

EGT2: IIA
ENGINEERING TRIPOS PART IIA

Friday 3 May 2019 9.30 to 11.10

Module 3E1

BUSINESS ECONOMICS

*Answer not more than **two** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS

Single-sided script paper

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM

CUED approved calculator allowed

10 minutes reading time is allowed for this paper at the start of the exam.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

- 1 (a) Using appropriate diagrams, explain a firm's profit maximisation under perfect competition. Make a distinction between the short-run and the long-run case. [25%]

*Firms use inputs/factors (**labour and capital**) to produce some good that they sell at a **market price**. Under perfect competition, both this price and the input/factor prices are **taken as given**. The firm's objective is profit maximisation under the constraint of the production technology. The **production technology** specifies how much output can be produced given the inputs, labour and capital. The resulting **isoquants** look similar to indifference curves. In the short run, the firm will **not be able to adjust the amount of capital**. Therefore, profit maximisation in the short run is achieved by choosing the **optimal amount of labour**. Produce the **profit equation and its short-run first order condition (FOC)**. Show that profit maximisation can be recast as **cost minimisation**. Illustrate the FOC **graphically using isocost and isoquant lines**. Explain that **cost minimisation** is the **inverse problem** to utility maximisation (choose lowest isoquant that just touches the isocost vs. choose the highest indifference curve that still touches the budget line).*

- (b) Explain and illustrate the Prisoners' Dilemma with the help of a payoff matrix. Why is it called a dilemma? Describe a real-life economic problem that has the structure of this game. [25%]

*Produce the **payoff matrix** for the PD [(1,1)/(4,0)/(0,4)/(3,3)]. Explain the two options (**strategy space**) the players have (e.g., by telling the metaphor of the prisoners). Explain that **cooperation** leads to the maximum joint payoff but individual payoff maximisation leads to the minimal joint payoff. The **Nash Equilibrium** is even a solution in **dominant strategies**. Describe the **Cournot duopoly** as an example of a PD, where both competitors **could do better through cooperation but have an incentive to defect**.*

- (c) Describe and compare the Cournot and the Stackelberg models of oligopoly. What are the welfare implications, for the economy as a whole, as well as for consumers and producers separately? [25%]

*Both models are examples of oligopolies. This means that there are few enough firms that **strategic interaction** matters. In both cases, firms compete over **quantities**. The difference between the two is the **timing**: in Cournot, firms act **simultaneously**; Stackelberg is **dynamic**, there is a **leader who sets its quantity first**, and **followers, who observe this quantity and react to it**. Produce the **quantity diagram** for the Cournot case and add the reaction function of the leader and follower for the Stackelberg case. Explain the leader's **first-mover advantage** (higher quantity, higher profit). Add the*

*chosen quantities in the diagram and explain that the higher **the sum of the two firms' quantities**, the higher the welfare.*

(d) In class, we derived the investment equation:

$$I = I_n [MPK - (P_K/P)(r + \delta)] + \delta K$$

Explain each part of the equation by examining how investment changes in response to changes of the variables MPK and r . [25%]

Explain the **three types of investment cost (borrowing (real rate r = nominal rate i + inflation π), depreciation, loss)**. As borrowing cost (r) or depreciation (δ) increase, the **profit rate declines** (as depreciation increases, capital must be replaced at a higher rate, e.g., rust, wear, etc.; as inflation increases, the real cost of borrowing increases), and **so does investment**. Produce the **diagram** that explains the corresponding shift in the investment curve. On the other hand, if marginal **productivity of capital** (MPK) increases or the **price of capital** (P_K) decreases or the **price of the output** (P) increases, the profit rate **increases** (less capital used per unit of output, each unit of output less costly to procure, each unit of output more profitable), and so does investment. Again, produce the corresponding **diagram** and the shift of the investment curve.

- 2 (a) Explain the concepts of perfect substitutes and perfect complements in consumption using an example for each. Illustrate both cases with appropriate diagrams. [25%]

*Substitutes are goods whose demanded quantity **rises** if the price of the other good rises. These can be thought of as **replacements**. Produce the **indifference curve diagram** for perfect substitutes (**straight lines**) and explain that the **MRS** is constant. The consumer will **only demand one good**, depending on the price ratio. Examples: apples and pears; pens and pencils etc. Complements are the **opposite case**, where the demanded quantity **decreases** if the price of the other good rises. These can be thought of as goods that “**belong together**” in that the use of one is compromised without the other. Produce the **indifference curve diagram** for perfect complements (**kinked straight lines**) and explain that these will always be demanded in **fixed ratios** (**straight line through the kinks**). Examples of complements: flour and sugar; running shoes and sports shorts etc.*

- (b) Describe the Nash Equilibrium concept using a pure coordination game. Compare Nash Equilibrium with a solution in dominant strategies concerning the existence and number of solutions. How do they differ in what they demand in terms of players' rationality? [25%]

*Produce the **payoff matrix** of a pure coordination game: (0,0), (3,1), (1,3), (0,0). Describe the players' **action space**. Explain the **best response** function and mention that interests of players are (partially) **aligned** in that they want to avoid **miscoordination** (0,0). Explain that the Nash Equilibrium (NE) solution is a **fixed-point** argument: it is a **pair of strategies** where each strategy is the **best response to the other strategy**. The consequence is that no player wants to **deviate unilaterally**. Describe the **three Nash Equilibria in this game**. In coordination games, there are **multiple** NE, resulting in **strategic uncertainty**. This highlights a property of NE: there is (**almost**) **always an NE**, but there can be more than one, making it necessary to add **refinements**. In contrast, the solution in dominant strategies (DS) is **often unique**. All solutions in dominant strategies are also NE. The problem is that **few games** (and, in fact, no coordination games) have a DS solution. Finally, NE is more demanding as it asks players to **consider other players' behaviour** while DS only looks at **own payoffs**.*

- (c) Consider a monopoly. Derive the firm's optimal quantity and price (**no price discrimination**), and contrast these with the case of perfect competition. What are the consequences of monopoly for welfare (consumer/producer surplus)? [25%]

*In contrast to oligopolists, a monopolist does not have to take into account competitors' strategies; in contrast to perfect competition, the monopolist's **quantity decision** will*

have an **influence on the price**. Therefore, her decision must **take into account the demand function**. Produce the **profit function** for the monopolist and derive the quantity decision through the **first order condition (FOC)** of profit maximisation. Illustrate the FOC **graphically** and show that the quantity produced in the monopoly case is **lower** than in the perfect competition case. Highlight the two **triangles** representing the **deadweight loss in consumer and producer surplus**.

(d) Name and explain two real-life examples of inefficient market outcomes due to externalities. According to the Coase Theorem, such inefficiencies should not happen, given certain assumptions. State the Coase Theorem and explain which assumptions of the Coase Theorem are violated in your two examples. [25%]

*Example 1: Asymmetric information – Insurance. The Coase Theorem (CT) would state that insurers will find an **efficient contract with each person** who wants to be insured. Since higher risks are more costly in expectation, the insurance will be more expensive (example higher risk: health insurance with pre-existing condition). In most cases, however, the **insured person is better informed** about the risk than the insurer. For example, health condition not easy to assess for insurer; fire hazard depends on precautions taken by the insured etc. That means, it is **more attractive for “bad risks”** to sign an insurance contract than for good risks. Since the insurer cannot discriminate, she will assume an average risk for everybody. This **“market for lemons” will then unravel** as the pool of insurance buyers deteriorates. CT fails here because **the information/enforcement costs are prohibitive**.*

*Example 2: Pollution – Steel plant. Pollution is an example of **negative externalities**. Negative externalities are by-products or unintended **consequences of another activity that have a negative impact on the utility or profit of third parties**. In this example, the steel plant **pollutes** the air around it, **reducing the utility** of the neighbours. CT would imply that the plant and the neighbours agree on the efficient level of pollution in a bargaining process. The neighbours (or the plant owners) are assumed to have **well-defined property rights** concerning the air quality, and the **bargaining process is assumed to be costless**. Both these assumptions **fail**: it is very difficult (without state regulation) to impose property rights for clean air; and reaching agreements with all neighbours is very cost and effort intensive.*

- 3 (a) Explain the concept of inferior goods using an appropriate diagram and giving two real-life examples. Also discuss the special case of a Giffen good. [25%]

*Normal are goods that are **more in demand** as the consumer's income rises. This is the case for many goods, such as **vacations, cinema tickets, etc.** Produce the **indifference curve diagram** of a normal good and show that the quantity demanded increases as the budget line is shifted outward. Inferior goods are the opposite. They are **consumed less as income rises**. Examples include **low-quality goods** such as **fast food, low-cost airline tickets** etc. Produce the corresponding **diagram**, analogously to the first one. Show that the quantity demanded decreases. A **Giffen good** is an extreme case of an inferior good: it is so inferior, that it is more demanded as its price increases. This only happens in extreme penury, such as **potatoes in the 19th century Ireland famine**. The price increase **effectively reduces the consumer's income** so that substitutes become less affordable, increasing the quantity demanded. Produce the corresponding **diagram**. Explain that all Giffen goods **must eventually turn "non-Giffen"**.*

- (b) Explain the concept of a public good. Why are markets not as good in providing public goods as they are in providing private goods? Illustrate your answer using two real-life examples of public goods and how they are provided. [25%]

***Examples: national defense; radio.** A public good is **non-rival**, meaning one person's consumption does not impinge another person's consumption (everybody profits from national defence without reducing other people's security; everybody can receive radio programmes without reducing other people's opportunities to do the same). A public good is also **non-excludable** (it is not possible to prevent a specific person from profiting from national defence; nobody can be prevented from receiving radio), so that nobody can be prevented from consuming it. Illustrate the **underprovision** of public goods by the modified supply and demand **diagram**. Using the diagram, explain how **non-rivalry and non-excludability combine to result in underprovision**. Explain that **state production** is often used to provide public goods and that **democratic and bureaucratic processes** can be used to determine the amount provided (parliament decides on the budgets for national defence and the BBC, ministries oversee the production, voters use the ballot to approve the politically decided allocations).*

- (c) Using Edgeworth Box diagrams, illustrate (i) the idea of Pareto efficiency and the contract curve, and (ii) general competitive equilibrium. With the help of a third Edgeworth Box, state and explain the first fundamental theorem of welfare economics. [25%]

*Produce a **first Edgeworth diagram**, explaining how it must be read and showing a case of a **Pareto inefficient** allocation and the region of Pareto better allocations (**almond-shaped area between indifference curves**). Using the same diagram, show an allocation that is **efficient (indifference curves touch)**. Finally, explain that the **contract curve is the set of all efficient allocations**, and that it will run **diagonally from the lower left corner to the upper right corner**, and why these corners are included in the contract curve. Then, produce a **second diagram**, introduce the **budget line** and explain how it **rotates** around the initial endowment as the price ratio changes. Explain that prices will adjust to an **equilibrium where the budget line is touched by two indifference curves**, one of each consumer. This is an equilibrium because, given the budget line, both consumers **maximise their utility** by choosing the equilibrium bundle. The theorem follows from these two illustrations: it states that **any general equilibrium is Pareto efficient**. This is evident as since indifference curve 1 touches the budget line in the equilibrium point and indifference curve 2 touches the budget line in the equilibrium point, the indifference curves **necessarily must be tangential to each other**, which is the definition of Pareto efficiency.*

- (d) Macroeconomic policy in open economies will have an impact on the trade balance. Name three different measures that the government can introduce to increase exports. Discuss the relative advantages and disadvantages of each measure. [25%]

- 1. **Expansionary monetary policy**: by either printing money or reducing the interest rate, the home currency is devalued. This makes exports cheaper and thus tends to have a positive effect on the trade balance (example: China).*
- 2. **Subsidies**: Exporting industries can be supported through subsidies. Otherwise unprofitable exports will tend to have a positive effect on the trade balance (example: Soviet countries).*
- 3. **Education and research**: investment in these sectors can increase the comparative advantage in highly profitable export-oriented industries (IT, media, biotech).*

*Discussion: **highlight the drawbacks** of expansionary monetary policy (e.g., will make **imports more expensive**, thus potentially drying up input factor markets; increases consumer prices and thus dampens domestic demand) and subsidies (market **distortions***

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*will lead to inefficient resource misallocations; taxpayer money). **Education and research best way** (also produces positive externalities through knowledge diffusion).*

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