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UNIVERSITY OF LONDON

EC3099 ZA

BSc degrees and Diplomas for Graduates in Economics, Management, Finance and the Social Sciences, the Diplomas in Economics and Social Sciences and Access Route

Industrial Economics

Friday, 22 May 2015-: 10:00 to 13:00

Candidates should answer **FOUR** of the following **EIGHT** questions: **TWO** from Section A, and **TWO** from Section B. All questions carry equal marks.

If more questions are answered than requested, only the first answers attempted will be counted.

PLEASE TURN OVER

SECTION A

Answer two questions from this section.

1. Answer both parts of this question.

- (a) A survey has found that small UK firms that produce customised components for UK manufacturers often do not rely on formal contracts for their relationship. Furthermore, over half of the firms claim that the technology used to support the relationship should be upgraded but this investment is not being made. Using the theory of transaction costs, describe why underinvestment often occurs in these relationships. **(10 marks)**
- (b) A recent report by McKinsey states that vertical integration is notoriously difficult to implement successfully and – when it turns out to be the wrong strategy – is costly to fix. As a result, the report recommends ‘don’t vertically integrate unless it is absolutely necessary to create or protect value.’ Describe how vertical integration can create or protect value and, given this, in which circumstances it might be a desirable strategy to follow for a firm. **(15 marks)**

2. Answer both parts of this question.

- (a) Explain why cartels tend to be unstable. How might the members of a cartel try to increase its stability? **(10 marks)**
- (b) Price wars imply losses for all the firms involved. Nevertheless price wars occur. Does this mean that firms behave irrationally? Discuss with reference to economic theories of price wars and any relevant empirical evidence. **(15 marks)**

3. Answer all parts of this question.
- (a) Two firms, A and B, produce a differentiated product and compete in the same market. Discuss, illustrating your argument with appropriate diagrams, the concepts of 'strategic substitutes' and 'strategic complements' in the context of this competition. What do these concepts mean, and which underlying models of competition are consistent with each of these concepts? You may support your answer with formal expressions as appropriate. **(8 marks)**
- (b) Firms A and B play a three-stage game. In the third stage, the firms are Cournot competitors if both are active in the industry, with fixed cost of production K and marginal costs c_A and c_B , respectively. The marginal cost of firm A depends on its choice of innovation investment, F , in stage 1, with c_A decreasing in F . Firm B can observe F and must decide, in stage 2, whether to enter the industry or not. In such a case, does firm A have an incentive to 'overinvest' in innovation? Explain, using formal modelling or diagrams as appropriate. Make sure to define what you mean by 'overinvestment'. **(10 marks)**
- (c) Does it matter to your answer in (b) whether the firms are Bertrand or Cournot competitors in the final stage of the game? Explain, including formal modelling or diagrams as appropriate to illustrate your argument. **(7 marks)**
4. 'The equilibrium number of firms in a homogeneous goods industry is lower the more intense is price competition among firms in the industry.'
Discuss this statement, with reference to a theoretical model and the empirical evidence.

SECTION B

Answer two questions from this section.

5. The profit of a firm can take one of two values, Π_1 and Π_2 , where $\Pi_2 - \Pi_1 > 10$. The firm is run by a manager who chooses between two levels of effort, $e = 1$ (high) and $e = 0$ (low). The manager's utility function is $U = w^{1/2} - e$, where w is her wage. Whether the firm makes Π_1 or Π_2 depends on the manager's effort and on the firm's environment, which is uncertain. In particular, if the manager's effort is high, the profit is Π_2 with probability 0.8 and Π_1 with probability 0.2. If the manager's effort is low, the profit is Π_2 with probability 0.3 and Π_1 with probability 0.7. Before the manager decides on the level of effort, the owners of the firm choose a contract for the manager, which specifies the value of w for each of the two possible values of Π . The owners' objective is to maximise expected net profit $E(\Pi - w)$. Given the incentive scheme chosen by the owners, the manager decides whether to take the job and, if she accepts, chooses e to maximise her expected utility $E(U)$. Her reservation wage is $w_0 = 4$. After the manager has made her choice, the profit is observed and the manager gets paid.

- (a) What is the optimal contract if the owners can observe the manager's effort? **(9 marks)**
- (b) What is the optimal contract if the owners cannot observe the manager's effort? **(12 marks)**
- (c) Show that the net profit of the owners is lower if the manager's effort is unobservable than if it is observable. **(4 marks)**

6. A monopolist produces a good with constant marginal cost equal to c , $c < 1$. Assume for now that all consumers have the demand $D(p) = 1 - p$. The population is of size 1.

- (a) Suppose that the monopolist cannot discriminate in any way among the consumers and has to charge a uniform price, p_U . Calculate the profit maximising price and the corresponding profit. **(5 marks)**
- (b) Suppose now that the monopolist can charge a two-part tariff, $T = A_T + p_T q$, where A_T is the fixed fee, p_T is the price per unit, and q is the quantity bought. Calculate the profit maximising two-part tariff and the corresponding profit. Compare p_U and p_T and comment. **(5 marks)**
- (c) Compare the welfare implications of the uniform price under (a) and the two-part tariff under (b). **(5 marks)**

Assume now that there are two types of consumers. Type 1 consumers have demand $D_1(p) = 1 - p$, and type 2 consumers have demand $D_2(p) = 1 - p/2$. The population is of size 1 and there are equally many consumers of the two types. Finally, assume that $c = 1/2$.

- (d) Calculate the two-part tariff that maximises the profit of the monopolist in this new situation. Compare the two-part tariffs found in parts (b) and (d) for $c = 1/2$ and comment. **(10 marks)**

7. Answer both parts of this question.

(a) Let two bars, A and B, sell the same beer at zero marginal cost in Smalltown. Smalltown consists of a single straight road of length 1, the Avenue, on which the bars must locate. There is a continuum of consumers living on the Avenue and each consumer wishes to buy one pint of beer. Consumers have a reservation value v . A consumer located at x , who buys the beer at a bar located at y , has to pay additionally to the price of the beer a travel cost $t = (x - y)^2$. Suppose that the price of beer is fixed by the government at p^* per pint, where $p^* < v$. Describe where the two bars would choose to locate, and explain your answer. How and why would your answer change if there were three bars in Smalltown? **(12 marks)**

(b) A natural monopolist has total cost $C(Q) = 300 + 15Q$ and faces market demand $Q = 200 - 2P$. Derive the monopolist's output and profit and the consumer surplus when:

- (i) price is set equal to marginal cost; (ii) price is set equal to average cost;
- (iii) there is two-part pricing and the monopolist chooses the tariff to maximise profit;
- (iv) there is two-part pricing and a regulator chooses the tariff to maximise consumer surplus, subject to the monopolist breaking even. For parts (iii) and (iv), you may assume that there are N identical consumers. **(13 marks)**

8. A profit maximising firm has the chance to research the cure for the common cold (CCC). If it spends $Z > 1$ on R&D, then it has probability $p(Z) = 1 - 1/Z$ of discovering the CCC (and zero probability otherwise). Assume that the firm has no other costs besides research costs and no other revenues other than those from selling the CCC if it discovers it. The present value of revenue from the CCC once discovered is Π . Units for research costs and CCC profits are millions of pounds.

- (a) Assume that Π is sufficiently high that the firm finds it profitable to do research. How much will it spend on research as a function of Π ? **(7 marks)**
- (b) What is the expected present value of profits in terms of Π if the firm optimally chooses Z ? What would happen if $\Pi < 4$? Explain. **(7 marks)**
- (c) Assuming no discounting, so that the present value of profits is just the sum of all future profits, and an annual profit of \$0.15 million from monopoly exploitation of CCC, what is the minimum patent length that will induce the company to do any research? **(7 marks)**
- (d) Assume the patent is the length you worked out in part (c). What is the maximum fixed license fee the company could charge for the CCC? **(4 marks)**

END OF PAPER

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BSc degrees and Diplomas for Graduates in Economics, Management, Finance and the Social Sciences, the Diplomas in Economics and Social Sciences and Access Route

Industrial Economics

Friday, 22 May 2015-: 10:00 to 13:00

Candidates should answer **FOUR** of the following **EIGHT** questions: **TWO** from Section A, and **TWO** from Section B. All questions carry equal marks.

If more questions are answered than requested, only the first answers attempted will be counted.

PLEASE TURN OVER

SECTION A

Answer two questions from this section.

1. Answer both parts of this question.

(a) A survey has found that small UK firms that produce customised components for UK manufacturers often do not rely on formal contracts for their relationship. Furthermore, over half of the firms claim that the technology used to support the relationship should be upgraded but this investment is not being made. Using the theory of transaction costs, describe why underinvestment often occurs in these relationships.

(10 marks)

(b) A recent report by McKinsey states that vertical integration is notoriously difficult to implement successfully and – when it turns out to be the wrong strategy – is costly to fix. As a result, the report recommends ‘don’t vertically integrate unless it is absolutely necessary to create or protect value.’ Describe how vertical integration can create or protect value and, given this, in which circumstances it might be a desirable strategy to follow for a firm.

(15 marks)

2. Answer both parts of this question.

(a) Explain why cartels tend to be unstable. How might the members of a cartel try to increase its stability?

(10 marks)

(b) How and why do price wars occur? Answer with reference to three different theories of price wars and discuss the evidence that exists supporting each as a good explanation of price wars. Is any one of these models a ‘better’ description of price wars? Explain.

(15 marks)

3. Using any suitable economic models, describe at least two different ways in which incumbent firms can deter the entry of rivals in a market.

4. ‘A major difficulty with the implementation of competition policy stems from the fact that many business practices which unambiguously reduce welfare are difficult to detect, while many business practices which are easy to detect have ambiguous welfare implications.’ Discuss.

SECTION B

Answer two questions from this section.

5. The profit of a firm can take one of two values, Π_1 and Π_2 , where $\Pi_2 - \Pi_1 > 10$. The firm is run by a manager who chooses between two levels of effort, $e = 1$ (high) and $e = 0$ (low). The manager's utility function is $U = w^{1/2} - e$, where w is her wage. Whether the firm makes Π_1 or Π_2 depends on the manager's effort and on the firm's environment, which is uncertain. In particular, if the manager's effort is high, the profit is Π_2 with probability 0.8 and Π_1 with probability 0.2. If the manager's effort is low, the profit is Π_2 with probability 0.3 and Π_1 with probability 0.7. Before the manager decides on the level of effort, the owners of the firm choose a contract for the manager which specifies the value of w for each of the two possible values of Π . The owners' objective is to maximise expected net profit $E(\Pi - w)$. Given the incentive scheme chosen by the owners, the manager decides whether to take the job and, if she accepts, chooses e to maximise her expected utility $E(U)$. Her reservation wage is $w_0 = 4$. After the manager has made her choice, the profit is observed and the manager gets paid.
- (a) What is the optimal contract if the owners can observe the manager's effort? **(9 marks)**
- (b) What is the optimal contract if the owners cannot observe the manager's effort? **(12 marks)**
- (c) Show that the net profit of the owners is lower if the manager's effort is unobservable than if it is observable. **(4 marks)**
6. Consider a market where N firms produce a homogeneous product and compete by simultaneously setting quantities. The inverse demand function has the general form $P = P(Q) = P(q_1 + q_2 + q_3 + \dots + q_N)$, where q_i is the quantity produced by firm i and P is the market price. The demand curve is downward sloping, so $P'(Q) < 0$. The total cost of firm i is given by $C_i(q_i)$.
- (a) Show that $(P - MC_i)/P = s_i/\varepsilon$, where MC denotes the marginal cost, s_i is the market share of firm i and ε is the absolute value of the price elasticity of demand. **(7 marks)**
- (b) Derive a 'weighted Lerner index' for the industry as a whole that is directly related to the Herfindahl index of market concentration, $H = \sum_i s_i^2$. **(6 marks)**
- (c) From your answer to part (b), can you therefore conclude that an increase in industry concentration will cause an increase in the industry price-cost margin? Explain why or why not. **(12 marks)**

7. Answer both parts of this question.

- (a) Let two bars, A and B, sell the same beer at zero marginal cost in Smalltown. Smalltown consists of a single straight road of length 1, the Avenue, on which the bars must locate. There is a continuum of consumers living in the Avenue and each consumer wishes to buy one pint of beer. Consumers have a reservation value v . A consumer located at x , who buys the beer at a bar located at y , has to pay additionally to the price of the beer a travel cost $t = (x - y)^2$. Suppose that the price of beer is fixed by the government at p^* per pint, where $p^* < v$. Describe where the two bars would choose to locate, and explain your answer. How and why would your answer change if the two bars were allowed to set the price of beer? **(12 marks)**
- (b) A natural monopolist has total cost $C(Q) = 300 + 15Q$ and faces market demand $Q = 200 - 2P$. Derive the monopolist's output and profit and the consumer surplus when:
- (i) price is set equal to marginal cost;
 - (ii) price is set equal to average cost;
 - (iii) there is two-part pricing and the monopolist chooses the tariff to maximise profit;
 - (iv) there is two-part pricing and a regulator chooses the tariff to maximise consumer surplus, subject to the monopolist breaking even.

For parts (iii) and (iv), you may assume that there are N identical consumers.

(13 marks)

8. A monopoly manufactures a good at zero cost. There is a monopoly retailer downstream who purchases this product from the manufacturer at price w and sells it to consumers at price p . In addition, the retailer undertakes advertising (a fixed cost) that affects the final demand for the good. In particular, final demand depends on both price p and advertising A and is given by $Q = 1 - p + \beta A$, where $0 < \beta < \sqrt{2}$. The cost of advertising to the retailer is $C(A) = A^2/2$. The retailer has zero cost of production (apart from what he pays to the manufacturer). The two firms play a two-stage game: at stage 1, the manufacturer sets his wholesale price w ; then, at stage 2, the retailer sets his retail price p and advertising level A (the latter two at the same time).
- (a) Compute the subgame perfect equilibrium prices and advertising levels, and the profits for manufacturer and retailer. **(5 marks)**
- (b) Now suppose that the manufacturer owns the retailer and sets the retail price and advertising himself. Compute the optimal levels of retail price and advertising, and profit, and explain how and why they differ from those in part (a). **(5 marks)**
- (c) Going back to the case where the manufacturer and the retailer are separate, describe how the manufacturer could design a vertical contract to restore the joint profit maximising solution. **(5 marks)**

Now suppose that instead of a single retailer there are two retailers of this product who compete in prices. Demand depends on the total amount of advertising, A , set by the two retailers: $Q = 1 - p + \beta A$. The retailers simultaneously set advertising first, and then they simultaneously set prices (hence the retailers' subgame has two stages and the overall game has three stages).

- (d) Derive the subgame perfect equilibrium prices and advertising levels for the retailers and the profit earned by the manufacturer in this case. **(5 marks)**
- (e) In the absence of vertical restraints or integration, is the manufacturer better off with a monopoly retailer as in part (a) or with two competing retailers as in part (d)? Explain. **(5 marks)**

END OF PAPER

Examiners' commentaries 2015

EC3099 Industrial economics

Important note

This commentary reflects the examination and assessment arrangements for this course in the academic year 2014–15. The format and structure of the examination may change in future years, and any such changes will be publicised on the virtual learning environment (VLE).

Information about the Subject guide and the Essential reading references

Unless otherwise stated, all cross-references will be to the latest version of the Subject guide (2015). You should always attempt to use the most recent edition of any Essential reading textbook, even if the commentary and/or online reading list and/or Subject guide refers to an earlier edition. If different editions of Essential reading are listed, please check the VLE for reading supplements – if none are available, please use the contents list and index of the new edition to find the relevant section.

General remarks

Learning outcomes

At the end of this unit, and having completed the Essential reading and activities, you should be able to:

- describe and explain the determinants of the size and structure of firms and the implications of the separation of ownership and control
- describe and explain the pricing behaviour by firms with market power and its welfare implications
- apply analytical models of firm behaviour and strategic interaction to evaluate various business practices, including tacit collusion, entry deterrence, product differentiation, price discrimination and vertical restraints
- recognise and explain the basic determinants of market structure and the key issues in competition policy and regulation.

Format of the examination

This unit is assessed by a three-hour examination. The examination consists of eight questions divided into two sections, each of four questions. Section A includes essay-type questions, while section B includes problem-type questions. You will be required to answer four questions, two from each section.

What are the examiners looking for?

Some examination questions will be problem-type questions, while others will be essay-type questions.

In general, problem-type questions are quite specific as to what you are supposed to do, and a good answer generally involves some use

of mathematics. When you answer problem-type questions in an examination, all the necessary steps must be shown. Moreover, you should take care to explain what the mathematics show – do not simply list equations.

Essay-type questions can be more or less specific, although a good answer to an essay-type question must include some rigorous economic analysis, usually with reference to some economic model or models.

Reading and preparation for the examination

It is important to read more widely than just the subject guide. In essay-type questions in particular, you get a higher mark by including relevant material not in the subject guide. And whatever the question, exposure to a wider set of readings is usually necessary to understand in depth the economics involved and be able to provide correct and comprehensive answers in the examination.

While there is no single best way to organise your study, it may be useful, for each topic in the syllabus, to start with the relevant chapter of the subject guide, then do the Essential and some of the recommended reading for that particular topic, then come back to the guide and attempt the various learning activities and sample examination questions.

Planning your time in the examination

Use your time efficiently, bearing in mind that all questions carry equal weight in the final mark. Your answers must be as detailed and comprehensive as possible given the time constraints (unless you are specifically asked to discuss something briefly), but you should not include material which is not relevant to the question.

Steps to improvement

- Your answers to problem-type questions should not simply list mathematical results but they should also explain what the mathematics mean.
- Your answers to essay-type questions must be focused, not too descriptive and must contain rigorous economic analysis.

Examination revision strategy

Many candidates are disappointed to find that their examination performance is poorer than they expected. This may be due to a number of reasons. The *Examiners' commentaries* suggest ways of addressing common problems and improving your performance. One particular failing is '**question spotting**', that is, confining your examination preparation to a few questions and/or topics which have come up in past papers for the course. This can have serious consequences.

We recognise that candidates may not cover all topics in the syllabus in the same depth, but you need to be aware that examiners are free to set questions on **any aspect** of the syllabus. This means that you need to study enough of the syllabus to enable you to answer the required number of examination questions.

The syllabus can be found in the Course information sheet in the section of the VLE dedicated to each course. You should read the syllabus carefully and ensure that you cover sufficient material in preparation for the examination. Examiners will vary the topics and questions from year to year and may well set questions that have not appeared in past papers. Examination papers may legitimately include questions on any topic in the syllabus. So, although past papers can be helpful during your revision, you cannot assume that topics or specific questions that have come up in past examinations will occur again.

If you rely on a question-spotting strategy, it is likely you will find yourself in difficulties when you sit the examination. We strongly advise you not to adopt this strategy.

Examiners' commentaries 2015

EC3099 Industrial economics – Zone A

Important note

This commentary reflects the examination and assessment arrangements for this course in the academic year 2014–15. The format and structure of the examination may change in future years, and any such changes will be publicised on the virtual learning environment (VLE).

Information about the Subject guide and the Essential reading references

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Comments on specific questions

Candidates should answer FOUR of the following EIGHT questions: TWO from Section A, and TWO from Section B. All questions carry equal marks.

Section A

Answer two questions from this section.

Question 1

Answer both parts of this question.

- a. A survey has found that small UK firms that produce customised components for UK manufacturers often do not rely on formal contracts for their relationship. Furthermore, over half of the firms claim that the technology used to support the relationship should be upgraded but this investment is not being made. Using the theory of transaction costs, describe why underinvestment often occurs in these relationships. (10 marks)

Reading for this question

Subject guide, Chapter 1; Tirole (1988) introductory chapter; Church and Ware (2000) Chapter 3.

Approaching the question

The relationships studied in the survey would tend to generate 'hold up' problems of the sort that reduce investment in relationships: they involve customised components, so that producers are making investments to adapt to the specific needs of buyers. As the buyers and sellers are separate, one would expect some opportunism in the relationship. There are few formal contracts in this sector, making it difficult to commit to payments that will be upheld ex post. It could be difficult to anticipate contingencies in any contract, even informal, that guides the relationship;

so even if contracts exist, they are unlikely to be complete. Indeed, for relatively small orders, one would expect that the costs of attempting to write a relatively complete contract would not be justified by the size of the contract. A very good answer would also describe a specific theoretical model to illustrate these arguments.

- b. A recent report by McKinsey states that vertical integration is notoriously difficult to implement successfully and – when it turns out to be the wrong strategy – is costly to fix. As a result, the report recommends ‘don’t vertically integrate unless it is absolutely necessary to create or protect value.’ Describe how vertical integration can create or protect value and, given this, in which circumstances it might be a desirable strategy to follow for a firm.**
- (15 marks)**

Reading for this question

Subject guide, Chapters 1, 7 and 8; Tirole (1988) introductory chapter and Chapters 3 and 4; Church and Ware (2000) Chapters 3, 5 and 22.

Approaching the question

The basic premise of the McKinsey report seems to be that it is best, as a default, not to vertically integrate. While markets often work well and competition in the buyer and seller market assures efficient exchange, one could give a more nuanced answer to this question from various perspectives.

First, the answer could describe double marginalisation where the number of buyers and sellers is not large on both sides of the market (typically, and in the subject guide, we look at a single buyer and a single seller). This basic externality would argue for vertical integration so as to prevent price rising too far, but in fact there are a number of vertical contracts that can at least partially resolve this problem, including two part tariffs and vertical restraints (such as quantity forcing or pricing constraints). This can be extended to the case of service provision, where again some kind of vertical restraint (including two part tariffs, but also including service contracts and other types of restraints) could be used to correct the externality that tends to result in underprovision of services. This is not a given, however, as the downstream market structure (e.g. a large number of competing retailers) can tend to control this sort of externality. If vertical restraints can go a long way towards resolving these vertical externalities, why integrate?

One reason might be transaction costs – see the answer to part (a) above. Candidates could outline the transaction cost argument for when markets fail, and could also include some kind of summary intuition for this relying on small numbers bargaining, high asset specificity or some kind of information failure in the contracting.

Vertical integration can also make sense for price discrimination reasons and market power reasons. Price discrimination may require control of resale, which can sometimes be facilitated by vertical integration into certain customer segments. It can also be used to promote barriers to entry, for example by forcing entrants to set up their own distribution network if they wish to enter. These points are developed in the subject guide.

Question 2

Answer both parts of this question.

- a. **Explain why cartels tend to be unstable. How might the members of a cartel try to increase its stability?** (10 marks)

Reading for this question

Subject guide, Chapter 4; Tirole (1988) Chapter 6; Church and Ware (2000) Chapter 10.

Approaching the question

The answer to this question should begin by analysing the incentives to collude as opposed to the incentives to defect from a cartel agreement in the context of a formal model of collusion as well as more generally. Factors that hinder or facilitate cartel stability should be discussed, and this could then provide a basis for assessing the ways cartel stability can be increased by firms. The emphasis should be on factors that can be affected by cartel members and not on exogenous industry characteristics.

- b. **Price wars imply losses for all the firms involved. Nevertheless price wars occur. Does this mean that firms behave irrationally? Discuss with reference to economic theories of price wars and any relevant empirical evidence.** (15 marks)

Reading for this question

Subject guide, Chapter 4; Tirole (1988) Chapter 6; Church and Ware (2000) Chapter 10.

Approaching the question

There are several theories that predict that price wars will occur between rational firms. A starting point for the discussion, including some empirical evidence, is provided in Chapter 4 of the subject guide.

Three theories are put forward. One is the Green-Porter model, where there is uncertainty about the level of demand when firms choose prices in each period. A firm cannot tell when it does badly in a period whether this is because demand was low or because some other firm cheated on a price agreement. Hence, even if firms collude (as they do in the subgame perfect equilibrium of the model), there are cases where a demand shock triggers a price war that lasts for several periods. This sort of 'accidental' price war is necessary to discipline behaviour. Without such occasional reversions, the equilibrium of (tacit) collusion could not be sustained because there would be too much of an incentive to cheat under the cover of uncertainty about the cause of the low prices. Also, the firms cannot collude on the full monopoly price: this increases the 'temptation' to cheat too much when there is imperfect observability of cheating. Green and Porter tested their model on late 19th century railroad price wars and found some empirical evidence to support it.

Rotemberg and Saloner postulate that demand fluctuates randomly but it is observable in each period before the price is set. Firms can also observe the past actions of their rivals. In such a case, the gain from cheating is bigger when demand is high than when it is low because the payoff from cheating increases with high demand. This means that firms must adjust the collusive agreement: they decrease the collusive price in booms so that the payoff from cheating shrinks and the incentive to cheat is reduced. No price wars occur in equilibrium but prices do move countercyclically. This is the opposite of Green and Porter's result. Some evidence consistent with the model was provided by Rotemberg and Saloner.

Finally, Slade proposes that firms have imperfect information about either demand or cost of rivals – but firms may have information of their own that can be inferred from their actions. Hence, a price cut can be a signal of the true cost of the firm or of demand. Firms, then, periodically cut prices, but these are the reflection of firms' updating their knowledge about the underlying competitive conditions of the industry and so reflect a move to a new collusive equilibrium. Levenstein and Levenstein and Suslow provide some support for this theory and Slade also provides evidence of price wars in downturns which could be consistent with this theory (as well as Green and Porter's theory).

Question 3

Answer all parts of this question.

- a. Two firms, A and B, produce a differentiated product and compete in the same market. Discuss, illustrating your argument with appropriate diagrams, the concepts of 'strategic substitutes' and 'strategic complements' in the context of this competition. What do these concepts mean, and which underlying models of competition are consistent with each of these concepts? You may support your answer with formal expressions as appropriate. (8 marks)
- b. Firms A and B play a three-stage game. In the third stage, the firms are Cournot competitors if both are active in the industry, with fixed cost of production K and marginal costs c_A and c_B , respectively. The marginal cost of firm A depends on its choice of innovation investment, F , in stage 1, with c_A decreasing in F . Firm B can observe F and must decide, in stage 2, whether to enter the industry or not. In such a case, does firm A have an incentive to 'overinvest' in innovation? Explain, using formal modelling or diagrams as appropriate. Make sure to define what you mean by 'overinvestment'. (10 marks)
- c. Does it matter to your answer in (b) whether the firms are Bertrand or Cournot competitors in the final stage of the game? Explain, including formal modelling or diagrams as appropriate to illustrate your argument. (7 marks)

Reading for this question

Subject guide, Chapter 5; Tirole (1988) Chapter 8; Church and Ware (2000) Chapters 13–16.

Approaching the question

- a. Strategic substitutes refer to the case where reaction functions slope downwards: an aggressive action by one firm induces a passive reaction by the other. Example: the Cournot model. Strategic complements refer to the case of a positive slope of reaction functions: an aggressive action by one firm induces an aggressive reaction by the other. Example: the Bertrand model with differentiated products. A good answer would link the slope of reaction functions with properties of the profit functions, using formal expressions to illustrate.
- b. In the case of strategic substitutes (Cournot), we have downward sloping reaction functions. There are two possible courses of action for firm A. Firm A may want to accommodate the entry of firm B. In such a case, if we compare with the behaviour when firms cannot influence their rivals (i.e. when F is not observable), we see an increased incentive to shift out the reaction function of firm A by investing to reduce marginal cost. The reason is that, as the reaction function shifts out, the stage 3 equilibrium moves to a point where firm A produces more and firm B produces less. This is to the benefit of firm A and is

the result of the downward sloping reaction functions. Alternatively, firm A may want to deter the entry of firm B. Again it will overinvest, as this reduces the potential third stage profit of firm B and makes its entry less likely.

- c. Yes, it does. For entry accommodation, the result is reversed when the game is one of strategic complements and reaction functions are upward sloping (Bertrand with differentiated products). Firm A's investment in cost-reducing innovation would shift its reaction function back: it would price lower for any given price by firm B. This would hurt firm A, so A tends to underinvest compared to the case where it cannot influence B's actions. However, for entry deterrence, overinvestment is appropriate in order to reduce the potential stage 3 profit of firm B and therefore the likelihood of entry by firm B.

Question 4

'The equilibrium number of firms in a homogeneous goods industry is lower the more intense is price competition among firms in the industry.' Discuss this statement, with reference to a theoretical model and the empirical evidence.

Reading for this question

Subject guide, Chapter 9; Sutton (1991).

Approaching the question

The core of the answer should include a discussion of the relationship between short-run competition and market structure with reference to a theoretical framework for the analysis of the determinants of market structure, such as the one outlined in Chapter 9 of the subject guide.

In an exogenous sunk cost industry, the key result of a positive effect of the intensity of short-run competition on market structure can be illustrated using a simple two-stage game: at stage 1 firms decide whether or not to enter at a certain sunk cost, while at stage 2 they are faced with various possible competition regimes, namely Bertrand competition, Cournot competition, and perfect collusion. Using a linear demand function and a constant marginal cost (the same for all firms), one can show that the number of firms that enter is lowest under Bertrand competition and highest under collusion. In other words, market concentration is higher the more intense the competition. The intuition for this result should be clearly explained. Some discussion of whether the result extends to endogenous sunk cost industries is also required.

The final part of the question asks for a brief discussion of empirical evidence. Some evidence provided by Symeonidis is discussed in the subject guide: a major shift in UK competition policy in the late 1950s has made it possible to compare a group of previously collusive industries (which experienced an increase in the intensity of price competition) with a 'control' group of non-collusive industries (which were not affected by the change in policy). Any other available evidence may also be discussed.

A very good answer might also indicate the main policy implications of these results. One such implication is that competition policy authorities should perhaps be less concerned with concentration than with ensuring that competition remains effective, i.e. firms do not collude and there are no barriers to entry.

Section B

Answer two questions from this section.

Question 5

The profit of a firm can take one of two values, Π_1 and Π_2 , where $\Pi_2 - \Pi_1 > 10$. The firm is run by a manager who chooses between two levels of effort, $e = 1$ (high) and $e = 0$ (low). The manager's utility function is $U = w^{1/2} - e$, where w is her wage. Whether the firm makes Π_1 or Π_2 depends on the manager's effort and on the firm's environment, which is uncertain. In particular, if the manager's effort is high, the profit is Π_2 with probability 0.8 and Π_1 with probability 0.2. If the manager's effort is low, the profit is Π_2 with probability 0.3 and Π_1 with probability 0.7. Before the manager decides on the level of effort, the owners of the firm choose a contract for the manager which specifies the value of w for each of the two possible values of Π . The owners' objective is to maximise expected net profit $E(\Pi - w)$. Given the incentive scheme chosen by the owners, the manager decides whether to take the job and, if she accepts, chooses e to maximise her expected utility $E(U)$. Her reservation wage is $w_0 = 4$. After the manager has made her choice, the profit is observed and the manager gets paid.

- What is the optimal contract if the owners can observe the manager's effort? (9 marks)
- What is the optimal contract if the owners cannot observe the manager's effort? (12 marks)
- Show that the net profit of the owners is lower if the manager's effort is unobservable than if it is observable. (4 marks)

Reading for this question

Subject guide, Chapter 2; Tirole (1988) introductory chapter; Church and Ware (2000) Chapter 3.

Approaching the question

- If the effort is observable, the owners can impose the level of effort they prefer. If they want no effort ($e = 0$), then they should give the reservation wage $w_0 = 4$ (note that in this case the manager obtains a reservation utility of $U_0 = w_0^{1/2} - 0 = 2$). Net expected profit will then be $0.3\Pi_2 + 0.7\Pi_1 - 4$. If the owners want high effort ($e = 1$), they should pay the manager a wage sufficient to guarantee him or her a utility of $U_0 = 2$. So the wage must be at least 9 (so that $U = 9^{1/2} - 1 = 2 = U_0$). Net expected profit will be $0.8\Pi_2 + 0.2\Pi_1 - 9$.

Clearly, the owners will choose to impose high effort if and only if $0.8\Pi_2 + 0.2\Pi_1 - 9 > 0.3\Pi_2 + 0.7\Pi_1 - 4 \Leftrightarrow \Pi_2 - \Pi_1 > 10$. Since the question has specified that $\Pi_2 - \Pi_1 > 10$, we conclude that the owners will choose to impose high effort in the case where effort is observable.

- If the effort is unobservable, the owners cannot simply impose a level of effort. Instead they may want to design an incentive scheme for the manager. Of course, if they want $e = 0$, all they need to do is give again the reservation wage $w_0 = 4$. Net expected profit will then be $0.3\Pi_2 + 0.7\Pi_1 - 4$. If they want $e = 1$, however, they will choose an incentive scheme such that to each realised level of profit corresponds a wage level. Formally, the owners must design a wage structure $w_i(\Pi_i)$, $i = 1, 2$, that maximises their expected net profit

$$0.8(\Pi_2 - w_2) + 0.2(\Pi_1 - w_1)$$

subject to a 'participation constraint'

$$0.8(w_2^{1/2} - 1) + 0.2(w_1^{1/2} - 1) \geq 2$$

and an ‘incentive-compatibility constraint’

$$0.8(w_2^{1/2} - 1) + 0.2(w_1^{1/2} - 1) \geq 0.3w_2^{1/2} + 0.7 w_1^{1/2} .$$

This maximisation problem is easy to solve because both constraints are satisfied with equality. We get a system of two equations in w_1 and w_2 . Solving we obtain $w_1 = 1.96$ and $w_2 = 11.56$. These are the wage levels that maximise the owners’ expected net profit, which is therefore equal to $0.8\Pi_2 + 0.2\Pi_1 - 9.64$. Clearly, the owners will choose to impose high effort if and only if $0.8\Pi_2 + 0.2\Pi_1 - 9.64 > 0.3\Pi_2 + 0.7\Pi_1 - 4 \Leftrightarrow \Pi_2 - \Pi_1 > 11.28$, which may or may not hold. If $\Pi_2 - \Pi_1 > 11.28$, the owners will implement the incentive scheme and induce high effort ($e = 1$), but if $10 < \Pi_2 - \Pi_1 < 11.28$, they will prefer $e = 0$ and will therefore just give a flat wage equal to 4.

- c. There are two cases, depending on whether $e = 1$ or $e = 0$ is the optimal contract for the owners under part (b). In both cases it is easy to show that the statement under part (c) holds.

Question 6

A monopolist produces a good with constant marginal cost equal to c , $c < 1$. Assume for now that all consumers have the demand $D(p) = 1 - p$. The population is of size 1.

- Suppose that the monopolist cannot discriminate in any way among the consumers and has to charge a uniform price, p_U . Calculate the profit maximising price and the corresponding profit. (5 marks)
- Suppose now that the monopolist can charge a two-part tariff, $T = A_T + p_T q$, where A_T is the fixed fee, p_T is the price per unit, and q is the quantity bought. Calculate the profit maximising two-part tariff and the corresponding profit. Compare p_U and p_T and comment. (5 marks)
- Compare the welfare implications of the uniform price under (a) and the two-part tariff under (b). (5 marks)

Assume now that there are two types of consumers. Type 1 consumers have demand $D_1(p) = 1 - p$, and type 2 consumers have demand $D_2(p) = 1 - p/2$. The population is of size 1 and there are equally many consumers of the two types. Finally, assume that $c = 1/2$.

- Calculate the two-part tariff that maximises the profit of the monopolist in this new situation. Compare the two-part tariffs found in parts (b) and (d) for $c = 1/2$ and comment. (10 marks)

Reading for this question

Subject guide, Chapter 7; Tirole (1988) Chapter 3; Church and Ware (2000) Chapter 5.

Approaching the question

- The monopolist chooses p to maximise $\pi = (p - c)(1 - p)$. The first-order condition is $1 - 2p - c = 0$. Hence $p_U = (1 + c)/2$ and therefore $\pi_U = (1 - c)^2/4$.
- The monopolist sets the price per unit equal to marginal cost and extracts all consumer surplus through the fixed fee. Hence $p_T = c < p_U$ and $\pi_T = A_T = (1 - c)^2/2$. In a situation with only one type of consumers, the optimal solution is to set price equal to marginal cost in order to induce the efficient level of consumption and maximise total surplus. The surplus is then extracted through the fixed fee. Under a uniform price the monopolist is forced to use the price per unit to make profit, so the price is set above marginal cost.

- c. Welfare is defined as profit plus consumer surplus. Welfare is maximised under a two-part tariff because the efficient level of consumption is induced. However, the consumers are better off under a uniform price, because the monopolist cannot extract all their surplus in that case. A detailed discussion of the welfare effects of price discrimination can be found in Chapter 7 of the subject guide.
- d. Suppose first that the monopolist serves both types of consumers. For a given price p , the monopolist will set the fixed fee equal to the consumer surplus of the low demand consumers (type 1), i.e. $A = (1 - p)^2/2$. The monopolist chooses p to maximise overall profit $(p - c)(1 - p) + (p - c)(1 - p/2) + 2(1 - p)^2/2$. It turns out that $p = 3/4$ and $A = 1/32$. The profit is $\pi = 9/64$.

The monopolist could instead serve only the high demand consumers (type 2). The price is then $p = c = 1/2$ and the optimal fixed fee is equal to the consumer surplus of type 2 consumers, i.e. $A = (1 - p/2)^2/2 = 9/32$. The resulting profit is $\pi = 9/32$ because only consumers of type 2 accept the contract and all profit comes from the fixed fee. Comparing profits, it is optimal for the monopolist to serve only the high demand consumers.

Comparing the two-part tariffs in parts (b) and (d), the price per unit is the same and equal to c . However, the fixed fee is higher in part (d), because the consumers served have a higher demand.

Question 7

Answer both parts of this question.

- a. Let two bars, A and B, sell the same beer at zero marginal cost in Smalltown. Smalltown consists of a single straight road of length 1, the Avenue, on which the bars must locate. There is a continuum of consumers living in the Avenue and each consumer wishes to buy one pint of beer. Consumers have a reservation value v . A consumer located at x , who buys the beer at a bar located at y , has to pay additionally to the price of the beer a travel cost $t = (x - y)^2$. Suppose that the price of beer is fixed by the government at p^* per pint, where $p^* < v$. Describe where the two bars would choose to locate, and explain your answer. How and why would your answer change if there were three bars in Smalltown? (12 marks)

Reading for this question

Subject guide, Chapter 6; Tirole (1988) Chapter 7; Church and Ware (2000) Chapter 11.

Approaching the question

When the price is fixed the two bars both locate at the centre (this can be shown by considering cases). This is the only Nash equilibrium, since in all other cases one of the bars can increase its market share (and therefore its profit) by deviating. In other words, in this case there is only a demand effect: each firm wants to move towards its rival because in this way it increases its market share, and therefore its profit.

With a fixed price and three bars, this Nash equilibrium breaks down: either bar can increase profit by moving slightly away from the centre since it captures almost half the demand rather than a third. In fact in this case, there is no Nash equilibrium in pure strategies (again, this can be shown by considering cases).

- b. A natural monopolist has total cost $C(Q) = 300 + 15Q$ and faces market demand $Q = 200 - 2P$. Derive the monopolist's output and profit and the consumer surplus when: (i) price is set equal to marginal cost; (ii) price is set equal to average cost; (iii) there is two-part pricing and the monopolist chooses the tariff to maximise profit; (iv) there is two-part pricing and a regulator chooses the tariff to maximise consumer surplus, subject to the monopolist breaking even. For parts (iii) and (iv), you may assume that there are N identical consumers. (13 marks)

Reading for this question

Subject guide, Chapters 8 and 11; Tirole (1988) Chapters 1 and 4; Church and Ware (2000) Chapters 4 and 25.

Approaching the question

- When $P = MC = 15$, we have $Q = 170$, $\pi = -300$, $CS = 0.5 \times 85 \times 170 = 7225$.
- In this case $P = AC \Leftrightarrow 100 - 0.5Q = 300/Q + 15 \Leftrightarrow 100Q - 0.5Q^2 = 300 + 15Q \Leftrightarrow Q^2 - 170Q + 600 = 0 \Leftrightarrow Q = 166.4$. We take the largest of the two solutions to the quadratic equation because it results in higher welfare. It follows that $P = 16.8$, $CS = 0.5 \times 83.2 \times 166.4 = 6922$, $\pi = 0$.
- The per unit price will be $P = MC = 15$. The fixed fee will be equal to CS in part (a) divided by N : $7225/N$. Also, $Q = 170$, $\pi = 7225 - 300 = 6925$, $CS = 0$.
- The per unit price will be $P = MC = 15$ to maximise consumer surplus. The fixed fee will be the fixed cost (300) divided by N : $300/N$. Then $Q = 170$, $\pi = 0$, $CS = 6925$.

Question 8

A profit maximising firm has the chance to research the cure for the common cold (CCC). If it spends $Z > 1$ on R&D, then it has probability $p(Z) = 1 - 1/Z$ of discovering the CCC (and zero probability otherwise). Assume that the firm has no other costs besides research costs and no other revenues other than those from selling the CCC if it discovers it. The present value of revenue from the CCC once discovered is Π . Units for research costs and CCC profits are millions of pounds.

- Assume that Π is sufficiently high that the firm finds it profitable to do research. How much will it spend on research as a function of Π ? (7 marks)
- What is the expected present value of profits in terms of Π if the firm optimally chooses Z ? What would happen if $\Pi < 4$? Explain. (7 marks)
- Assuming no discounting, so that the present value of profits is just the sum of all future profits, and an annual profit of 0.15 from monopoly exploitation of CCC, what is the minimum patent length that will induce the company to do any research? (7 marks)
- Assume the patent is the length you worked out in part (c). What is the maximum fixed license fee the company could charge for the CCC? (4 marks)

Reading for this question

Subject guide, Chapters 5 and 10; Tirole (1988) Chapters 1 and 10; Church and Ware (2000), Chapters 4 and 18.

Approaching the question

- The firm will maximise its expected profits by choosing the level of R&D spending Z . It will then get a present value of revenue Π with probability $p(Z)$. The expected present value of profits is therefore

$V(Z) = p(Z)\Pi - Z$. Differentiation with respect to Z leads to the first order condition:

$$p'(Z)\Pi - 1 = 0 \Leftrightarrow \Pi/(Z^2) - 1 = 0.$$

The solution $Z^* = \Pi^{1/2}$ is the optimal level of R&D spending.

- b. At the optimal level of spending, Z^* , expected profits are:

$$V^* = p(Z^*)\Pi - Z^* = (1 - 1/\Pi^{1/2}) \Pi - \Pi^{1/2} = \Pi^{1/2} (\Pi^{1/2} - 2).$$

This expression is increasing in Π for $\Pi > 1$. When $\Pi = 4$, $V^* = 0$. This means that if $\Pi < 4$, then the present value of doing research must be negative, and the firm would spend nothing on researching the CCC.

- c. After the patent expires anyone can produce the drug and there are no more profits to be made. This means that for n years the firm earns 0.15 per year, where n is the patent length. The total present value of revenue from the CCC is $0.15n$. We saw in part (b) that the profits must be at least 4 for the company to break even, so the shortest patent length which lets the company break even solves $0.15n = 4 \Leftrightarrow n = 26.667$.
- d. Once the firm has discovered the CCC, the net present value of profits is $0.15n = 4$. This is the maximum value of a license, since it is the maximum the firm buying the license could earn from selling the CCC.

Examiners' commentaries 2015

EC3099 Industrial economics – Zone B

Important note

This commentary reflects the examination and assessment arrangements for this course in the academic year 2014–15. The format and structure of the examination may change in future years, and any such changes will be publicised on the virtual learning environment (VLE).

Information about the Subject guide and the Essential reading references

Unless otherwise stated, all cross-references will be to the latest version of the Subject guide (2015). You should always attempt to use the most recent edition of any Essential reading textbook, even if the commentary and/or online reading list and/or Subject guide refers to an earlier edition. If different editions of Essential reading are listed, please check the VLE for reading supplements – if none are available, please use the contents list and index of the new edition to find the relevant section.

Comments on specific questions

Candidates should answer FOUR of the following EIGHT questions: TWO from Section A, and TWO from Section B. All questions carry equal marks.

Section A

Answer two questions from this section.

Question 1

Answer both parts of this question.

- a. A survey has found that small UK firms that produce customised components for UK manufacturers often do not rely on formal contracts for their relationship. Furthermore, over half of the firms claim that the technology used to support the relationship should be upgraded but this investment is not being made. Using the theory of transaction costs, describe why underinvestment often occurs in these relationships. (10 marks)

Reading for this question

Subject guide, Chapter 1; Tirole (1988) introductory chapter; Church and Ware (2000) Chapter 3.

Approaching the question

The relationships studied in the survey would tend to generate 'hold up' problems of the sort that reduce investment in relationships: they involve customised components, so that producers are making investments to adapt to the specific needs of buyers. As the buyers and sellers are separate, one would expect some opportunism in the relationship. There are few formal contracts in this sector, making it difficult to commit to payments that will be upheld ex post. It could be difficult to anticipate contingencies in any contract, even informal, that guides the relationship; so even if contracts exist, they are unlikely to be complete. Indeed, for

relatively small orders, one would expect that the costs of attempting to write a relatively complete contract would not be justified by the size of the contract. A very good answer would also describe a specific theoretical model to illustrate these arguments.

- b. **A recent report by McKinsey states that vertical integration is notoriously difficult to implement successfully and – when it turns out to be the wrong strategy – is costly to fix. As a result, the report recommends ‘don’t vertically integrate unless it is absolutely necessary to create or protect value.’ Describe how vertical integration can create or protect value and, given this, in which circumstances it might be a desirable strategy to follow for a firm.**
(15 marks)

Reading for this question

Subject guide, Chapters 1, 7 and 8; Tirole (1988) introductory Chapter and Chapters 3 and 4; Church and Ware (2000) Chapters 3, 5 and 22.

Approaching the question

The basic premise of the McKinsey report seems to be that it is best, as a default, not to vertically integrate. While markets often work well and competition in the buyer and seller market assures efficient exchange, one could give a more nuanced answer to this question from various perspectives.

First, the answer could describe double marginalisation where the number of buyers and sellers is not large on both sides of the market (typically, and in the subject guide, we look at a single buyer and a single seller). This basic externality would argue for vertical integration so as to prevent price rising too far, but in fact there are a number of vertical contracts that can at least partially resolve this problem, including two part tariffs and vertical restraints (such as quantity forcing or pricing constraints). This can be extended to the case of service provision, where again some kind of vertical restraint (including two part tariffs, but also including service contracts and other types of restraints) could be used to correct the externality that tends to result in underprovision of services. This is not a given, however, as the downstream market structure (e.g. a large number of competing retailers) can tend to control this sort of externality. If vertical restraints can go a long way towards resolving these vertical externalities, why integrate?

One reason might be transaction costs – see the answer to part (a) above. Candidates could outline the transaction cost argument for when markets fail, and could also include some kind of summary intuition for this relying on small numbers bargaining, high asset specificity, or some kind of information failure in the contracting.

Vertical integration can also make sense for price discrimination reasons and market power reasons. Price discrimination may require control of resale, which can sometimes be facilitated by vertical integration into certain customer segments. It can also be used to promote barriers to entry, for example by forcing entrants to set up their own distribution network if they wish to enter. These points are developed in the subject guide.

Question 2

Answer both parts of this question.

- a. **Explain why cartels tend to be unstable. How might the members of a cartel try to increase its stability?** (10 marks)

Reading for this question

Subject guide, Chapter 4; Tirole (1988) Chapter 6; Church and Ware (2000) Chapter 10.

Approaching the question

The answer to this question should begin by analysing the incentives to collude as opposed to the incentives to defect from a cartel agreement in the context of a formal model of collusion as well as more generally. Factors that hinder or facilitate cartel stability should be discussed, and this could then provide a basis for assessing the ways cartel stability can be increased by firms. The emphasis should be on factors that can be affected by cartel members and not on exogenous industry characteristics.

- b. **How and why do price wars occur? Answer with reference to three different theories of price wars and discuss the evidence that exists supporting each as a good explanation of price wars. Is any one of these models a "better" description of price wars? Explain.** (15 marks)

Reading for this question

Subject guide, Chapter 4; Tirole (1988) Chapter 6; Church and Ware (2000) Chapter 10.

Approaching the question

There are several theories that predict that price wars will occur between rational firms. A starting point for the discussion, including some empirical evidence, is provided in Chapter 4 of the subject guide.

Three theories are put forward. One is the Green-Porter model, where there is uncertainty about the level of demand when firms choose prices in each period. A firm cannot tell when it does badly in a period whether this is because demand was low or because some other firm cheated on a price agreement. Hence, even if firms collude (as they do in the subgame perfect equilibrium of the model), there are cases where a demand shock triggers a price war that lasts for several periods. This sort of 'accidental' price war is necessary to discipline behaviour. Without such occasional reversions, the equilibrium of (tacit) collusion could not be sustained because there would be too much of an incentive to cheat under the cover of uncertainty about the cause of the low prices. Also, the firms cannot collude on the full monopoly price: this increases the 'temptation' to cheat too much when there is imperfect observability of cheating. Green and Porter tested their model on late 19th century railroad price wars and found some empirical evidence to support it.

Rotemberg and Saloner postulate that demand fluctuates randomly but it is observable in each period before the price is set. Firms can also observe the past actions of their rivals. In such a case, the gain from cheating is bigger when demand is high than when it is low because the payoff from cheating increases with high demand. This means that firms must adjust the collusive agreement: they decrease the collusive price in booms so that the payoff from cheating shrinks and the incentive to cheat is reduced. No price wars occur in equilibrium but prices do move countercyclically. This is the opposite of Green and Porter's result. Some evidence consistent with the model was provided by Rotemberg and Saloner.

Finally, Slade proposes that firms have imperfect information about either demand or cost of rivals – but firms may have information of their own that can be inferred from their actions. Hence, a price cut can be a signal of the true cost of the firm or of demand. Firms, then, periodically cut prices, but these are the reflection of firms' updating their knowledge about the underlying competitive conditions of the industry and so reflect a move to a new collusive equilibrium. Levenstein and Levenstein and Suslow provide some support for this theory and Slade also provides evidence of price wars in downturns which could be consistent with this theory (as well as Green and Porter's theory).

Question 3

Using any suitable economic models, describe at least two different ways in which incumbent firms can deter the entry of rivals in a market.

Reading for this question

Subject guide, Chapters 5 and 6; Tirole (1988) Chapter 8; Church and Ware (2000) Chapters 13–16.

Approaching the question

Various examples of entry deterrence are described in detail in the subject guide: capacity expansion and 'overinvestment' (Chapter 5), and product proliferation (Chapter 6). Bundling is also briefly mentioned. Candidates should outline the models, examine critically the key assumptions necessary for entry deterrence to work, summarise the results and explain the intuition.

Question 4

'A major difficulty with the implementation of competition policy stems from the fact that many business practices which unambiguously reduce welfare are difficult to detect, while many business practices which are easy to detect have ambiguous welfare implications.' Discuss.

Reading for this question

Subject guide, Chapter 10; Tirole (1988) Chapters 3, 4, 6 and 9; Church and Ware (2000) various chapters.

Approaching the question

A good answer should begin by discussing business practices which unambiguously reduce welfare but are difficult to detect, such as collusion and predatory pricing, focusing on why these practices have adverse welfare effects and why they are difficult to detect. Circumstances where the welfare effects are not necessarily unambiguously negative could also be discussed. Next, the answer should examine business practices which are relatively easy to detect but have ambiguous welfare implications, such as vertical restraints and price discrimination, again focusing on the reasons why such practices are relatively easy to detect and why their welfare effects are ambiguous.

A very good answer would provide details, complement the theoretical arguments with relevant empirical evidence and may also briefly mention how competition authorities in various parts of the world are tackling these problems in practice.

Section B

Answer two questions from this section.

Question 4

The profit of a firm can take one of two values, Π_1 and Π_2 , where $\Pi_2 - \Pi_1 > 10$. The firm is run by a manager who chooses between two levels of effort, $e = 1$ (high) and $e = 0$ (low). The manager's utility function is $U = w^{1/2} - e$, where w is her wage. Whether the firm makes Π_1 or Π_2 depends on the manager's effort and on the firm's environment, which is uncertain. In particular, if the manager's effort is high, the profit is Π_2 with probability 0.8 and Π_1 with probability 0.2. If the manager's effort is low, the profit is Π_2 with probability 0.3 and Π_1 with probability 0.7. Before the manager decides on the level of effort, the owners of the firm choose a contract for the manager which specifies the value of w for each of the two possible values of Π . The owners' objective is to maximise expected net profit $E(\Pi - w)$. Given the incentive scheme chosen by the owners, the manager decides whether to take the job and, if she accepts, chooses e to maximise her expected utility $E(U)$. Her reservation wage is $w_0 = 4$. After the manager has made her choice, the profit is observed and the manager gets paid.

- What is the optimal contract if the owners can observe the manager's effort? (9 marks)
- What is the optimal contract if the owners cannot observe the manager's effort? (12 marks)
- Show that the net profit of the owners is lower if the manager's effort is unobservable than if it is observable. (4 marks)

Reading for this question

Subject guide, Chapter 2; Tirole (1988) introductory chapter; Church and Ware (2000) Chapter 3.

Approaching the question

- If the effort is observable, the owners can impose the level of effort they prefer. If they want no effort ($e = 0$), then they should give the reservation wage $w_0 = 4$ (note that in this case the manager obtains a reservation utility of $U_0 = w_0^{1/2} - 0 = 2$). Net expected profit will then be $0.3\Pi_2 + 0.7\Pi_1 - 4$. If the owners want high effort ($e = 1$), they should pay the manager a wage sufficient to guarantee him or her a utility of $U_0 = 2$. So the wage must be at least 9 (so that $U = 9^{1/2} - 1 = 2 = U_0$). Net expected profit will be $0.8\Pi_2 + 0.2\Pi_1 - 9$.

Clearly, the owners will choose to impose high effort if and only if $0.8\Pi_2 + 0.2\Pi_1 - 9 > 0.3\Pi_2 + 0.7\Pi_1 - 4 \Leftrightarrow \Pi_2 - \Pi_1 > 10$. Since the question has specified that $\Pi_2 - \Pi_1 > 10$, we conclude that the owners will choose to impose high effort in the case where effort is observable.

- If the effort is unobservable, the owners cannot simply impose a level of effort. Instead they may want to design an incentive scheme for the manager. Of course, if they want $e = 0$, all they need to do is give again the reservation wage $w_0 = 4$. Net expected profit will then be $0.3\Pi_2 + 0.7\Pi_1 - 4$. If they want $e = 1$, however, they will choose an incentive scheme such that to each realised level of profit corresponds a wage level. Formally, the owners must design a wage structure $w_i(\Pi_i)$, $i = 1, 2$, that maximises their expected net profit

$$0.8(\Pi_2 - w_2) + 0.2(\Pi_1 - w_1)$$

subject to a 'participation constraint'

$$0.8(w_2^{1/2} - 1) + 0.2(w_1^{1/2} - 1) \geq 2$$

and an 'incentive-compatibility constraint'

$$0.8(w_2^{1/2} - 1) + 0.2(w_1^{1/2} - 1) \geq 0.3w_2^{1/2} + 0.7w_1^{1/2} .$$

This maximisation problem is easy to solve because both constraints are satisfied with equality. We get a system of two equations in w_1 and w_2 . Solving we obtain $w_1 = 1.96$ and $w_2 = 11.56$. These are the wage levels that maximise the owners' expected net profit, which is therefore equal to $0.8\Pi_2 + 0.2\Pi_1 - 9.64$. Clearly, the owners will choose to impose high effort if and only if $0.8\Pi_2 + 0.2\Pi_1 - 9.64 > 0.3\Pi_2 + 0.7\Pi_1 - 4 \Leftrightarrow \Pi_2 - \Pi_1 > 11.28$, which may or may not hold. If $\Pi_2 - \Pi_1 > 11.28$, the owners will implement the incentive scheme and induce high effort ($e = 1$), but if $10 < \Pi_2 - \Pi_1 < 11.28$, they will prefer $e = 0$ and will therefore just give a flat wage equal to 4.

- c. There are two cases, depending on whether $e = 1$ or $e = 0$ is the optimal contract for the owners under part (b). In both cases it is easy to show that the statement under part (c) holds.

Question 6

Consider a market where N firms produce a homogeneous product and compete by simultaneously setting quantities. The inverse demand function has the general form $P = P(Q) = P(q_1 + q_2 + q_3 + \dots + q_N)$, where q_i is the quantity produced by firm i and P is the market price. The demand curve is downward sloping, so $P'(Q) < 0$. The total cost of firm i is given by $C_i(q_i)$.

- a. Show that $(P - MC_i)/P = s_i/\varepsilon$, where MC denotes the marginal cost, s_i is the market share of firm i and ε is the absolute value of the price elasticity of demand. (7 marks)
- b. Derive a 'weighted Lerner index' for the industry as a whole that is directly related to the Herfindahl index of market concentration, $H = \sum_i s_i^2$. (6 marks)
- c. From your answer to part (b), can you therefore conclude that an increase in industry concentration will cause an increase in the industry price-cost margin? Explain why or why not. (12 marks)

Reading for this question

Subject guide, Chapters 3 and 9; Tirole (1988) Chapter 5; Church and Ware (2000) Chapter 8 and 12.

Approaching the question

- a. Firm i chooses q_i to maximise its profit $\Pi^i = q_i P(q_i + Q_{-i}) - C_i(q_i)$, where

$Q_{-i} = q_1 + q_2 + \dots + q_{i-1} + q_{i+1} + \dots + q_N$ is taken as given.

$$\text{The FOC is: } \frac{\partial \Pi^i}{\partial q_i} = q_i \frac{dP(q_i + Q_{-i})}{dq_i} + P(q_i + Q_{-i}) - \frac{dC_i(q_i)}{dq_i} = 0.$$

$$\text{This can be written as: } \frac{P - MC_i}{P} = -\frac{q_i}{P} \frac{dP}{dQ} = -\frac{q_i}{Q} \frac{Q}{P} \frac{dP}{dQ} = \frac{s_i}{\varepsilon} .$$

- b. The weighted Lerner index for the industry can be defined as

$$\sum_i s_i \left(\frac{P - MC_i}{P} \right) = \sum_i \frac{s_i^2}{\varepsilon} = \frac{H}{\varepsilon} ,$$

where $H = \sum_i s_i^2$ is the Herfindahl index, a measure of industry

concentration: H takes values between 0 and 1, with H = 1 being monopoly.

- c. In a Cournot oligopoly, an exogenous increase in H – because of a horizontal merger, say – will cause an increase in the weighted Lerner index (a measure of market power).

However, concentration is ultimately an endogenous variable, driven by fundamental economic factors like technology, demand and the industry competitive regime. Therefore when we observe both a high H and a high price-cost margin in an industry, we cannot conclude that the former necessarily causes the latter, since both may be driven by a third variable (one candidate is efficiency differences among firms).

Moreover, high concentration need not be associated with a high price-cost margin at all, as when tougher competition because of deregulation or trade liberalisation, say, causes firm exit and mergers – and therefore a rise in concentration – and at the same time a decline in the price-cost margin.

Question 7

Answer both parts of this question.

- a. Let two bars, A and B, sell the same beer at zero marginal cost in Smalltown. Smalltown consists of a single straight road of length 1, the Avenue, on which the bars must locate. There is a continuum of consumers living in the Avenue and each consumer wishes to buy one pint of beer. Consumers have a reservation value v . A consumer located at x , who buys the beer at a bar located at y , has to pay additionally to the price of the beer a travel cost $t = (x - y)^2$. Suppose that the price of beer is fixed by the government at p^* per pint, where $p^* < v$. Describe where the two bars would choose to locate, and explain your answer. How and why would your answer change if the two bars were allowed to set the price of beer? (12 marks)

Reading for this question

Subject guide, Chapter 6; Tirole (1988) Chapter 7; Church and Ware (2000) Chapter 11.

Approaching the question

When the price is fixed the two bars both locate at the centre (this can be shown by considering cases). This is the only Nash equilibrium, since in all other cases one of the bars can increase its market share (and therefore its profit) by deviating. In other words, in this case there is only a demand effect: each firm wants to move towards its rival because in this way it increases its market share, and therefore its profit.

If the price is not fixed, then in addition to the demand effect, there is a strategic effect: each firm wants to move away from its rival because in this way products become more differentiated, price competition is less intense, and profits increase. The interplay of the two effects can lead to some differentiation or even maximal differentiation (location at the ends of the line).

- b. A natural monopolist has total cost $C(Q) = 300 + 15Q$ and faces market demand $Q = 200 - 2P$. Derive the monopolist's output and profit and the consumer surplus when: (i) price is set equal to marginal cost; (ii) price is set equal to average cost; (iii) there is two-part pricing and the monopolist chooses the tariff to maximise profit; (iv) there is two-part pricing and a

regulator chooses the tariff to maximise consumer surplus, subject to the monopolist breaking even. For parts (iii) and (iv), you may assume that there are N identical consumers. (13 marks)

Reading for this question

Subject guide, Chapters 8 and 11; Tirole (1988) Chapters 1 and 4; Church and Ware (2000) Chapters 4 and 25.

Approaching the question

- i. When $P = MC = 15$, we have $Q = 170$, $\pi = -300$, $CS = 0.5 \times 85 \times 170 = 7225$.
- ii. In this case $P = AC \Leftrightarrow 100 - 0.5Q = 300/Q + 15 \Leftrightarrow 100Q - 0.5Q^2 = 300 + 15Q \Leftrightarrow Q^2 - 170Q + 600 = 0 \Leftrightarrow Q = 166.4$. We take the largest of the two solutions to the quadratic equation because it results in higher welfare. It follows that $P = 16.8$, $CS = 0.5 \times 83.2 \times 166.4 = 6922$, $\pi = 0$.
- iii. The per unit price will be $P = MC = 15$. The fixed fee will be equal to CS in part (a) divided by N : $7225/N$. Also, $Q = 170$, $\pi = 7225 - 300 = 6925$, $CS = 0$.
- iv. The per unit price will be $P = MC = 15$ to maximise consumer surplus. The fixed fee will be the fixed cost (300) divided by N : $300/N$. Then $Q = 170$, $\pi = 0$, $CS = 6925$.

Question 8

A monopoly manufactures a good at zero cost. There is a monopoly retailer downstream who purchases this product from the manufacturer at price w and sells it to consumers at price p . In addition, the retailer undertakes advertising (a fixed cost) that affects the final demand for the good. In particular, final demand depends on both price p and advertising A and is given by $Q = 1 - p + \beta A$, where $0 < \beta < \sqrt{2}$. The cost of advertising to the retailer is $C(A) = A^2/2$. The retailer has zero cost of production (apart from what he pays to the manufacturer). The two firms play a two-stage game: at stage 1, the manufacturer sets his wholesale price w ; then, at stage 2, the retailer sets his retail price p and advertising level A (the latter two at the same time).

- a. Compute the subgame perfect equilibrium prices and advertising levels, and the profits for manufacturer and retailer. (5 marks)
- b. Now suppose that the manufacturer owns the retailer and sets the retail price and advertising himself. Compute the optimal levels of retail price and advertising, and profit, and explain how and why they differ from those in part (a). (5 marks)
- c. Going back to the case where the manufacturer and the retailer are separate, describe how the manufacturer could design a vertical contract to restore the joint profit maximising solution. (5 marks)

Now suppose that instead of a single retailer there are two retailers of this product who compete in prices. Demand depends on the total amount of advertising, A , set by the two retailers: $Q = 1 - p + \beta A$. The retailers simultaneously set advertising first, and then they simultaneously set prices (hence the retailers' subgame has two stages and the overall game has three stages).

- d. Derive the subgame perfect equilibrium prices and advertising levels for the retailers and the profit earned by the manufacturer in this case. (5 marks)
- e. In the absence of vertical restraints or integration, is the manufacturer better off with a monopoly retailer as in part (a) or with two competing retailers as in part (d)? Explain. (5 marks)

Reading for this question

Subject guide, Chapter 8; Tirole (1988) Chapter 4; Church and Ware (2000) Chapter 22.

Approaching the question

- a. We proceed by backward induction. Taking the wholesale price, w , as given, the retailer chooses the retail price and advertising levels in order to solve:

$$\max_{p,A} (p-w)(1-p+\beta A) - \frac{A^2}{2}$$

This problem has two first-order conditions. Using them and solving we get

$$p(w) = w + \frac{1-w}{2-\beta^2} \quad \text{and} \quad A(w) = \beta \frac{1-w}{2-\beta^2}, \quad \text{so} \quad Q(w) = \frac{1-w}{2-\beta^2}.$$

The manufacturer anticipates this demand and chooses his wholesale price to maximize his profit, $wQ(w)$, which yields the solution

$$w^a = \frac{1}{2} \Rightarrow p^a = \frac{1}{2} + \frac{1}{2(2-\beta^2)}, \quad A^a = \frac{\beta}{2(2-\beta^2)}.$$

The profit of the retailer is $\pi_r^a = 1/[8(2-\beta^2)]$ and the profit of the manufacturer is $\pi_m^a = 2\pi_r^a$.

- b. The single vertically integrated monopolist does not use a wholesale price but instead chooses p and A directly by solving:

$$\max_{p,A} p(1-p+\beta A) - \frac{A^2}{2}$$

The first order conditions are:

$$\frac{\partial \pi^J}{\partial p} = 1 + \beta A - 2p = 0$$

$$\frac{\partial \pi^J}{\partial A} = p\beta - A = 0$$

This is identical to the retailer's problem in (a) for the case where $w = 0$, which we can simply use in the above expressions to obtain the solution. The price under integration is $p^J = 1/(2-\beta^2)$, the advertising level is $A^J = \frac{\beta}{2-\beta^2}$ and the total profit of the integrated firm is given

by $\pi^J = 1/[2(2-\beta^2)] = 4\pi_r^a$. This profit exceeds the sum of the

manufacturer's and the retailer's profits when they act as successive monopolies, which is $3\pi_r^a$. The reason for this difference is that the

decentralised setup suffers from the double marginalisation problem as well as by underprovision of advertising by the retailer.

- c. The manufacturer can use a two-part tariff: he prices the good at marginal cost (zero here) to the retailer, which obviously results in the integrated-monopolist price and advertising levels, and also charges

a fixed fee which determines how the (now maximal) joint profit is distributed between manufacturer and retailer. The fixed fee can be set to ensure that both parties agree on the contract. This vertical contract increases efficiency unambiguously as both consumer surplus (through a lower consumer price) and joint profit increase.

Note that resale price maintenance by itself fails to maximise joint profit because of the presence of advertising: even if the retail price were fixed to p_j , advertising would be distorted downward whenever the manufacturer charged a wholesale price above marginal cost (which he would in order to make profit).

- d. Given a wholesale price, w , and starting with the pricing subgame (after advertising levels have been chosen and observed), it is clear that for any advertising levels there is price (Bertrand) competition leading to marginal cost pricing, i.e. both retailers' price will equal w in any case and both will make zero profit at this stage (any costs of advertising are already sunk at this stage). Knowing this, neither firm will advertise, because advertising is costly and price competition does not allow them to recoup these costs. The problem here is that although advertising increases demand, it does so for both firms (an externality) and does not yield any returns due to subsequent price competition. Anticipating this result – that competitive retailers will not advertise – in the first stage, the manufacturer faces demand $1 - w$ and maximises profits $w(1 - w)$ with optimal wholesale price $w^d = 1/2$, leading to profits $\pi_m^d = 1/4$.
- e. We compare manufacturer profits in parts (a) and (d). Having a monopolist retailer is better than Bertrand-competing retailers whenever $\pi_m^a > \pi_m^d$, which is equivalent to the condition $\beta > 1$.

What is the economic intuition for this result? The manufacturer faces a trade-off between two externalities: (perfect) competition among retailers solves the double marginalization problem, but at the cost of having no advertising. A monopoly retailer, on the other hand, fully internalises the advertising externality, but at the cost of an inefficient extra price mark-up. The latter arrangement is better for the manufacturer when advertising is sufficiently important in increasing demand (as captured by a high β).