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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

Industrial Economics

Wednesday, 4 May 2016 : 14:30 to 17:30

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. Describe the transaction costs-property rights approach to the theory of the firm, including a careful examination of the key elements of this approach and discussion of the basic theoretical predictions. What is the empirical support for this approach? **(25 marks)**

2. Answer both parts of this question.
 - (a) 'Firms which produce identical products never locate close to each other.' Discuss this statement, with reference to the literature on horizontal product differentiation. **(15 marks)**

 - (b) Caffè is a small shop located next to the Department of Economics where generations of economics students have bought their coffee in the breaks. Mr. George, the owner of Caffè, is a keen user of price discrimination. In particular, he sells either one cup of coffee for £1 or 10 cups of coffee for £8. As most people can only drink one cup of coffee at a time, people that buy 10 cups are allowed to spread the consumption over time using a system with a card. What type of price discrimination is this? Discuss how price discrimination could work in this particular example. Mr. George often hears students saying: 'No, I do not want to buy the card for 10 cups of coffee, because then I drink too much coffee'. Based on your knowledge about price discrimination, do you think that students with a card drink too much coffee? Explain your answer. **(10 marks)**

3. 'Predatory pricing is never a rational strategy for firms.' Discuss this statement with reference to economic theories of predation, and briefly outline policy responses to predatory pricing. **(25 marks)**

4. 'Asymmetric information is a cause of inefficiency in markets.' Discuss this statement with reference to (i) markets for experience goods and (ii) research and development activities of firms. Outline some possible responses, including government policy, to the problem of asymmetric information. **(25 marks)**

SECTION B

Answer two questions from this section.

5. Two firms, 1 and 2, compete in quantities in a market for a homogeneous good. The inverse demand function is $P(Q) = 20 - Q$, where Q is total industry output. Both firms have zero marginal cost.
- (a) Suppose that firm 1 chooses its quantity first. After observing the quantity chosen by firm 1, firm 2 chooses its quantity. Derive the equilibrium quantities and the equilibrium profits of the two firms. Compare the equilibrium quantities and profits and explain the intuition for why they differ across the two firms. **(8 marks)**
- (b) How might your answer in part (a) change if firms chose prices rather than quantities? **(4 marks)**

Consider now the same market as above, but suppose that firm 1 is an incumbent while firm 2 has to incur a fixed cost f to enter the market. Again firm 1 chooses its quantity first. Firm 2 observes the quantity chosen by firm 1 and has to take two decisions: whether to enter the market or not, and (if it decides to enter the market) how much to produce. Assume that if firm 2 is indifferent between entering and not entering, it does not enter.

- (c) Find the optimal quantity of firm 1 and the optimal decisions of firm 2 (entry/no entry and quantity produced) when $f = 9$. **(7 marks)**
- (d) Do the decisions of the two firms change if $f = 1$? Compare with your result in part (c) and provide intuition. **(6 marks)**
6. Consider a horizontally differentiated market where consumers are uniformly distributed on a line of length one. Each consumer buys one unit of a brand product. In addition to the money price, consumers incur linear transport costs: cost of t per unit of distance travelled. An incumbent monopolist produces two brands, one at the left-hand end of the line, call it L, and the other at the right-hand end, R. Suppose that a second firm enters with an identical brand at point L. Unit production costs are zero.
- (a) If the incumbent continues to produce both brands after entry has occurred, calculate the equilibrium prices and profits for the incumbent and the entrant. **(10 marks)**
- (b) Now suppose the incumbent decides to withdraw its brand at point L after entry has occurred. Calculate the new equilibrium prices and profits for the two firms. What will the monopolist choose to do once entry occurs, produce only its brand at R or produce both brands? **(8 marks)**
- (c) Discuss, using the results above as well as more generally, the factors that determine the credibility of strategic brand proliferation. **(7 marks)**

7. Two manufacturers produce a differentiated product. Their goods are distributed through retailers and each manufacturer grants exclusive territories to the retailers carrying his good. Hence intra-brand competition is eliminated and the only competition is between good 1 and good 2 in any given territory. Final demand for good 1 within any given territory is given by $q_1 = 1 - p_1 + bp_2$, while final demand for good 2 within any given territory is given by $q_2 = 1 - p_2 + bp_1$, where $0 < b < 1$ (so the own-price effect on demand is stronger than the effect of the rival's price). Production and retail costs are zero. The firms play a two-stage game. First the manufacturers simultaneously set two-part tariffs $T_i(q_i) = F_i + w_i q_i$, $i = 1, 2$. Then the retailers, after observing both two-part tariffs, simultaneously set retail prices.
- (a) Compute the subgame-perfect equilibrium prices and profits for the retailers and the manufacturers in any given territory. **(17 marks)**
- (b) Discuss informally whether the granting of exclusive territories allows the manufacturers to increase their profits. Will welfare be higher or lower compared to the case without exclusive territories? Provide intuition for your answer. **(8 marks)**
8. Consider the following two-stage game. There is a large number of potential entrants in a market for a homogeneous product. At stage 1 firms simultaneously decide whether or not to enter at a cost of entry F . At stage 2 those firms that have entered simultaneously set quantities. The demand function is given by $Q = S/p$, where Q is total quantity produced and S is total expenditure on the product (here a measure of market size, and hence exogenously fixed). The marginal cost is constant and equal to c for all firms.
- (a) Derive the stage 2 Cournot-Nash equilibrium. **(6 marks)**
- (b) Derive the stage 2 equilibrium price, profit for each firm and industry profit, and examine how each is related to the number of firms N . **(6 marks)**
- (c) Compute the long-run equilibrium number of firms N^* and show how it depends on market size S and the cost of entry F . Provide intuition for these results. **(6 marks)**
- (d) Now suppose that at stage 2 firms collude to raise prices above the Cournot-Nash price that you computed in part (b). Do you expect the long-run equilibrium number of firms N^{COLL} to be higher or lower than N^* ? Explain. **(7 marks)**

END OF PAPER

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Industrial Economics

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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. Using any suitable economic models, describe at least two different reasons as to why firms can make considerable net profits in the long run even under conditions of free entry. **(25 marks)**

2. Answer both parts of this question.
 - (a) It is often claimed that collusion is harder to sustain in industries where firms face large and infrequent orders from buyers because infrequency of interaction between firms hinders collusion. Explain the theoretical basis for this claim. **(12 marks)**

 - (b) Is higher industry concentration always associated with higher profitability? Explain your answer. **(13 marks)**

3. 'Predatory pricing is never a rational strategy for firms.' Discuss this statement with reference to economic theories of predation, and briefly outline policy responses to predatory pricing. **(25 marks)**

4. 'Asymmetric information is a cause of inefficiency in markets.' Discuss this statement with reference to (i) markets for experience goods and (ii) research and development activities of firms. Outline some possible responses, including government policy, to the problem of asymmetric information. **(25 marks)**

SECTION B

Answer two questions from this section.

5. Answer both parts of this question.

- (a) Consider a market where N symmetric firms produce a homogeneous product and compete by simultaneously setting quantities. The inverse demand function is given by $P = a - Q$, where Q is the total quantity produced. The marginal cost of production is constant and equal to c for all firms. Derive the aggregate quantity produced at the Cournot-Nash equilibrium. Then derive the equilibrium price, the equilibrium profit for each firm, and the equilibrium industry profit, and show that all three are decreasing in N . **(13 marks)**
- (b) A monopolistic firm sells its product to two types of customers, business customers and other customers. Its total costs are given by $TC = 20 + 2Q$, where Q denotes total output. The total demand of business customers is given by $Q^B = 14 - p$. The total demand of other customers is given by $Q^T = 5 - 0.5p$. Assuming that third-degree price discrimination between the two groups is possible, calculate the prices that the firm will charge each group, the amount it will sell to each group, the consumer surplus of each group, and the firm's total profit. Then describe informally and provide intuition for how a ban on price discrimination would affect the consumer surplus of business customers, the consumer surplus of other customers and the firm's profit. **(12 marks)**

6. Consider a horizontally differentiated market where consumers are uniformly distributed on a line of length one. Each consumer buys one unit of a brand product. In addition to the money price, consumers incur linear transport costs: cost of t per unit of distance travelled. An incumbent monopolist produces two brands, one at the left-hand end of the line, call it L , and the other at the right-hand end, R . Suppose that a second firm enters with an identical brand at point L . Unit production costs are zero.

- (a) If the incumbent continues to produce both brands after entry has occurred, calculate the equilibrium prices and profits for the incumbent and the entrant. **(10 marks)**
- (b) Now suppose the incumbent decides to withdraw its brand at point L after entry has occurred. Calculate the new equilibrium prices and profits for the two firms. What will the monopolist choose to do once entry occurs, produce only its brand at R or produce both brands? **(8 marks)**
- (c) Discuss, using the results above as well as more generally, the factors that determine the credibility of strategic brand proliferation. **(7 marks)**

7. Two manufacturers produce a differentiated product. Their goods are distributed through retailers and each manufacturer grants exclusive territories to the retailers carrying his good. Hence intra-brand competition is eliminated and the only competition is between good 1 and good 2 in any given territory. Final demand for good 1 within any given territory is given by $q_1 = 1 - p_1 + bp_2$, while final demand for good 2 within any given territory is given by $q_2 = 1 - p_2 + bp_1$, where $0 < b < 1$ (so the own-price effect on demand is stronger than the effect of the rival's price). Production and retail costs are zero. The firms play a two-stage game. First the manufacturers simultaneously set two-part tariffs $T_i(q_i) = F_i + w_i q_i$, $i = 1, 2$. Then the retailers, after observing both two-part tariffs, simultaneously set retail prices.
- (a) Compute the subgame-perfect equilibrium prices and profits for the retailers and the manufacturers in any given territory. **(17 marks)**
- (b) Discuss informally whether the granting of exclusive territories allows the manufacturers to increase their profits. Will welfare be higher or lower compared to the case without exclusive territories? Provide intuition for your answer. **(8 marks)**
8. Consider a homogeneous good industry with inverse demand given by $p = 100 - 2(Q + q)$ where Q is the output of an incumbent firm and q is the output of a potential entrant to the market. The incumbent's total cost function is $C(Q) = 10Q$, whereas the cost function of the entrant is $C(q) = F + 20q$, where F is a sunk cost incurred to enter the market. The entrant observes the incumbent producing some units of output and expects this output level to be maintained.
- (a) Determine the incumbent's optimal output in the absence of entry. **(6 marks)**
- (b) Suppose entry occurs and the entrant takes the incumbent's output as given. Show that the entrant's equilibrium profit is decreasing in the incumbent's quantity. **(7 marks)**
- (c) Calculate the output that the incumbent should set to deter entry. **(7 marks)**
- (d) Discuss how the incumbent's decision to deter entry or not might depend on F and provide intuition. **(5 marks)**

END OF PAPER

Examiners' commentaries 2016

EC3099 Industrial economics

Important note

This commentary reflects the examination and assessment arrangements for this course in the academic year 2015–16. 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 (2011). 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 refer 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 course 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 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 section containing 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. Whatever the question, exposure to a wider set of readings is usually necessary to understand in depth the economics involved and to 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 Further reading for that particular topic, then come back to the subject guide and attempt the various learning activities and sample examination questions.

Planning your time in the examination

Use your time efficiently and remember 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). However, you should avoid including material that is not relevant to the question.

Steps to improvement

- Your answers to problem-type questions should not simply list mathematical results, they should 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 2016

EC3099 Industrial economics – Zone A

Important note

This commentary reflects the examination and assessment arrangements for this course in the academic year 2015–16. 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

Describe the transaction costs-property rights approach to the theory of the firm, including a careful examination of the key elements of this approach and discussion of the basic theoretical predictions. What is the empirical support for this approach? (25 marks)

Reading for this question

Subject guide (2015) Chapter 1.

Tirole, J. *The theory of industrial organization*. (Cambridge, MA: MIT Press, 1988) [ISBN 9780262200714] Introductory chapter.

Church, J.R. and R. Ware *Industrial organization: a strategic approach*. (Irwin McGraw-Hill, 2000) [ISBN 9780256205718] Chapter 3.

Approaching the question

A good answer to this question should start by explaining what the transaction costs-property rights approach to the theory of the firm tries to do: that is, it provides an explanation for the size and structure of firms. Candidates should describe and discuss the three key elements of the transaction costs approach (investment specificity, opportunistic behaviour, and bounded rationality), leading on to a statement of the key theoretical prediction of the transaction costs approach: namely, that the more specific the investments required for the production and sale of a product, the higher the probability of integration (common ownership), as opposed

to a contractual relationship between separate firms. A very good answer would illustrate these ideas by outlining an appropriate formal model.

Candidates should clarify why integration solves or reduces the problem of potential opportunistic behaviour, with reference to the literature on property rights. The idea being that integration reduces opportunistic behaviour because if, for example, firm A acquires firm B, then the manager of firm B loses control of the physical assets of firm B, so they have much less bargaining power.

Question 2

Answer both parts of this question.

- a. **'Firms which produce identical products never locate close to each other.'**
Discuss this statement, with reference to the literature on horizontal product differentiation. (15 marks)

Reading for this question

Subject guide (2015), Chapter 6; Tirole (1988) Chapter 7; Church and Ware (2000) Chapter 11.

Approaching the question

A good answer to this question would discuss in some detail the economics of horizontal product differentiation. A very good answer would, in addition, describe a formal model and discuss the economic mechanisms that drive the location choice of firms.

Additional insight can be obtained by comparing the case where two firms choose locations, and then prices, to the case where price is exogenous and the only choice variable is location. Possible extensions to this answer include models with more than two firms.

An important point to discuss is the interaction between various effects. The demand effect (i.e. the fact that each firm wants to move towards its rival because in this way it increases its market share, and therefore its profit) works against differentiation. The competition effect (namely, that 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) promotes differentiation. In addition, the presence of positive externalities that induce firms to locate close to one another, will also work against differentiation. For instance, when consumers do not know the characteristics or prices of products sold by all firms in a market, lowering consumer search costs by locating close to one another may lead to higher overall demand.

- a. Caffè is a small shop located next to the Department of Economics where generations of economics students have bought their coffee in the breaks. Mr George, the owner of Caffè, is a keen user of price discrimination. In particular, he sells either one cup of coffee for £1 or 10 cups of coffee for £8. As most people can only drink one cup of coffee at a time, people that buy 10 cups are allowed to spread the consumption over time using a system with a card. What type of price discrimination is this? Discuss how price discrimination could work in this particular example. Mr George often hears students saying: 'No, I do not want to buy the card for 10 cups of coffee, because then I drink too much coffee'. Based on your knowledge about price discrimination, do you think that students with a card drink too much coffee? Explain your answer.

Reading for this question

Subject guide (2015), Chapter 7; Tirole (1988) Chapter 3; Church and Ware (2000) Chapter 5.

Approaching the question

Mr George does not in general know whether the type of consumer entering his shop is a low or high demand consumer. He therefore offers a menu of choices (card or single cup) and lets the consumer choose. His objective is to induce the consumers to self-select. This is second-degree price discrimination.

A good answer to this question must briefly describe the basic principles of second-degree price discrimination. In addition, a very good answer could also, for example, include the following considerations:

- There are costs associated with buying a card since the coffee is paid in advance and this involves an opportunity cost (the money could, for instance, have earned interest on a bank account instead).
- The consumer might never drink all 10 cups of coffee (for instance, if the card was lost).
- The more coffee a consumer drinks, the shorter the period they will need to store the card, so the lower the opportunity cost of buying the card and the lower the probability of losing it before consuming all 10 cups of coffee.

Mr George sorts the consumers into two segments, a low demand segment that buys one cup of coffee at a time, and a high demand segment that buys a card. Assuming that consumers are homogenous within the two segments, the theory of price discrimination suggests that the high consumption segment pays the marginal cost of coffee and consumes the efficient amount. If so, the statement is false.

Question 3

'Predatory pricing is never a rational strategy for firms.' Discuss this statement with reference to economic theories of predation, and briefly outline policy responses to predatory pricing. (25 marks)

Reading for this question

Subject guide (2015), Chapter 5; Tirole (1988) Chapter 9; Church and Ware (2000) Chapter 21.

Approaching the question

Candidates should begin by defining predatory pricing, then summarise the arguments in support of the quotation. An economic rationale for predation as a rational strategy should then be provided in the form of a detailed discussion of two theories of predation; namely, the long purse theory and the reputation model. Finally, the answer should outline policy toward predation, including a discussion of the trade-off between simple rules and a 'rule of reason' approach.

Question 4

'Asymmetric information is a cause of inefficiency in markets.' Discuss this statement with reference to (i) markets for experience goods and (ii) research and development activities of firms. Outline some possible responses, including government policy, to the problem of asymmetric information. (25 marks)

Reading for this question

Subject guide (2015), Chapters 6 and 10; Tirole (1988) Chapter 2; Church and Ware (2000) Chapter 6.

Approaching the question

A good answer should begin by describing two types of asymmetric information: hidden actions, leading to problems of moral hazard; and hidden characteristics, resulting in adverse selection. You should then analyse in detail how these problems affect: (i) markets for experience goods; and (ii) research and development activities of firms.

Candidates should describe how, in the former case, the issue arises that product quality is not observable by consumers before a purchase and is learned only after the product is bought. This could lead to underprovision of quality or even the collapse of the market. In the latter case, information regarding an R&D project is often different between the prospective innovator and other parties (including banks and other potential external funding sources). This results in under-financing of innovation in the private market. A very good answer would illustrate this using particular examples and case studies.

The final part of the answer should outline different responses to these problems such as warranties, reputation acquired through repeat purchases, minimum quality standards or safety regulations, venture capital, government subsidies for R&D, and others.

Section B

Answer two questions from this section.

Question 5

Two firms, 1 and 2, compete in quantities in a market for a homogeneous good. The inverse demand function is $P(Q) = 20 - Q$, where Q is total industry output. Both firms have zero marginal cost.

- Suppose that firm 1 chooses its quantity first. After observing the quantity chosen by firm 1, firm 2 chooses its quantity. Derive the equilibrium quantities and the equilibrium profits of the two firms. Compare the equilibrium quantities and profits and explain the intuition for why they differ across the two firms. (8 marks)
- How might your answer in part (a) change if firms chose prices rather than quantities? (4 marks)
- Consider now the same market as above, but suppose that firm 1 is an incumbent while firm 2 has to incur a fixed cost f to enter the market. Again firm 1 chooses its quantity first. Firm 2 observes the quantity chosen by firm 1 and has to take two decisions: whether to enter the market or not, and (if it decides to enter the market) how much to produce. Assume that if firm 2 is indifferent between entering and not entering, it does not enter.

Find the optimal quantity of firm 1 and the optimal decisions of firm 2 (entry/no entry and quantity produced) when $f = 9$. (7 marks)

- Do the decisions of the two firms change if $f = 1$? Compare with your result in part (c) and provide intuition. (6 marks)

Reading for this question

Subject guide (2015), Chapter 5; Tirole (1988) Chapter 8; Church and Ware (2000) Chapters 13–16.

Approaching the question

- We proceed by backward induction. At stage 2, firm 2 chooses q_2 to maximise its profit $(20 - q_1 - q_2)q_2$, taking q_1 as given. The FOC gives the optimal response of firm 2: $q_2 = R_2(q_1) = (20 - q_1)/2$. The corresponding profit is $\pi_2 = (20 - q_1)^2/4$.

At stage 1 firm 1 anticipates firm 2's reaction function and chooses q_1 to maximise its profit $[(20 - q_1 - (20 - q_1)/2)]q_1$. This gives $q_1 = 10$, therefore $q_2 = 5 < q_1$, and also $\pi_1 = 50$ and $\pi_2 = 25 < \pi_1$. Firm 1 takes into account that a higher quantity q_1 induces firm 2 to produce less, since the firms' actions are strategic substitutes. Because of its first-mover advantage, firm 1 earns a higher profit than firm 2.

- b. There is no longer a first-mover advantage for firm 1. If firm 1 sets a price higher than marginal cost, firm 2 can undercut that price, obtain the entire demand and make positive profit, while firm 1 makes zero profit. Alternatively, firm 1 can set price equal to marginal cost, in which case both firms make zero profit whatever the price of firm 2 (provided it is not lower than marginal cost).
- c. Again we apply backward induction. At stage 2 firm 2 earns maximised profit $\pi_2 = (20 - q_1)^2/4 - f$ if it enters the market and zero if it does not enter. Therefore firm 2 will **not** enter if and only if $\pi_2 \leq 0 \Leftrightarrow (20 - q_1)^2/4 - f \leq 0$.

Now consider firm 1 at stage 1. For $f = 9$, firm 1 must choose one of the following two candidate quantities. If it (optimally) accommodates entry, $q_1 = 10 \Rightarrow \pi_1 = 50$ (from part (i)). To deter entry, it must set q_1 so that $(20 - q_1)^2/4 - f \leq 0 \Leftrightarrow 20 - 2\sqrt{9} \leq q_1 \leq 20 + 2\sqrt{9} \Leftrightarrow 14 \leq q_1 \leq 26$. Since $\partial\pi_1/\partial q_1 < 0$ for $q_1 > 10$ (conditional on $q_2 = 0$), firm 1 will choose the **minimum** quantity that ensures $\pi_2 = 0$. Hence $q_1 = 14 \Rightarrow \pi_1 = (20 - 14 - 0)14 = 84$.

What will firm 1 do, accommodate entry or deter entry? Its profit is higher when $q_1 = 14$ and entry of firm 2 is deterred, so firm 1 will set $q_1 = 14$. Firm 2 will choose **not** to enter.

- d. Again firm 2 will **not** enter if and only if $(20 - q_1)^2/4 - f \leq 0$. For $f = 1$, firm 1 must choose one of the following two candidate quantities. If it (optimally) accommodates entry, $q_1 = 10 \Rightarrow \pi_1 = 50$. To deter entry, it must set q_1 so that $(20 - q_1)^2/4 - f \leq 0 \Leftrightarrow 20 - 2\sqrt{1} \leq q_1 \leq 20 + 2\sqrt{1} \Leftrightarrow 18 \leq q_1 \leq 22$. Since $\partial\pi_1/\partial q_1 < 0$ for $q_1 > 10$ (conditional on $q_2 = 0$), firm 1 will choose the **minimum** quantity that ensures $\pi_2 = 0$. Hence $q_1 = 18 \Rightarrow \pi_1 = (20 - 18 - 0)18 = 36$.

What will firm 1 do? Its profit is higher when $q_1 = 10$ and firm 2 enters, so firm 1 will set $q_1 = 10$. Firm 2 will choose to enter and produce $q_2 = 5$.

It is only profitable for firm 1 to deter entry if the cost of entry is high for firm 2. Otherwise, entry deterrence is too costly, because it requires firm 1 to produce a very high quantity.

Question 6

Consider a horizontally differentiated market where consumers are uniformly distributed on a line of length one. Each consumer buys one unit of a brand product. In addition to the money price, consumers incur linear transport costs: cost of t per unit of distance travelled. An incumbent monopolist produces two brands, one at the left-hand end of the line, call it L, and the other at the right-hand end, R. Suppose that a second firm enters with an identical brand at point L. Unit production costs are zero.

- a. If the incumbent continues to produce both brands after entry has occurred, calculate the equilibrium prices and profits for the incumbent and the entrant. (10 marks)
- b. Now suppose the incumbent decides to withdraw its brand at point L after entry has occurred. Calculate the new equilibrium prices and profits for the

two firms. What will the monopolist choose to do once entry occurs, produce only its brand at R or produce both brands? (8 marks)

- c. Discuss, using the results above as well as more generally, the factors that determine the credibility of strategic brand proliferation. (7 marks)

Reading for this question

Subject guide (2015), Chapter 6; Tirole (1988) Chapter 7; Church and Ware (2000) Chapter 11.

Approaching the question

- a. If the incumbent continues to produce both brands after entry has occurred, there will be two identical brands at L. Price competition will drive their prices to marginal cost, which is zero. Both the incumbent and the entrant will make zero profit from their brand at L. Of course, the incumbent also has a brand at R and will make some profit from it. To find the demand for the brand at R, consider the marginal consumer who is located at distance y from L and is indifferent between L and R. Let $P_{I,R}$ denote the price of the incumbent's brand at R. We have: $0 + ty = P_{I,R} + t(1 - y) \Leftrightarrow y = \frac{1}{2} + P_{I,R}/2t$. Hence the incumbent's profit from its brand at R (as well its overall profit) will be $\Pi_{I,R} = P_{I,R} \times (1 - \frac{1}{2} - P_{I,R}/2t)$. The price that maximises this profit expression is $t/2$ and the corresponding equilibrium profit is $t/8$.
- b. If the incumbent drops the brand at L, only two brands remain: one produced by the entrant at E and one produced by the incumbent at R. Differentiation implies that the prices $P_{E,L}$ and $P_{I,R}$ will now be higher than marginal cost. For the marginal consumer located at distance y from L we now have: $P_{E,L} + ty = P_{I,R} + t(1 - y) \Leftrightarrow y = \frac{1}{2} + (P_{I,R} - P_{E,L})/2t$. The incumbent will choose $P_{I,R}$ to maximise $P_{I,R} \times [1 - \frac{1}{2} - (P_{I,R} - P_{E,L})/2t]$ and the entrant will choose $P_{E,L}$ to maximise $P_{E,L} \times [\frac{1}{2} + (P_{I,R} - P_{E,L})/2t]$. Solving the system of the two first-order conditions we obtain $P_{E,L} = P_{I,R} = t$ and corresponding equilibrium profits $t/2$. The incumbent monopolist's profit is now higher than in part a, therefore the incumbent will choose to drop the brand at L.
- c. This analysis implies that the incumbent would not be able to use a brand proliferation strategy to deter entry if the entry of the second firm were endogenous. Why? Note that the use of brand proliferation to deter entry involves strategically producing an excessive number of brands in order to decrease the potential demand for brands of new entrants. This strategy can work if (in addition to increasing returns to scale at the brand level and localised competition between brands) there is a sufficiently large cost of repositioning a brand in the product space or of withdrawing a brand. When this cost is zero or too low, an incumbent firm would not be committed to all its chosen locations, so entry could not be deterred. In our example, if there were a fixed cost k of dropping the brand at L, the incumbent would choose to continue to produce two brands if $t/2 - k > t/8 \Leftrightarrow k > 3t/8$. Knowing this, the second firm would not enter.

Question 7

Two manufacturers produce a differentiated product. Their goods are distributed through retailers and each manufacturer grants exclusive territories to the retailers carrying his good. Hence intra-brand competition is eliminated and the only competition is between good 1 and good 2 in any given territory. Final demand for good 1 within any given territory is given by $q_1 = 1 - p_1 + bp_2$, while final demand for good 2 within any given territory is given by $q_2 = 1 - p_2 + bp_1$, where $0 < b < 1$ (so the own-price effect on demand is stronger than the effect of the rival's price). Production and retail costs are zero. The firms play a two-stage game. First the manufacturers simultaneously set two-part tariffs $T_i(q_i) = F_i + w_i q_i$, $i = 1, 2$. Then the retailers, after observing both two-part tariffs, simultaneously set retail prices.

- Compute the subgame-perfect equilibrium prices and profits for the retailers and the manufacturers in any given territory. (17 marks)
- Discuss informally whether the granting of exclusive territories allows the manufacturers to increase their profits. Will welfare be higher or lower compared to the case without exclusive territories? Provide intuition for your answer. (8 marks)

Reading for this question

Subject guide (2015), Chapter 8; Tirole (1988) Chapter 4; Church and Ware (2000) Chapter 22.

Approaching the question

- The profit functions of the two competing retailers – one selling good 1, the other selling good 2 – in any given territory are $(p_1 - w_1)(1 - p_1 + bp_2)$ and $(p_2 - w_2)(1 - p_2 + bp_1)$, respectively, where w_1 and w_2 have already been set by the manufacturers and are taken as given by the retailers. The two retailers set retail prices simultaneously. Retailer i chooses p_i to maximise his profit taking p_j as given, where $i = 1, 2, j \neq i$. Solving the system of the two first-order conditions, we obtain equilibrium prices

$$p_i^R = \frac{2 + b + 2w_i + bw_j}{4 - b^2}$$

with corresponding quantities

$$q_i^R = 1 - p_i^R + bp_j^R = \frac{2 + b - 2w_i + b^2 w_i + bw_j}{4 - b^2}$$

where $i = 1, 2, j \neq i$.

Competition among the retailers takes place at stage 2 of a two-stage game. At stage 1 the manufacturers simultaneously choose two-part tariffs, each of them anticipating the way the retailers will act at stage 2. Manufacturer i , $i = 1, 2$, chooses a wholesale price w_i and a fixed fee F_i that the retailer of good i must pay if he wants to carry the good.

What do manufacturers do at stage 1? Firstly, each of them can use the fixed fee to extract all the profit made by his retailer at stage 2. Also, each of them may make some additional profit by charging a wholesale price above marginal cost (which is zero). The total profit of manufacturer 1 in any territory is therefore given by $w_1 q_1^R + F_1 = w_1 q_1^R + (p_1^R - w_1) q_1^R = p_1^R q_1^R$, an expression which is a function of w_1, w_2 and b (see above). Similarly for manufacturer 2. Manufacturer 1 then chooses w_1 to maximise $p_1^R q_1^R$ taking w_2 as given, and similarly manufacturer 2 chooses w_2 to maximise $p_2^R q_2^R$ taking w_1 as given.

Solving the system of the two first-order conditions, we get the equilibrium wholesale prices

$$\hat{w}_1 = \hat{w}_2 = \frac{b^2}{4 - 2b - b^2}.$$

Substituting into the respective profit functions $p_1^R q_1^R$ and $p_2^R q_2^R$, we obtain the equilibrium profits

$$\hat{\Pi}_1 = \hat{\Pi}_2 = \frac{4 - 2b^2}{(4 - 2b - b^2)^2}.$$

- b. When there are no exclusive territories, then in any given territory good 1 is distributed by a large number of retailers who all compete with each other. Assuming that there is no spatial differentiation among retailers in any given territory, the retail price of good 1, p_1 , is driven down to w_1 . Similarly, for good 2: $p_2 = w_2$. In other words, distribution by retailers with exclusive territories allows manufacturers to obtain a retail price which is higher, and therefore closer to the joint-profit maximising level, than if retailers faced intra-brand competition. Profits are also closer to the joint-profit maximising level and, by suitable choice of franchise fee, manufacturers can appropriate these profits for themselves. The result being that quantities sold – and therefore welfare – are lower than in the absence of exclusive territories.

Question 8

Consider the following two-stage game. There is a large number of potential entrants in a market for a homogeneous product. At stage 1 firms simultaneously decide whether or not to enter at a cost of entry F . At stage 2 those firms that have entered simultaneously set quantities. The demand function is given by $Q = S/p$, where Q is total quantity produced and S is total expenditure on the product (here a measure of market size, and hence exogenously fixed). The marginal cost is constant and equal to c for all firms.

- Derive the stage 2 Cournot-Nash equilibrium. (6 marks)
- Derive the stage 2 equilibrium price, profit for each firm and industry profit, and examine how each is related to the number of firms N . (6 marks)
- Compute the long-run equilibrium number of firms N^* and show how it depends on market size S and the cost of entry F . Provide intuition for these results. (6 marks)
- Now suppose that at stage 2 firms collude to raise prices above the Cournot-Nash price that you computed in part (b). Do you expect the long-run equilibrium number of firms N^{coll} to be higher or lower than N^* ? Explain. (7 marks)

Reading for this question

Subject guide (2015), Chapters 3 and 9; Tirole (1988) Chapter 5; Church and Ware (2000) Chapter 8.

Sutton, J. *Sunk costs and market structure*. (Cambridge, MA: MIT Press, 1991) [ISBN 9780262193054].

Approaching the question

- Suppose that N firms have entered at stage 1 and compute the stage 2 Cournot-Nash equilibrium quantities, price and profits. The first-order condition for profit maximisation for firm i is $SQ^{-1} - SQQ^{-2} - c = 0$,

where $Q = qN$ by symmetry. You should find that the stage 2 quantity for each firm is equal to $\bar{q} = S(N-1)/cN^2$.

- b. The stage 2 equilibrium price is equal to $\bar{p} = cN/(N-1)$ and the equilibrium profit for each firm is given by $\pi = S/N^2$. Industry profit is S/N . All these expressions are decreasing in N .
- c. At stage 1 firms enter as long as they can make a non-negative net profit. From the free-entry zero-profit condition we have $\bar{\pi} = F \Leftrightarrow S/N^2 = F \Leftrightarrow N^* = (S/F)^{1/2}$. The number of firms increases with market size and falls as the cost of entry rises.
- d. A formal answer is not necessary here (and may be tricky, as the joint monopoly outcome is not well defined for an isoelastic demand function). The idea is that, for any given number of firms N , each firm will make a larger profit under collusion than at the Cournot-Nash equilibrium. When N is allowed to vary due to free entry, this will result in a larger number of firms entering the market in the collusive equilibrium than in the Cournot-Nash equilibrium. This result is essentially driven by the free-entry zero-profit condition.

Examiners' commentaries 2016

EC3099 Industrial economics – Zone B

Important note

This commentary reflects the examination and assessment arrangements for this course in the academic year 2015–16. 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 (2011). 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 refer 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

Using any suitable economic models, describe at least two different reasons as to why firms can make considerable net profits in the long run even under conditions of free entry. (25 marks)

Reading for this question

Subject guide (2015) Chapters 5 and 6.

Tirole, J. *The theory of industrial organisation*. (Cambridge, MA: MIT Press, 1988) [ISBN 9780262200714] Chapters 6 and 7.

Church, J.R. and R. Ware *Industrial organization: a strategic approach*. (Irwin McGraw Hill, 2000) [ISBN 9780256205718] Chapters 11 and 13–16.

Approaching the question

One source of considerable net profits in the long run, under conditions of free entry, is the presence of vertical differentiation. The subject guide describes a model of vertical differentiation in which free entry does not lead to zero net profits at equilibrium. You should outline this model (or a related one), summarise the results and explain the intuition.

A second source of considerable net profits in the long run, under conditions of free entry, is the presence of first-mover advantages. One model that illustrates this in the context of a horizontally differentiated industry, is the model of entry deterrence through product proliferation by incumbent firms (described in the subject guide). Again, you should

present the model, examine critically the key assumptions necessary for the product proliferation strategy to work, derive the results, and explain the intuition. Or you can use a different model to illustrate the basic idea, as long as you take care to allow explicitly for free entry.

Question 2

Answer both parts of this question.

- e. It is often claimed that collusion is harder to sustain in industries where firms face large and infrequent orders from buyers because infrequency of interaction between firms hinders collusion. Explain the theoretical basis for this claim. (12 marks)

Reading for this question

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

Approaching the question

A good answer should start by briefly summarising how tacit collusion can be sustained through the use of trigger strategies in infinitely repeated games. The answer should point out that the analysis predicts that collusion is feasible if the discount factor that firms apply to future profits is at least as high as a certain critical value $\bar{\delta}$. Intuitively, collusion is feasible if firms care sufficiently about the future. Then the effect of infrequent interaction in this contexts should be discussed, both intuitively and formally. The argument being that, if interaction is infrequent, firms care less about the future. For instance, if firms meet every two periods, then the profit from collusion is:

$$\sum_{t=0}^{\infty} \delta^{2t} (\Pi^M / 2) = \frac{\Pi^M}{2} (1 + \delta^2 + \delta^4 + \dots) = \frac{\Pi^M}{2(1 - \delta^2)},$$

while if they meet every period it is

$$\sum_{t=0}^{\infty} \delta^t (\Pi^M / 2) = \frac{\Pi^M}{2} (1 + \delta + \delta^2 + \dots) = \frac{\Pi^M}{2(1 - \delta)},$$

where N is the number of firms. As a result, the critical value $\bar{\delta}$ is higher when interaction is infrequent, and hence collusion is less likely to be sustainable in that case.

- b. Is higher industry concentration always associated with higher profitability? Explain your answer. (13 marks)

Reading for this question

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

Sutton, J. *Sunk Costs and Market Structure*. (Cambridge, MA: MIT Press, 1991) [ISBN 9780262193054].

Approaching the question

You should begin by pointing out that there are at least two alternative mechanisms that can generate a positive link between concentration and profitability. First, an increase in concentration may facilitate collusion between firms, and hence, in the absence of additional entry, lead to an increase in profitability. Second, an increase in the degree of cost asymmetry among firms in an industry could raise both concentration and industry profit; however, note that this would imply a correlation between the two variables, not a causal link.

On the other hand, higher industry concentration is **not** always associated with higher profitability. To see this, one needs to treat concentration as an endogenous variable which is determined by a number of exogenous variables such as the size of the market, the level of sunk costs and the degree of competition in an industry. According to this approach, the profit of each firm is determined by a free-entry condition, so it depends largely on the level of entry costs, not concentration. In fact, since concentration may be the result of intense competitive pressure, it is even possible for industry profitability to be lower when concentration is higher – provided there is free entry.

Question 3

'Predatory pricing is never a rational strategy for firms.' Discuss this statement with reference to economic theories of predation, and briefly outline policy responses to predatory pricing. (25 marks)

Reading for this question

Subject guide, Chapter 5; Tirole (1988) Chapter 9; Church and Ware (2000) Chapter 21.

Approaching the question

You should begin by defining predatory pricing, then summarise the arguments in support of the quotation. Next, two theories of predation should be discussed in some detail to provide an economic rationale for predation as a rational strategy: the long purse theory and the reputation model. The final part of the answer should outline policy toward predation, including a discussion of the trade-off between simple rules and a 'rule of reason' approach.

Question 4

'Asymmetric information is a cause of inefficiency in markets.' Discuss this statement with reference to (i) markets for experience goods and (ii) research and development activities of firms. Outline some possible responses, including government policy, to the problem of asymmetric information. (25 marks)

Reading for this question

Subject guide, Chapters 6 and 10; Tirole (1988) Chapter 2; Church and Ware (2000) Chapter 6.

Approaching the question

A good answer should begin by describing two types of asymmetric information: hidden actions, leading to problems of moral hazard, and hidden characteristics, resulting in adverse selection. The answer should then analyse in some detail how these problems affect (i) markets for experience goods and (ii) research and development activities of firms.

Candidates should describe how, in the former case, the issue is that product quality is not observable by consumers before a purchase and is learned only after the product is bought. This could lead to underprovision of quality or even the collapse of the market. In the latter case, information regarding an R&D project is often different between the prospective innovator and other parties (including banks and other potential external funding sources) This results in under-financing of innovation in the private market. A very good answer would illustrate this using particular examples and case studies.

The final part of the answer should outline different responses to these problems such as warranties, reputation acquired through repeat purchases, minimum quality standards or safety regulations, venture capital, government subsidies for R&D, and others.

Section B

Answer two questions from this section.

Question 5

Answer both parts of this question.

- a. Consider a market where N symmetric firms produce a homogeneous product and compete by simultaneously setting quantities. The inverse demand function is given by $P = a - Q$, where Q is the total quantity produced. The marginal cost of production is constant and equal to c for all firms. Derive the aggregate quantity produced at the Cournot-Nash equilibrium. Then derive the equilibrium price, the equilibrium profit for each firm, and the equilibrium industry profit, and show that all three are decreasing in N . (13 marks)

Reading for this question

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

Approaching the question

Each firm i chooses q_i to maximise $\Pi^i = q_i(P - c) = q_i(a - q_1 - q_2 - \dots - q_N - c)$. The first-order condition for this maximisation problem is

$$\frac{\partial \Pi^i}{\partial q_i} = a - 2q_i - \sum_{j \neq i} q_j - c = 0.$$

There are N such first-order conditions, one for each firm, and the Nash equilibrium is the solution of the system of the N equations. Because the firms are symmetric, the solution to this system must be a symmetric solution, i.e. all firms will choose the same level of output, say q . The first-order condition for firm i can be written as $a - (N + 1)q - c = 0$,

which gives the equilibrium quantities $q^* = \frac{a - c}{N + 1}$.

To obtain the equilibrium price and profit, substitute q^* into the demand function and the profit function $\Pi^i = q_i(P - c)$. Then differentiate the expressions you derived with respect to N and show that the derivatives are negative.

- b. A monopolistic firm sells its product to two types of customers, business customers and other customers. Its total costs are given by $TC = 20 + 2Q$, where Q denotes total output. The total demand of business customers is given by $Q^B = 14 - p$. The total demand of other customers is given by $Q^I = 5 - 0.5p$. Assuming that third-degree price discrimination between the two groups is possible, calculate the prices that the firm will charge each group, the amount it will sell to each group, the consumer surplus of each group, and the firm's total profit. Then describe informally and provide intuition for how a ban on price discrimination would affect the consumer surplus of business customers, the consumer surplus of other customers and the firm's profit. (12 marks)

Reading for this question

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

Approaching the question

The firm acts as a monopolist in each market. In particular, the firm chooses a price for business customers, p^B , and a price for other customers, p^T , to maximise its total profit $\Pi = p^B Q^B + p^T Q^T - (20 + 2Q^B + 2Q^T)$. Straightforward calculations give $p^{B*} = 8$, $Q^{B*} = 6$, $p^{T*} = 6$, $Q^{T*} = 2$. Consumer surplus is $CS^{B*} = 18$ for business customers and $CS^{T*} = 4$ for other customers (a diagram might help with calculating consumer surplus). Total profit is $\Pi^* = 24$.

The firm will set a price between p^{B*} and p^{T*} if it cannot discriminate. Consumer surplus will therefore rise for business customers (who now face a lower price) and fall for other customers (who now face a higher price) compared to the situation under (a). Total profit will fall (this must be so, since the firm maximised its total profit when it was able to discriminate).

Question 6

Consider a horizontally differentiated market where consumers are uniformly distributed on a line of length one. Each consumer buys one unit of a brand product. In addition to the money price, consumers incur linear transport costs: cost of t per unit of distance travelled. An incumbent monopolist produces two brands, one at the left-hand end of the line, call it L, and the other at the right-hand end, R. Suppose that a second firm enters with an identical brand at point L. Unit production costs are zero.

- If the incumbent continues to produce both brands after entry has occurred, calculate the equilibrium prices and profits for the incumbent and the entrant. (10 marks)
- Now suppose the incumbent decides to withdraw its brand at point L after entry has occurred. Calculate the new equilibrium prices and profits for the two firms. What will the monopolist choose to do once entry occurs, produce only its brand at R or produce both brands? (8 marks)
- Discuss, using the results above as well as more generally, the factors that determine the credibility of strategic brand proliferation. (7 marks)

Reading for this question

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

Approaching the question

- If the incumbent continues to produce both brands after entry has occurred, there will be two identical brands at L. Price competition will drive their prices to marginal cost, which is zero. Both the incumbent and the entrant will make zero profit from their brand at L. Of course, the incumbent also has a brand at R and will make some profit from it. To find the demand for the brand at R, consider the marginal consumer who is located at distance y from L and is indifferent between L and R. Let $P_{I,R}$ denote the price of the incumbent's brand at R. We have: $0 + ty = P_{I,R} + t(1 - y) \Leftrightarrow y = \frac{1}{2} + P_{I,R}/2t$. Hence the incumbent's profit from its brand at R (as well its overall profit) will be $\Pi_{I,R} = P_{I,R} \times (1 - \frac{1}{2} - P_{I,R}/2t)$. The price that maximises this profit expression is $t/2$ and the corresponding equilibrium profit is $t/8$.
- If the incumbent drops the brand at L, only two brands remain: one produced by the entrant at E and one produced by the incumbent at R. Differentiation implies that the prices $P_{E,L}$ and $P_{I,R}$ will now be higher than marginal cost. For the marginal consumer located at distance y from L we now have: $P_{E,L} + ty = P_{I,R} + t(1 - y) \Leftrightarrow y = \frac{1}{2} + (P_{I,R} - P_{E,L})/2t$.

The incumbent will choose $P_{i,R}$ to maximise $P_{i,R} \times [1 - \frac{1}{2} - (P_{i,R} - P_{E,L}) / 2t]$ and the entrant will choose $P_{E,L}$ to maximise $P_{E,L} \times [\frac{1}{2} + (P_{i,R} - P_{E,L}) / 2t]$. Solving the system of the two first-order conditions we obtain $P_{E,L} = P_{i,R} = t$ and corresponding equilibrium profits $t/2$. The incumbent monopolist's profit is now higher than in part (a), therefore the incumbent will choose to drop the brand at L.

- c. This analysis implies that the incumbent would not be able to use a brand proliferation strategy to deter entry if the entry of the second firm were endogenous. Why? Note that the use of brand proliferation to deter entry involves strategically producing an excessive number of brands in order to decrease the potential demand for brands of new entrants. This strategy can work if (in addition to increasing returns to scale at the brand level and localised competition between brands) there is a sufficiently large cost of repositioning a brand in the product space or of withdrawing a brand. When this cost is zero or too low, an incumbent firm would not be committed to all its chosen locations, so entry could not be deterred. In our example, if there were a fixed cost k of dropping the brand at L, the incumbent would choose to continue to produce two brands if $t/2 - k > t/8 \Leftrightarrow k > 3t/8$. Knowing this, the second firm would not enter.

Question 7

Two manufacturers produce a differentiated product. Their goods are distributed through retailers and each manufacturer grants exclusive territories to the retailers carrying his good. Hence intra-brand competition is eliminated and the only competition is between good 1 and good 2 in any given territory. Final demand for good 1 within any given territory is given by $q_1 = 1 - p_1 + bp_2$, while final demand for good 2 within any given territory is given by $q_2 = 1 - p_2 + bp_1$, where $0 < b < 1$ (so the own-price effect on demand is stronger than the effect of the rival's price). Production and retail costs are zero. The firms play a two-stage game. First the manufacturers simultaneously set two-part tariffs $T_i(q_i) = F_i + w_i q_i$, $i = 1, 2$. Then the retailers, after observing both two-part tariffs, simultaneously set retail prices.

- a. Compute the subgame-perfect equilibrium prices and profits for the retailers and the manufacturers in any given territory. (17 marks)
- b. Discuss informally whether the granting of exclusive territories allows the manufacturers to increase their profits. Will welfare be higher or lower compared to the case without exclusive territories? Provide intuition for your answer. (8 marks)

Reading for this question

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

Approaching the question

- a. The profit functions of the two competing retailers – one selling good 1, the other selling good 2 – in any given territory are $(p_1 - w_1)(1 - p_1 + bp_2)$ and $(p_2 - w_2)(1 - p_2 + bp_1)$, respectively, where w_1 and w_2 have already been set by the manufacturers and are taken as given by the retailers. The two retailers set retail prices simultaneously. Retailer i chooses p_i to maximise his profit taking p_j as given, where $i = 1, 2$, $j \neq i$. Solving the system of the two first-order conditions, we obtain equilibrium prices

$$p_i^R = \frac{2 + b + 2w_i + bw_j}{4 - b^2}$$

with corresponding quantities

$$q_i^R = 1 - p_i^R + bp_j^R = \frac{2 + b - 2w_i + b^2 w_i + bw_j}{4 - b^2}$$

where $i = 1, 2, j \neq i$.

Competition among the retailers takes place at stage 2 of a two-stage game. At stage 1 the manufacturers simultaneously choose two-part tariffs, each of them anticipating the way the retailers will act at stage 2. Manufacturer i , $i = 1, 2$, chooses a wholesale price w_i and a fixed fee F_i that the retailer of good i must pay if he wants to carry the good.

What do manufacturers do at stage 1? For one thing, each of them can use the fixed fee to extract all the profit made by his retailer at stage 2. Also, each of them may make some additional profit by charging a wholesale price above marginal cost (which is zero). The total profit of manufacturer 1 in any territory is therefore given by $w_1 q_1^R + F_1 = w_1 q_1^R + (p_1^R - w_1) q_1^R = p_1^R q_1^R$, an expression which is a function of w_1, w_2 and b (see above). Similarly for manufacturer 2. Manufacturer 1 then chooses w_1 to maximise $p_1^R q_1^R$ taking w_2 as given, and similarly manufacturer 2 chooses w_2 to maximise $p_2^R q_2^R$ taking w_1 as given. Solving the system of the two first-order conditions, we get the equilibrium wholesale prices

$$\hat{w}_1 = \hat{w}_2 = \frac{b^2}{4 - 2b - b^2}.$$

Substituting into the respective profit functions $p_1^R q_1^R$ and $p_2^R q_2^R$, we obtain the equilibrium profits for the manufacturers:

$$\hat{\Pi}_1 = \hat{\Pi}_2 = \frac{4 - 2b^2}{(4 - 2b - b^2)^2}.$$

The retailers make zero profit.

- b. When there are no exclusive territories, then in any given territory good 1 is distributed by a large number of retailers who all compete with each other. Assuming that there is no spatial differentiation among retailers in any given territory, the retail price of good 1, p_1 , is driven down to w_1 . Similarly for good 2: $p_2 = w_2$. In other words, distribution by retailers with exclusive territories allows manufacturers to obtain a retail price which is higher, and therefore closer to the joint-profit maximising level, than if retailers faced intra-brand competition. Profits are also closer to the joint-profit maximising level and, by suitable choice of franchise fee, the manufacturers can appropriate these profits for themselves. Quantities sold, and therefore welfare, are lower than in the absence of exclusive territories.

Question 8

Consider a homogeneous good industry with inverse demand given by $p = 100 - 2(Q + q)$ where Q is the output of an incumbent firm and q is the output of a potential entrant to the market. The incumbent's total cost function is $C(Q) = 10Q$, whereas the cost function of the entrant is $C(q) = F + 20q$, where F is a sunk cost incurred to enter the market. The entrant observes the incumbent producing some units of output and expects this output level to be maintained.

- Determine the incumbent's optimal output in the absence of entry. (6 marks)
- Suppose entry occurs and the entrant takes the incumbent's output as given. Show that the entrant's equilibrium profit is decreasing in the incumbent's quantity. (7 marks)
- Calculate the output that the incumbent should set to deter entry. (7 marks)
- Discuss how the incumbent's decision to deter entry or not might depend on F and provide intuition. (5 marks)

Reading for this question

Subject guide, Chapter 5; Tirole (1988) Chapters 1 and 8; Church and Ware (2000) Chapters 2 and 13-16.

Approaching the question

- This is a standard monopoly problem. The optimal output is 22.5.
- The underlying game here is a sequential game as follows. First the incumbent chooses a level of output Q . Then the potential entrant, having observed the incumbent's choice and expecting this output level to be maintained, decides to enter and chooses the level of output q that maximises her profit. The profit function of the potential entrant is given by $\pi = pq - 20q - F$. Maximisation of this expression with respect to q taking Q as given gives $q^* = (40 - Q)/2$ and corresponding equilibrium profit $\pi^* = (40 - Q)^2/2 - F$. This profit expression is decreasing in Q .
- In this part, we introduce the possibility that the potential entrant decides not to enter. From part (b) we know that the maximum profit the potential entrant can make, if she enters, is $\pi^* = (40 - Q)^2/2 - F$. To keep the potential entrant out of the market, the incumbent has to choose a value of Q such that $\pi^* \leq 0$. Any $Q \geq 40 - (2F)^{1/2}$ ensures that $\pi^* \leq 0$. A good answer could proceed to calculate the exact level of Q that deters entry and maximises the incumbent's profit: $Q = 40 - (2F)^{1/2}$.
- The lower the level of F , the higher the output that the incumbent needs to produce to deter entry and the lower the profit of the incumbent under entry deterrence. If F is below a certain level, then the incumbent will be better off accommodating entry.