point) by adjusting his personal asset allocation.

Comments on question 3: *There were good and bad attempts at this question. Candidates struggled most with part (ii): an argument that makes perfect sense in the textbook but is difficult to reproduce under exam conditions.*

4 (i) MM says that "The market value of a firm is independent of its capital structure".

The implication of this is that the value of a company is determined solely by its real assets not by the securities it issues. Its financing decisions should be independent of its investment decisions.

(ii) In practice capital structure does matter as there are market imperfections such as taxes and costs of bankruptcy.

The interest that a company pays is a tax-deductible expense. Dividends and retained earnings are not.

Consistently profitable firms with lots of taxable profits to shield may generally therefore be expected to borrow more than firms with uncertain future profits all other things being equal.

To counter this, investors know that levered firms may fall into financial distress. The costs of financial distress depend on the probability of distress and the magnitude of the costs.

Firms for whom financial distress would be particularly costly may generally be expected to borrow less than other firms so as to minimise the probablilty of distress.

The debt-equity decision can be thought of as a "trade-off" between interest tax shields and the costs of financial distress.

The differing capital positions maintained by airlines and drug companies are mainly a result of differing costs of financial distress. Some assets — (like real estate or aeroplanes) can pass through bankruptcy largely unscathed; the value of others e.g. intangible assets linked to the health of the firm such as human capital, R&D and brand image, would be far more acutely affected. As a result debt ratios tend to be lower in the pharmaceutical industry where value depends on continued success in research and development.

(iii) $r_{assets} = r_{debt} * \text{Debt} / (\text{Debt} + \text{Equity}) + r_{equity} * \text{Equity} / (\text{Debt} + \text{Equity})$

$r_{assets} - r_{debt} * \text{Debt} / (\text{Debt} + \text{Equity}) = r_{equity} * \text{Equity} / (\text{Debt} + \text{Equity})$

$r_{assets} - r_{debt} * \text{Debt} / (\text{Debt} + \text{Equity})] * [(\text{Debt} + \text{Equity}) / \text{Equity}] = r_{equity}$

$r_{assets} * [(\text{Debt} + \text{Equity}) / \text{Equity}] - r_{debt} * [\text{Debt} / \text{Equity}] = r_{equity}$

$r_{assets} * [(\text{Debt} / \text{Equity} + 1] - r_{debt} * [\text{Debt} / \text{Equity}] = r_{equity}$

$r_{assets} * 1 + r_{assets} * [\text{Debt} / \text{Equity}] - r_{debt} * [\text{Debt} / \text{Equity}] = r_{equity}$
$r_{assets} + [\text{Debt} / \text{Equity}] * [r_{assets} - r_{debt}] = r_{equity}$

(iv) **Data**

Number of shares	500
Price per share	100
Market value of shares	5,000
Market value of debt	5,000
Interest at 8%	400

			Outcomes	
Operating income	400	800	**1,200**	1,600
Interest	400	400	**400**	400
Equity earnings	0	400	**800**	1,200
Earnings per share	0	0.8	**1.6**	2.4
Return on shares	0.0%	8.0%	**16.0%**	24.0%
			Expected outcome	

Value of Company is unchanged by financial restructuring hence repurchasing half of the common stocks and substituting an equal value of debt means the market value of shares and debt must now be 5,000 each.

Number of shares has halved from 1,000 to 500. Share price is unchanged.

One year's interest on the Debt = 8% of 5,000 = 400 and this is payable whatever the level of operating income.

Hence at the expected 1,200 operating income level, 400 is paid to debt-holders leaving 800 for equity earnings.

This gives 800 / 500 per share = 1.6.

Return on shares as a % is therefore 1.6 / 10 = 16%.

Repeat analysis for three other levels of operating income.

(v) Assume the shareholder can borrow on the same terms as the Company.

If a shareholder borrows 10, they could invest 20 in MM Airlines by only committing 10 of their own money.

At the anticipated level of operating income their return in the unlevered firm would be 12% * 20 = 2.4.

They would then have to pay interest on their borrowing of 10
i.e. 8% * 10 = 0.8.

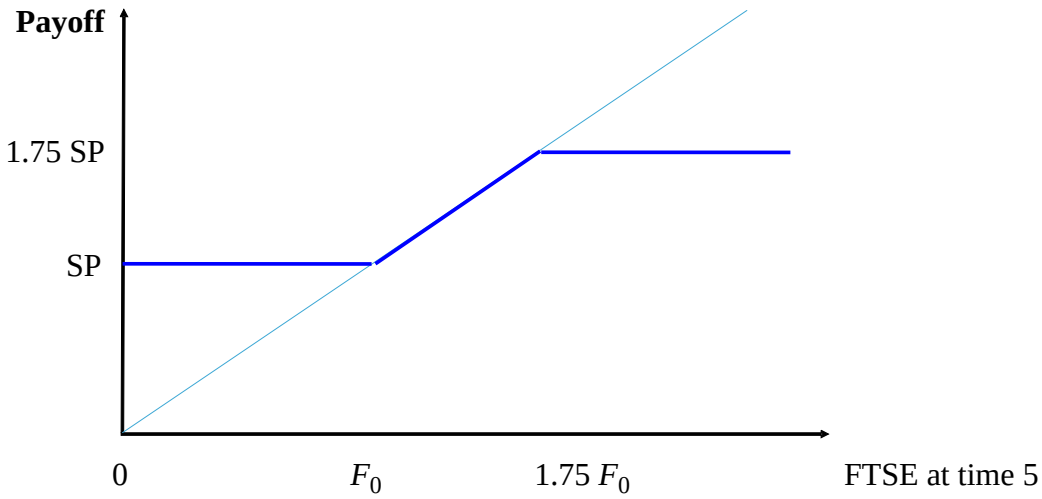
Their total return would therefore be 2.4 – 0.8 = 1.6.

Based on a personal investment of 10, this gives a return of 1.6 / 10 = 16|%.

MM Airlines' financial restructuring does not therefore increase value as it does not do anything investors could not do for themselves.

Comments on question 4: *This question was well answered.*

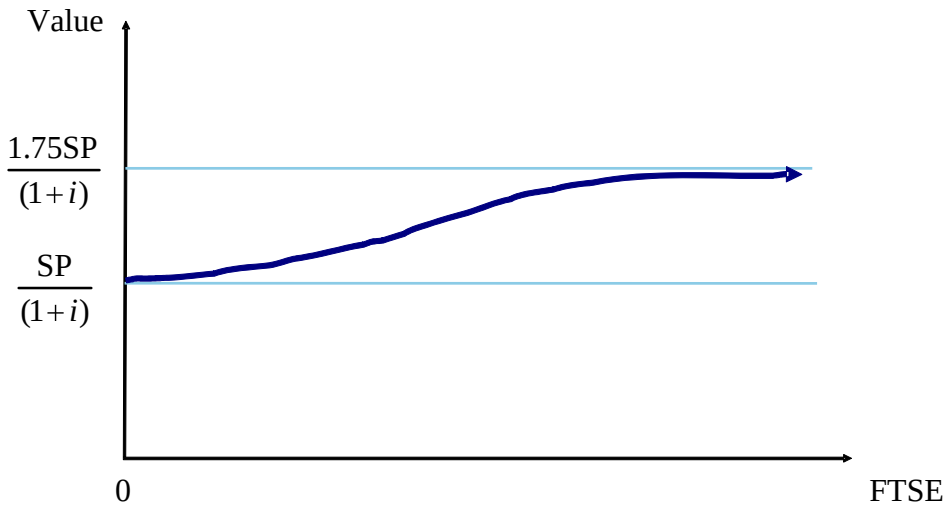
5 (i) Could start with diagram showing payoff



A replicating portfolio for this consists of:

- A zero coupon bond paying SP at time 5 (SP = single premium).
- A call option to buy SP/F_0 units of FTSE at price F_0 at time 5.
- Less a call option to buy SP/F_0 units of FTSE at price 1.75F_0 at time 5 (i.e. company needs to *write* or *short* a call).

(ii) As FTSE tends to zero, price tends to <u>discounted</u> single premium.



As FTSE tends to infinity, price tends to 175% of <u>discounted</u> single premium.

(iii) Acceptable main answers were:

- If only it were that simple.
- No — need new model.
- Might get away with just recalibrating.
- Actually, our model is already a best est and we have deflators to get market consistent values. We can use existing model but without the deflators.

	Our existing model	*Model that we need*
Purpose	Reproducing market consistent values	Getting to best estimate Probability distribution of what could happen to our life fund
Calibration	Artificial calibration / probabilities, geared to reproducing market prices	Needs to be our own best estimate of distribution of returns

Examples of calibration differences:

(a)	Equity risk premium	Irrelevant (or "we've used risk neutral so zero")	Best est or expected return on equities
(b)	Equity volatility	Market inferred	Best est

Example of model differences:

Distribution of equity returns	Simple, not that relevant e.g. lognormal dist'n	Maybe needs thicker tails to not understate probability of crashes

It was not necessary to make all the above points to get full marks

Comments on question 5: *This was the worst answered question on the paper. In (ii), candidates tended to forget the one year's discount factor in quoting the limiting values of a policy one year from maturity as the FTSE tended to infinity or zero. Part (iii) was intended to test candidates' understanding of paragraph 11 in unit 7, and tended to be poorly answered.*

6 (i) The types of credit risk exposures include:

- corporate bonds
- premium debtors (premiums still to be collected)
- reinsurance recoveries
- derivative contracts
- government bonds (only if stated that this is due to a country's credit rating, e.g. Argentina)
- prepaid reinsurance premiums
- inter-company loans and reinsurances
- other sensible answers credited too

(ii) The three key components are:

- credit exposure
- default probability
- loss given default (or recovery rate)

(iii) Controls we'd expect to see:

- Risk appetite statement, or other company policy on credit risk
  - Rules in place for limits, what types of credit risk was appropriate, when collateral needs to be posted by counterparties.

- Controls to be at aggregate level over whole balance sheet and to apply equally to (for example) banks and reinsurers.

- Initial credit checks on counterparties.
  - Using specialist credit agencies.

- Ongoing credit checks on counterparties.
  - With alarm bells on bad news (including degrades).

- Monitoring of credit exposure by counterparty.

  - With alarm bells on exceeding specified limits.

- Monitoring of potential credit exposure (in case of derivatives).

- Reinsurance treaties & derivative agreements to include special provisions saying what to do if credit exposure gets too big.

If corrective action is necessary, then:

- Credit exposure could be closed out completely (cancel reinsurance, move to another bank, etc.).

- Exposure could be reduced (e.g. require the posting of collateral for reinsurers).

- Default probability could be reduced using credit derivatives, third party letters of credit, etc.

- Pre-agreed collateral requirements or close out requirements should kick in.

Comments on question 6: *This was the second lowest scoring question (as a %) on the paper, but that is not unusual for a question of this type.*

7 (i) (a) Project A has IRR of 50% — agreed.

Problem is that A involves borrowing rather than lending, so NPV at 20% is negative — this project destroys shareholder value.

Project B's IRR satisfies $2.5x^2 - 3x + 1 = 0$ where $x = 1/(1 + \text{IRR})$

This equation has imaginary roots, so IRR doesn't exist, which is why the assistant conveniently ignored it: Can't use IRR to evaluate it if IRR doesn't exist.

Project C1 has IRR 100% and C2 has IRR 75%.

So C1 does indeed have higher IRR.

But at 20%, C2 has bigger NPV, so biggest IRR doesn't correspond to biggest NPV, so doesn't maximise shareholder value; OR Assistant has not considered the relative size of the investments required.

(b) Better is to use net present value (NPV) as evaluation tool.

Use IRR hurdle rate of 20% as discount rate for consistency.

Approve projects with positive NPV.

In case of mutually exclusive projects choose project with higher NPV (provided that there is capital to support all projects).

Project A

NPV = $1 - 1.5/1.2 = -0.25$
Negative so reject proposal.

Project B

NPV = $2.5/(1.2)^2 - 3/1.2 + 1 = 0.24$
Positive so accept proposal.

Project C

C1 NPV = 2/1.2 – 1 = 0.67
C2 NPV = 3.5/1.2 – 2 = 0.92
C2 has higher NPV, so choose C2.

(ii) (a) Sensitivity testing is the adjustment of a single assumption to optimistic and pessimistic levels and the examination of the effect on results.

Would do this for pretty well every assumption being made.

For example cost of bricks, level of house prices, etc.

Sensitivity testing can be criticised on grounds that when things go wrong it's not just the one assumption that goes wrong, hence…….

(b) Scenario testing is looking at realistic scenarios in which a number of assumptions are not borne out in practice (can be considered a combination of sensitivities that make sense in combination).

So lots of thought needs to go into these imaginary scenarios, and what happens to all assumptions within each scenario.

For example, bad weather, major employer moving out of area,…..

Scenario testing is great for "what-if" but gives no (or little) indication of probabilities, hence…….

(c) In Monte Carlo simulation, rather than fixed assumptions we need a probability distribution for each major assumption……..
……and correlations between them

Then use computer to simulate lots of equally likely scenarios and to evaluate project (e.g. calculate NPV) in each and generate a NPV probability dist'n.

Provides information to understand full range of outcomes and hence make a much more informed decision.

Comments on question 7: *It was surprising that this was only an averagely scoring question rather than one of the better ones. Part of the problem was that candidates didn't immediately spot that projects A, B and C1/C2 were deliberately constructed to highlight three common criticisms of IRR as a decision making tool.*

8 (i) We have 2 assets that we can use to construct the replicating portfolio:

- Advance season ticket
  - Current value 1,600
  - Payoff 2,000 if promotion achieved
  - Payoff 1,000 if promotion not achieved

- One year bond
  - Current value 1,000 (say)
  - Payoff 1,100 in both states

Need to value a contingent claim (the Stub) that pays 200 if promotion achieved and 0 otherwise.

Construct a replicating portfolio of a advance season tickets and b bonds.

For this to be replicating portfolio,

- $200 = 2{,}000a + 1{,}100b$
- $0 = 1{,}000a + 1{,}100b$

Solution $a = 0.2$, $b = -2/11$

So replicating portfolio is 0.2 advance season tickets and –2,000/11 cash

Value of Stub is value of replicating portfolio

$= 0.2 * 1{,}600 - 2{,}000/11$

$= 1520/11$

(ii) Can express as $(1/1.1) * (200p + 0(1 - p))$ where $p = 19/25$

Or can express as $0.5 * (200D_{up} + 0D_{not\ up})$ where $D_{up} = 76/55$

(iii) Possible reasons.

- No arbitrageurs around to force prices to market consistent ones / risks in "shorting" season tickets.

- Illiquid market / limited supply of season tickets.

- Fans unable to borrow cash at risk free rate

The examiners were looking for points related to the assumptions underlying market consistent valuation, so no credit was given for lack of confidence in internet, feeling of betraying the club, etc.

(iv) Calculate payoffs:

	Option 1	Option 2	Option 3
Promotion achieved	5000+(1520/11)*1.1−1600*1.1 =3392	5000+(1520/11)*1.1−2000 =3152	5000−1800 =3200
Not achieved	5000+(1520/11)*1.1−1600*1.1 =3392	5000+(1520/11)*1.1−1000 =4152	5000−1000 =4000

Calculate expected utility, using best estimate probability (not "risk neutral" probability).

ln(3392) =8.13	0.5*(ln(3152)+ln(4152) =8.19	0.5*(ln(3200)+ln(4000) =8.18

Option 2 has biggest expected utility, so is preferred option (i.e. sell stub today and buy season ticket next year).

(v) Buying a season ticket a year in advance looks very much like betting on the team achieving promotion. The bookmaker is now offering better odds than those inherent in the season ticket price. Or could say there's a cheaper way to replicate payoffs from a season ticket.

(vi) Cash required to buy a season ticket can be replicated by investing 1,000/1.1 in a one-year bond and betting 500 on promotion.

Cost of this is 1,000/1.1 + 500 = 15,500/11, or about £1,409.09.

This is the price that advance season tickets need to be reduced to for the bookmaker option to no longer be cheaper.

(vii) Replicating portfolio is still the same.

Value of it is now 0.2 * 15,500/11 – 2,000/11

which comes to £100 exactly.

Comments on question 8: *This question spread out the pack, being was very well answered by the best candidates, while others struggled. In particular, it was shocking how many candidates maximised the utility of the expectation rather than the expectation of the utility in (iv). If everybody went around doing this then there would be no money to be made in insurance!*

END OF EXAMINERS' REPORT