UNIVERSITY OF CAMBRIDGE
Registrary's Office

Dr James Knapton
Information Compliance Officer

James Lawrence
By email

Reference: FOI-2017-127

31 March 2017

Dear Mr Lawrence,

Your request was received on 3 March 2017 and I am dealing with it under the terms of the Freedom of Information Act 2000 ('the Act').

You asked:

> *Could you please release all the exam papers and model solutions, as far as possible, that Economics students sat in the academic year 2014-2015.*

The exam papers are attached. Please note that the attached documentation should not be copied, reproduced or used except in accordance with the law of copyright.

The model solutions, insofar as they are held, are exempt under section 36(2)(c) of the Act. In the reasonable opinion of the Vice-Chancellor (who is the University's 'qualified person' to make such decisions), their disclosure would be likely to prejudice the effective conduct of public affairs because it would be likely to fundamentally compromise the core University process of high-quality education and examination.

As this is a qualified exemption, the University has considered whether, in all the circumstances of the case, the public interest in maintaining the exemption outweighs the public interest in disclosing the information. The University does not consider that the public interest is served in any way by the disclosure of the content of these particular model answers. Instead it would enable the students to learn 'by rote' the answers required for success in the examination, fundamentally compromising the examination process and the University's mission 'to contribute to society through the pursuit of education, learning, and research at the highest international levels of excellence'. It would also, by making the model solutions public, render it impossible to reuse certain question types from year-to-year for quality control purposes and therefore would necessitate a greater degree of academic staff

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time in creating new questions and model solutions each year to the extent that their other duties in teaching and research would be adversely affected.

If you are unhappy with the service you have received in relation to your request and wish to make a complaint or request an internal review of this decision, you should write to Dr Kirsty Allen, Head of the Registrary's Office, quoting the reference above, at The Old Schools, Trinity Lane, Cambridge, CB2 1TN or send an email marked for her attention to foi@admin.cam.ac.uk. The University would normally expect to receive your request for an internal review within 40 working days of the date of this letter and reserves the right not to review a decision where there has been undue delay in raising a complaint. If you are not content with the outcome of your review, you may apply directly to the Information Commissioner for a decision. Generally, the Information Commissioner cannot make a decision unless you have exhausted the complaints procedure provided by the University. The Information Commissioner may be contacted at: The Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF (https://ico.org.uk/).

Yours sincerely,

James Knapton

UNIVERSITY OF CAMBRIDGE

ECT1/PBT1
ECONOMICS TRIPOS PART I
PSYCHOLOGICAL AND BEHAVIOURAL SCIENCES TRIPOS PART 1

Monday 8 June 2015 9:00-12:00

Paper 1

MICROECONOMICS

Answer **ALL SIX** questions from Section A and **TWO** questions from Section B.

Section A and B will each carry 50% of the total marks for this paper.

Each question within each section will carry equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

SECTION A

1. Find all the Nash equilibria of the following game:

	L	M	R
u	2,0	1,3	5,-1
m	-1,2	3,0	3,1
r	4,1	2,2	0,0

2. Marco has an income of £100, which he spends on two goods, A and B. Initially, the prices of the two goods are $P_A = 10$, and $P_B = 10$, and his utility-maximizing consumption is to choose quantities $Q_A = 3$, and $Q_B = 7$. Suppose that the price of good B falls from £10 to £5, while Marco's income is unchanged, and that Marco's new utility-maximizing consumption bundle is $Q_A = 2.5$ and $Q_B = 15$ at these new prices. Further, after this price reduction, if enough income were taken away from Marco to put him back on his original indifference curve, then he would choose to consume $Q_A = 1.5$, and $Q_B = 9$.

   (a) Determine the change in consumption of B due to the substitution effect, and the income effect, respectively.
   (b) Is product B is a normal good or an inferior good? If it is an inferior good, is it also a Giffen good? Explain your answer.

3. Do the functions $x^{\alpha}y^{(1-\alpha)}$ and $\alpha \ln(x) + (1-\alpha)\ln(y)$ represent the same preferences, where x and y are goods? If instead we view x and y as factors of production, then do these functions represent the same production function? Explain.

4. Firm 1 has the profit function $ln(x) - cx$ and Firm 2 has the profit function $ln(y) - cy + dx$, where x is the quantity of input chosen by 1 and y is the quantity of input chosen by 2. c and d are strictly positive parameters. The firms simultaneously choose input quantities.

   (a) Find the Nash equilibrium.
   (b) Find the quantities which would maximize the sum of the two firms' profits. Explain why 1's input is higher than the Nash equilibrium quantity.
   (c) Find a tax which would cause the two firms to choose the solution in part (b).

5. At its current level of output, a competitive firm's marginal product of capital is twice its marginal product of labour. The price of labour is £6 per unit, and the price of capital is £3 per unit.

   (a) Is the firm minimizing its cost of manufacturing at its current level of output? If not, how can it reduce its costs?
   (b) Suppose instead that the firm is a monopolist. Does this affect your answer to part (a), and if so, how? Explain.

6. An exchange economy has two agents, A and B, and two goods, x and y. If x^i and y^i (where $i = A, B$) are the amounts consumed by i of x and y respectively then the marginal rate of substitution of agent i is y^i/x^i. The total endowment of good x is 3 and of good y is 2. Find the competitive equilibrium price ratio.

SECTION B

7. "Experimental evidence shows that people do not behave in accordance with the predictions of game theory". Discuss.

8. Two firms each have constant marginal cost $c > 0$ and no fixed costs. They produce identical products and face a linear demand curve $q = a - p$, where q is total quantity, p is price and $a > c$.

   (a) If the firms formed a cartel to maximize the sum of their profits, what price would they both charge?

   (b) Suppose that each firm sets its own price and the market lasts for just two periods, with each observing the first period's prices before the second period. Find the subgame-perfect equilibria in pure strategies. Carefully define the strategies and explain your argument.

   (c) Suppose that each firm sets its own price in each period, the game lasts indefinitely, and they both discount future payoffs. Under what conditions does a subgame-perfect equilibrium exist in which, in equilibrium, they always both charge the price you found in part (a)? Discuss the intuition for your answer.

   (d) How would your answer to (c) change if each firm could only observe the other firm's price with a lag of one period, i.e., a firm cannot observe the t-period price until the beginning of period $t + 2$?

9. A monopolist faces an inverse demand curve given by $P = 11 - Q$, where P and Q are the price and quantity respectively, with P being measured in pounds per unit, and Q in thousands of units. Suppose that the monopolist has a constant average and marginal cost, of £6 per unit.

   (a) Derive the monopolist's profit-maximizing quantity, and the corresponding price. What is the resulting profit? Check that the monopolist is producing on the elastic portion of her demand curve, and explain why that must be the case.

   (b) Suppose that a government regulatory agency sets a price ceiling of £7 per unit, so that the maximum price the monopolist can charge is £7. What is the monopolist's profit-maximizing quantity, and the corresponding price? What is the resulting profit?

   (c) Suppose that the regulatory agency wants to maximize the level of output chosen by the monopolist. What price ceiling should it set, and what is the resultant output and the profit in that case?

Question Continued on next page.

(d) Suppose, instead of setting a price ceiling of £7, the regulatory agency had allowed some imports of the good. Specifically, suppose that it had set an import quota of 1.5 thousand units. Further, suppose that these imports went to those consumers who had the highest willingness to pay. Would the resulting price have been higher or lower than £7? Discuss.

10. Three people, numbered 1, 2 and 3, each have to decide whether to contribute to the provision of a public good. Each can provide £200 or nothing. If three people contribute, the value of the good is £500, if two contribute the value is £400, and if one or none contributes the value is zero. A player's payoff is the value of the public good minus the value of that player's contribution.

(a) Suppose that they each decide simultaneously whether to contribute. Find all the Nash equilibria in pure strategies.

(b) Now suppose that they decide in sequence, in order of player number, and each observes the previous decisions. (i) Draw the extensive form. (ii) How many subgames does the game have? (iii) Describe all the subgame-perfect Nash equilibria.

(c) If the game is as in (b) except that the value of the public good is £200 in the event that there are only two contributions, find the subgame-perfect equilibrium which has the highest sum of players' payoffs. Comment.

(d) Suppose again that the game is as in (b) except that players 1 and 2 decide simultaneously rather than sequentially. Use backward induction to derive the reduced game between 1 and 2 and hence find all the subgame-perfect Nash equilibria.

11. You are given the following linear demand curve for a particular good, called good 1:

$$Q_1(p_1, p_2, m) = 100 - 2p_1 + 4p_2 + 3m$$

where p_1 and p_2 are the prices of good 1 and good 2, respectively, and m is income.

(a) Are good 1 and good 2 substitutes or complements for each other? Explain.

(b) Find the own price elasticity of demand, the cross-price elasticity of demand, and the income elasticity of demand.

(c) Suppose that $m = 10$ and $p_2 = 2$. For what combination of Q_1 and p_1, if any, is the own price elasticity unity? Explain your answer.

(d) Suppose that $p_1 = 4$ and $p_2 = 2$. At what income levels, if any, is good 1 a luxury good? Explain your answer.

12. Consider a firm whose production function is given by:

$$f(x_1, x_2) = (2x_1 + x_2)^{\frac{1}{2}}$$

where x_1 and x_2 represent the quantities used of the two inputs.

(a) Does this production function exhibit increasing, decreasing, or constant returns to scale? Explain briefly.

(b) If the firm faces factor prices of $(1, 1)$ for the two inputs, what is the cheapest way to produce 4 units of output? Explain.

(c) Derive the cost function for this firm, as a function of its output y, when factor prices are $(1, 1)$.

(d) Suppose that the firm operates in a perfectly competitive market, in which it can sell its output at a price of p per unit. What is its profit-maximizing level of output? Explain briefly.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT1
ECONOMICS TRIPOS PART I

Tuesday 9 June 2015 9:00-12:00

Paper 2

MACROECONOMICS

Answer **ALL SIX** questions from Section A and **TWO** questions from Section B.

Section A and B will each carry 50% of the total marks for this paper.

Each question within each section will carry equal weight.

Write your **candidate number** (not your name) on the cover of each booklet. Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

SECTION A

1. The nominal GDP of the UK in the third quarter of 2014 was approximately £451 bn. In the same period, the exchange rate was around 1.26 € per £.

   (a) What is the nominal GDP of the UK in terms of euros in the third quarter of 2014?
   (b) How would you adjust this number to make the GDP of the UK comparable to the GDP of countries in the Eurozone?

2. Explain what happens to the natural rate of unemployment of the UK in the following scenarios:

   (a) New European labour laws allow EU citizens to work in countries of the European Union without work permits.
   (b) A new policy changes the maximum duration of Job Seekers Allowance in a fiscal year from 26 to 30 weeks.

3. What is the money multiplier? Can it be less than one? Assume that the reserve deposit ratio is 15% and the currency deposit ratio is 1%. By how much should the Bank of England increase the monetary base in order to achieve an increase in the money supply of £10 million?

4. What is the 'Keynes effect'? What assumptions must be made about monetary policy for this effect to operate?

5. Describe the long run implications of the following for the trade balance and real exchange rate of a small open economy:

   (a) A reduction in the world real interest rate.
   (b) A tax rise.

6. What is the effect of the following on the equilibrium government spending multiplier in a closed economy with fixed prices:

   (a) A reduction in unemployment insurance.
   (b) A decision by the central bank to react more aggressively to the output gap.

SECTION B

7. Can the classical model of production be reconciled with the differences in income per capita across countries?

8. Consider an economy with constant population, described by the Solow model. Assume that in this economy there is a government that just spends resources without contributing to production or capital accumulation. The production function in per capita terms is $y = \sqrt{k}$, where y is output per capita and k is capital stock per capita. The government maintains a balanced budget and government spending is financed by proportional income taxation at a constant income tax rate τ. Households save a constant fraction s of their disposable income, and consume the rest of their income. Capital depreciates at rate δ. It is assumed that $0 \leq \tau < 1$, $0 < s < 1$ and $0 < \delta < 1$.

   (a) Write the resource constraint for this economy in per capita terms. Use this to derive equilibrium investment per capita.
   (b) Derive the fundamental equation of the Solow growth model for this economy.
   (c) Derive the steady state capital per capita k^*. How does k^* change when the tax rate τ increases? Provide an intuitive explanation for your answer.
   (d) Discuss (without doing any derivations) how your answer in (c) may change if the government spending were productive, i.e. if G entered the production function as a factor of production.

9. Why is it important to have good estimates of long run macroeconomic variables such as potential output and the natural rate of unemployment? What are the difficulties in obtaining high quality estimates for these two variables?

10. A small open economy with sticky prices is described by the following relationships:

$$\begin{aligned} C &= 1000 + 0.6(Y - T), \\ I &= 400 - 50r, \\ G &= 400,\ T = 300, \\ NX &= 400 - 100e - 0.1Y, \end{aligned}$$

where Y is aggregate income, C is consumption, T is taxation, I is investment, G is government expenditure and NX is net exports. The nominal exchange rate, e, is pegged at a value of 1.2.

   (a) First, assume that the domestic interest rate, r, is equal to the world rate, r^*, and that $r^* = 2$.
      i. Find the equilibrium income and net exports in this economy.

ii. What is the effect on income and net exports of an increase in government spending to 500?

(b) Now suppose that the relationship between r and r^* is given by:

$$r = r^* + \gamma(G - T).$$

i. Discuss briefly why this relationship might arise.

ii. Derive the equilibrium government spending multiplier, $\frac{dY}{dG}$, in terms of γ, and provide a brief interpretation of your result.

11. A central bank in a closed economy is setting the nominal interest rate, i, so that the real interest rate, r, satisfies the following equation:

$$r = 2 + 0.5\left(\pi - \bar{\pi}\right).$$

The inflation target, $\bar{\pi}$, is 2, but consumers and firms in the economy currently anticipate deflation at a rate of 1 per cent.

(a) Show that there is a minimum value for π such that the central bank is able to adhere to its rule, and compute this minimum. What happens for lower values of π?

(b) Current levels of consumer demand, investment and government spending in the economy imply the following IS equation:

$$Y = 500 - 100r.$$

Derive an aggregate demand curve for this economy in inflation-output space, and comment briefly on its shape.

(c) The long-run level of aggregate supply in this economy is given by $\overline{Y} = 450$. Discuss, with the use of diagrams, what policy options are available to ensure $Y = \overline{Y}$. How would you expect inflation expectations to evolve if there is no policy change?

12. To what extent can the Phillips curve account for developments in the United Kingdom economy, in relation to the following:

(a) Adoption of inflation targeting after 1992.

(b) Demand-pull pressures since the financial crisis of 2008.

(c) Cost-push pressures, e.g. energy prices, in recent years.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT1
ECONOMICS TRIPOS PART I

Friday 12 June 2015 09:00-12:00

Paper 3

QUANTITATIVE METHODS IN ECONOMICS

There will be a 15 minute reading time prior to the beginning of the examination.

This paper is divided into four Sections:
Sections A and B are Mathematics; Sections C and D are Statistics.

You should do the appropriate number of questions from each Section.
The number of questions to be attempted is at the beginning of each Section.
Answer all parts of the questions.

Answers from the Mathematics and the Statistics Sections must be written in separate booklets with the letter of the Section written on each cover sheet.

Section A carries 30% of the marks
Section B carries 20% of the marks
Section C carries 30% of the marks
Section D carries 20% of the marks

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 2
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator
New Cambridge Elementary Statistical Tables

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

SECTION A - Answer **ALL FOUR** questions from this Section.

1. (a) Calculate the n^{th}-order Taylor approximation for e^x about $x = 0$.

   (b) Use the Taylor series approximation formula of order 2 to approximate the function:

   $$f(x) = \sqrt{4 + x}$$

   (c) Use your result in (b) to estimate both:

   i. $\sqrt{4.01}$

   ii. The maximum absolute value of the remainder given your answer to (c)i.

2. (a) The demand D_t and supply S_t for a good in period t are given respectively by:

   $$\begin{aligned} D_t &= a - bp_t \\ S_t &= -c + dp_{t-1} \end{aligned}$$

   where p_t is the price in period t and a, b, c and d are positive constants.

   i. If market equilibrium determines actual prices at all times write down an equation linking p_t and p_{t-1}.

   ii. Determine the steady state p^* for the price process that you formulated in answer to (a)i.

   iii. If at $t = 0$ the price is p_0 determine a solution for p_t in terms of p_0 and p^*.

   iv. Hence or otherwise determine restrictions on a, b, c and d, if any, under which the system converges on the steady state.

   (b) Let

   $$y(t) = ae^{-bt}$$

   where a and b are constants.

   i. Differentiate y with respect to t and express your result as a differential equation.

   ii. Drawing on your result in (b)i above or otherwise, solve the following. Suppose that for a small island economy with population at time t given by z_t, the maximum population supportable at all times is z_M, and that the rate of change of the population at time t is a constant, β, times the deviation of the population from this maximum. What is the current population if at time $t = 0$ it was z_0? Give your answer in terms of z_0, z_M and β.

3. Evaluate the following stating your answers, in each case, in terms of powers of e:

(a)

$$\int_2^3 \left[\left(2xe^{x^2-4}\right) + \frac{1}{x} - ln\,(1.5)\right] dx$$

(b)

$$\int_1^6 \frac{3}{2} e^{3(3x-2)^{1/2}} dx$$

4. Find and interpret the stationary points of the following functions:

(a) $f(x,y) = \frac{4}{3}x^3 + y^3 - 64x - 12y + 10$

(b) $f(x,y) = e^{\alpha}$ where $\alpha = -2y^2 - 6xy - 3x^3$

(TURN OVER)

SECTION B - Answer **ONE** question from this Section.

5. Consider the following function:

$$Q = K^{\alpha} L^{\beta}$$

Where Q is a firm's output level, K and L are respectively inputs of capital and labour, and α and β are positive constants.

(a) Determine the values of α and β for which the function is concave.

(b) Suppose now that $\alpha = \beta$, r is the unit price of capital and w is the wage rate.

i. What is the optimum level of long run production costs expressed in terms of output Q?

ii. Determine the marginal response of long run cost to a change in output

iii. How does the result determined in (b)ii compare to the value of the Lagrange multiplier at the optimum determined in (b)i? Explain the relationship.

iv. Suppose that capital is fixed in the short run at $\overline{K}$. Determine the short run cost curve in terms of $\overline{K}$ and Q.

v. Determine the relation between K and Q when the short run and long run marginal costs are equal, and comment on your answer.

6. The cost function facing a firm for a given product is given by

$$C(q) = \alpha^2 + q + q^2 \quad \alpha > 0$$

where q is the level of output produced. The demand for the product in question is given by

$$q^d = 52 - p$$

where p is the price.

(a) Compute the marginal cost curve and the average cost curve for the firm

(b) Suppose that, despite being the only firm in the market, this firm is competitive in that it takes the price as given in making all its decisions. If the firm is profit maximising determine how much the firm wants to produce at each price level, and hence determine the equilibrium levels of price and output.

(c) By how much would the optimal profit level at the equilibrium change if there is a very small change to α? Interpret your result.

(d) Suppose that after a period of time there are N firms in the market, each facing the above cost function, and all price takers. Determine the equilibrium values of p and q for each firm.

(e) Suppose that firms have entered the market until the point that each makes zero profits. Determine N if $\alpha = \frac{1}{2}$. Determine the equilibrium p and q.

(f) Check whether your solution values for p and q and N are consistent with the following equations,

$$\begin{aligned} p &= 1 + 2q \\ p &= \frac{1}{4q} + 1 + q \end{aligned}$$

and interpret your findings.

(g) Suppose now that the firm in part (b) had instead been a monopolist. What price would the firm have set and how much would it be able to sell? How do these results compare to those for the price-taking firm examined in (b)?

Section C - Answer **ALL FOUR** questions from this Section.

7. A driving test has both a theory section T and practical section P. Both must be passed at the same attempt in order to pass the driving test. The pass rate for the practical is 80% and for the theory 70%. Also 90% pass at least one or other section at each attempt at the driving test.

   (a) What is the probability of someone passing the driving test?

   (b) What is the probability that an individual passes the theory section given that they have passed the practical section?

   (c) The rules say that if someone fails the driving test at a particular attempt then they can resit the entire test. Treating successive attempts as independent, what is the probability an individual will take n attempts to pass for $n = 1, 2, 3, \ldots$?

   (d) Show that with enough resits an individual eventually passes the driving test.

8. A random variable X has an exponential distribution if its probability density function is given by

$$f(x) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

   where $\lambda > 0$ is a parameter

   (a) Calculate $E(X)$, $E(X^2)$ and hence calculate $Var(X)$.

   (b) Show that the median of X is given by $\frac{ln(2)}{\lambda}$.

9. Random samples from two populations A and B with population means μ_A and μ_B and population variances σ_A^2 and σ_B^2 are collected. The following sample statistics are calculated

Sample	A	B
Sample size (n)	80	60
Sample mean ($\overline{x}$)	10.7	11.5
Sample variance (s^2)	6.4	4.3

   where $\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$ is the sample mean and $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2$ the sample variance estimator.

   Stating clearly any assumptions you make

   (a) Obtain a 95% confidence interval for μ_A.

   (b) Test at the 5% significance level the hypothesis that $\mu_A = \mu_B$ against the alternative $\mu_A < \mu_B$.

10. Two economists get in an argument about how to best estimate the effect of education on wages. Both have the same data on wages and education, where *wage* is measured in pounds sterling per hour and *educ* is measured in years. They both estimate the regression function:

$$wage = \beta_0 + \beta_1 educ + u$$

One economist simply estimates the regression function, measuring *wage* in pounds sterling and *educ* in years. She estimates $\hat{\beta}_0 = 2$, $\hat{\beta}_1 = 3$. The other, being more precise, estimates the regression function using *wage* in pence (and thus multiplies *wage* by 100) and *educ* in days (and thus multiplies years of education by 365). He claims this will give more precise estimates and higher R^2.

(a) Calculate the second economist's estimates of β_0 and β_1.

(b) Which economist's regression will obtain a higher R^2?

Section D - Answer **ONE** question from this Section.

11. A hypothesis test H_0 concerns the value of a population parameter p. A test statistic is given that lies in some set Ω.

    (a) Explain carefully the acceptance region A and rejection region R for a hypothesis test. Why do we choose A and R to be mutually exclusive and exhaustive?

    (b) Explain carefully what is meant by the size and power of a test against some alternative hypothesis H_1.

    (c) To determine if a coin is fair I will toss it n times and reject the hypothesis that it is fair (and conclude it is biased against heads) if I see no heads in n tosses. How large must I choose n so that this test has size below 5%?

    (d) I decide to toss a coin 10 times and reject the hypothesis that it is fair if I observe 9 or 10 tails. What is the size of this test?

    (e) What is the power of the test described in (d) against the alternative $H_1 : Prob(head) = p$ as a function of p? Where will this power function be at a maximum? Explain why this is so.

12. You have data on 88 housing transactions. Each house is reported to have one of two styles: colonial or modern. There are 27 colonial and 61 modern houses in your dataset. Each of the houses in your dataset has at least one bedroom and no more than 7 bedrooms. There are 42 houses with 4 or more bedrooms and 46 houses with 3 or fewer bedrooms. Your dataset reports the following variables:

    - P, house price in 1000s of £
    - SQ, the square footage of the house
    - C, a dummy variable describing the style; 1= colonial, 0=modern
    - M, a dummy variable describing the style; 1=modern, 0=colonial
    - BD, a dummy referring to the number of bedrooms; $BD = 1$ for 3 or fewer bedrooms, $BD = 0$ for 4 or more bedrooms

    The following sample statistics are reported:

    - $E(P) = 293.55$, with standard deviation 102.71
    - $E(P|C = 1) = 272.37$, with standard deviation 111.69
    - $E(P|C = 0) = 302.92$, with standard deviation 97.98
    - $E(P|BD = 1) = 261.05$, with standard deviation 53.71

- $E(P|BD = 0) = 329.14$, with standard deviation 129.37

(a) Test, at the 95% confidence level, the hypothesis that there is no difference in price between colonial and modern houses.

(b) Test, at the 95% confidence level, the hypothesis that houses with four or more bedrooms, have a higher price than houses with 3 or fewer bedrooms.

(c) You estimate the least squares regression of house prices on square footage and obtain the following parameter estimates with standard errors reported in parentheses:

$$\hat{P} = \underset{(24.742)}{11.204} + \underset{(0.012)}{0.140}SQ \tag{1}$$

Interpret the coefficient on SQ and perform a hypothesis test, at the 5% significance level, that the coefficient is significantly different from zero.

(d) After estimating (1), you calculate the residuals of the regression and plot them in Figure 1.

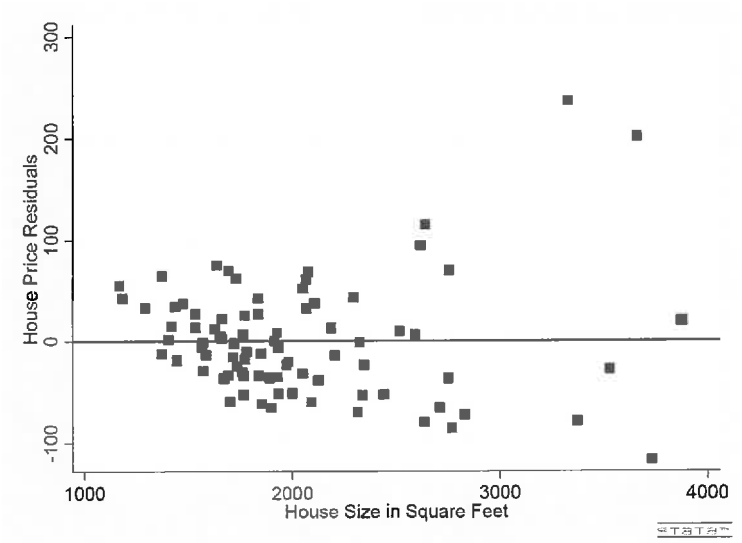


Figure 1 House price residuals from equation (1)

Which, if any, of the assumptions of the Gauss-Markov Theorem might be violated? Does the additional information provided in Figure 1 affect your answer to part (c) above? Explain.

(e) You next estimate the following two alternative specifications of the relationship between house prices and square footage.

$$\widehat{ln(P)} = \underset{(0.076)}{4.824} + \underset{(0.000036)}{0.000401}SQ \quad (2)$$

$$\widehat{ln(P)} = \underset{(0.641)}{-0.975} + \underset{(0.084)}{0.873}ln(SQ) \quad (3)$$

Interpret the coefficients on SQ in (2) and on $ln(SQ)$ in (3). (Assume that all assumptions of the Gauss-Markov Theorem are satisfied).

(f) Finally, you estimate the following:

$$\widehat{ln(P)} = \underset{(0.079)}{4.773} + \underset{(0.000036)}{0.00039}SQ + \underset{(0.0450)}{0.0858}C \quad (4)$$

How do you interpret the coefficient on C? Suppose you estimate this equation again, but add an additional regressor, M (defined above). How will the inclusion of M affect your estimate of the coefficient on C? Justify your answer.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT1
ECONOMICS TRIPOS PART I

Thursday 11 June 2015 9:00-12:00

Paper 4

POLITICAL AND SOCIOLOGICAL ASPECTS OF ECONOMICS

Answer **FOUR** questions only.

Answer all parts to the question.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION

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

1. Why has there been a worldwide increase of interest in statutory minimum wages? What are their limitations as policy instruments to reduce income inequality?

2. 'The political conditions in Britain between 1945 and 1979 forced the Conservative and Labour parties to have similar policies.' Discuss.

3. 'The policies of the 1979 - 1990 British Conservative government and the manner of their implementation indicate that this government did not subscribe to the traditional beliefs of the Conservative Party.' Discuss.

4. 'New Labour had no choice but to create a new consensus in British politics based upon the free economy and the strong state.' Discuss.

5. Is the EU's single market a sufficient foundation for monetary union among its members? What other main features of the Eurozone are seen as key to its sustainability?

6. (a) Outline a model in which investment in human capital affects economic growth.
   (b) Assess whether investments in primary schooling actually increase income, particularly for developing countries.
   (c) Assess whether policymakers should target the supply of education or school quality to improve educational outcomes in poor countries.

7. (a) Define social capital.
   (b) Discuss whether attitudinal or participation data are a better measure of social capital. Give examples to illustrate your argument.
   (c) Does social capital increase economic growth?

8. (a) What is income inequality? Outline two different measures of income inequality.
   (b) How does income inequality affect the savings rate of an economy?
   (c) Assess whether income inequality decreases with economic development.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT1
ECONOMICS TRIPOS PART I

Wednesday 10 June 2015 9:00-12:00

Paper 5

BRITISH ECONOMIC HISTORY

Answer **FOUR** questions only.

Answer all parts to the question.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION

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

1. To what extent does the Agricultural Revolution explain the later Industrial Revolution?

2. Explain the related concepts of an 'Industrious Revolution' and a 'Consumer Revolution'. How do these concepts figure in explaining the 'Industrial Revolution' in Britain?

3. How large were the profits Britain extracted from its colonies in the eighteenth century? Were these profits vital for the Industrial Revolution?

4. To what extent did the Industrial Revolution generate a rapid increase in standards-of-living for the working class? Discuss with respect to real wages and at least one other measure.

5. The large amount of capital invested abroad between 1850 and 1914 has been argued to have caused a lack of investment in domestic industry and lead to late Victorian decline. To what extent does the evidence endorse this view?

6. Failings in British manufacturing before 1914, particularly falling behind Germany and USA in specific industries, have been attributed to the poor provision of education in Britain. Explain this argument and consider whether recent comparative evidence demonstrates a deficiency in this area.

7. The roots of Britain's long term decline have been identified in late Victorian Britain. Outline the argument about long term decline. Consider how long term decline can be equated with a verdict of 'no failure' during the period 1873 to 1896.

8. Answer both parts:
   (a) To what extent is 'unemployment persistence' a feature of the labour market during the 1930s?
   (b) Evaluate two suggested explanations for the persistence of unemployment during the 1930s

9. Evaluate the historical evidence on two mechanisms through which the General Tariff may have influenced the economic recovery during the 1930s.

10. Define 'path dependence', and suggest two illustrations of this concept to British economic history in the 1920s.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT2
ECONOMICS TRIPOS PART IIA

Monday 1 June 2015 9:00am-12:00pm

Paper 1

MICROECONOMICS

The paper is divided into two Sections - A and B.

Answer **FOUR** questions in total **with at least ONE** question from each Section.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

SECTION A

1. Jacques and Gilles live up on a hill. They would like to plant new trees on the hill, where there are currently no trees. They have identical utility functions:

$$U = 4\log(X) + 2\log(T)$$

where X is a (private) consumption good, with price = £1, and T is the total number of trees on the hill. The cost of planting a tree is also £1. Jacques and Gilles also have identical incomes: $Y_J = Y_G = £100$. Assume that Jacques and Gilles are the only agents in this society.

   (a) Suppose that trees on the hill are planted privately, where T_J is the number of trees planted by Jacques and T_G is the number of trees planted by Gilles. The two tree lovers act independently to maximize their individual utility, while anticipating the planting actions of each other. What is the private equilibrium number of trees that would be planted on the hill?

   (b) What is the Pareto efficient number of trees that should be planted on the hill? Explain the similarities or differences between the Pareto efficient number of trees and the private equilibrium obtained in part (a).

   (c) Suppose that a social planner decides that 10 trees should be planted on the hill. Further, she decides that tree planting will be a public-private partnership. To raise funds for planting these 10 trees, the social planner levies a lump sum tax of £5 each on Jacques and Gilles. Of course, Jacques and Gilles can also plant trees independently, in addition to the ones planted by the social planner, to maximize their individual utility. What is the new equilibrium number of trees planted on the hill? Explain the similarities or differences between the number obtained here, and the private equilibrium obtained in part (a).

2. Consider a small open economy, Home, which produces and consumes three goods: good 1, good 2, and good 3. The goods differ in the factor intensity of their production, and each good can be traded with the rest of the world. Suppose that, as a result of political turmoil overseas, a large amount of (physical) capital is repatriated back to Home.

   (a) How would you expect this 'capital shock' to affect the composition of output in Home? Explain.

   (b) Suppose that initially, before the increase in capital stock, good 1 was being exported, and goods 2 and 3 were being imported. Is it possible that the capital shock might lead to good 2 being exported? Explain.

   (c) Suppose that the capital shock draws so much capital from the rest of the world that the export supply of good 3 from the rest of the world becomes an upward-sloping curve. Describe the impact on welfare, in Home and in the rest of the world, of an import tariff imposed by Home on good 3.

3. Christie spends a significant share of her income on football boots, and the rest on a composite good, whose price is normalized to 1. She is currently employed at the market wage of w. Her uncle Joe urges her to join his shoe factory, where she receives the same market wage w, but where she will be entitled to the employee discount on the purchase of football boots. With the discount, she will pay p' for each pair of boots, which is lower than the market price p. She also receives an offer from a competing shoe company called "Rival", which offers Christie a fixed amount E to endorse its products. Uncle Joe will not hire Christie if she accepts Rival's offer. Still, Rival's offer is attractive enough to make Christie indifferent between accepting it and taking her uncle Joe's job. Christie accepts the endorsement deal. Unfortunately, before she gets a chance to cash the endorsement cheque, Rival goes bankrupt. So the endorsement deal is off, and uncle Joe has already refused to hire Christie. However, uncle Joe is willing to give Christie the job again (with the employee discount on football boots), but only if Christie agrees to pay him a bribe B to get the job.

   (a) Suppose that both goods are normal goods. In that case, is the highest bribe B that Christie is willing to pay greater than or less than the endorsement fee E? Explain. (You may find it helpful to draw a diagram).

   (b) Now suppose that Christie's preferences can be represented by a quasi-linear utility function $u(s) + g$, where s is football boots, and g is the composite good. Again, compare E with B. Explain your answer.

4. Consider an exchange economy populated by three individuals, Kurly, Larry, and Moe, and two goods, guavas and nuts. The preferences of the three individuals can be characterized as follows. Kurly always demands equal quantities of both goods. Larry spends two-thirds of his income on guavas, and the rest on nuts. Moe never consumes nuts. Let nuts be the numeraire good, so its price is normalized to one, and use p to denote the price of guavas.

   (a) What utility functions would represent the preferences of each of these individuals? Draw indifference curves for each of the three.

   (b) Suppose that the endowments of Kurly, Larry, and Moe are (5,0), (3,6) and (0,4) respectively, where each pair of numbers denotes the number of units of guavas and nuts that the individual is endowed with. Compute the competitive equilibrium, and in particular the equilibrium price ratio and the consumption allocation.

   (c) Suppose that Moe receives an additional endowment of four units of guavas. Compute the new equilibrium price ratio, and the new equilibrium consumption levels for each individual. Compare these equilibrium outcomes with those in part (b), and comment briefly.

SECTION B

5. Mr. Average has constant relative risk aversion with coefficient $\rho > 0$, implying that his vNM utility function is $u(x) = \frac{x^{1-\rho}}{1-\rho}$.

   (a) What property does a risk averse agent's preference satisfy? What property does the preference of an agent with constant relative risk aversion satisfy?

   (b) Suppose a representative portfolio of equities has gross return over 1 year X, which is .9 with probability 1/2 and 1.26 with probability 1/2, while a risk-free bond has gross return $r = 1.01$. Mr. Average chooses to invest 30% of his savings in equities and the rest in bonds. Calculate ρ.

   (c) Suppose Mr. Average is given a hypothetical choice between having wealth W and having wealth given by the lottery $(\frac{1}{2}, 0.9W; \frac{1}{2}, 2W)$. Which would he choose?

   (d) How do the calculations above illustrate the *equity premium puzzle*? Suggest a possible explanation of the puzzle.

6. Country X would like to sell GDP bonds to country Y. One GDP bond pays $\Pi = 1€$ in 1 year's time if the GDP growth of country X is greater than 1%, and $\Pi = 0$ in one year's time if GDP growth is less than 1%. There is a market portfolio with gross return M which can be either high, $M = 1.3$, or low, $M = 0.9$. The joint probabilities of high and low market returns and high and low growth are given below:

$\mathbb{P}$	growth in country X $> 1\%$	growth in country X $< 1\%$
$M = 1.3$	0.4	0.1
$M = 0.9$	0.1	0.4

   There is a risk free asset with gross return $r = 1$ (i.e. no interest is paid over the year).

   (a) Calculate $\mathbb{E}[M]$, $\text{Var}[M]$, $\mathbb{E}[\Pi]$ and $\text{Cov}[M, \Pi]$.

   (b) Assuming the CAPM equation holds, find the current market value of a single GDP bond.

   (c) An inverse GDP bond pays 1€ in 1 year's time only when the GDP growth of country X is less than 1%. Which has a greater market value, a GDP bond or an inverse GDP bond? Explain.

   (d) Briefly, why might country Y be concerned about adverse selection or moral hazard when it buys GDP bonds from country X?

7. A town hires a company to carry out a construction project. The company has a choice $r \in \{1, 2\}$ of resources to devote to the project; this choice of r is not observed by the town. The project may face delays, and bad weather makes delays more likely. The joint probabilities of good weather and delays depend on r and are as follows:

$\mathbb{P}$ when $r = 2$	good weather	bad weather
on time	45%	25%
delayed	5%	25%

and

$\mathbb{P}$ when $r = 1$	good weather	bad weather
on time	35%	10%
delayed	15%	40%

(a) The town offers a contract in which the company's payment T may depend on whether the project was completed on time and may also depend on the weather. Suppose the town is risk neutral, receiving utility $10 - T$ if the project is completed on time, and $5 - T$ if it is completed late. The company is risk averse, receiving utility $u(T) - r$, where $u'' < 0$, and has known reservation utility $\bar{u}$.

i. Describe the optimal contract, assuming that this involves the company choosing $r = 2$. How will this depend, if at all, on whether there are delays and on the weather? Explain how risk is distributed in this contract. (You do not need to set up any optimization problems or calculate the optimal contracts.)

ii. Does the town's inability to observe r reduce the utility it can achieve, compared with when it can observe r? Explain.

(b) Now suppose the town is risk averse while the company is risk neutral. The town receives utility $v(10 - T)$ if the project is completed on time, and $v(5 - T)$ if it is completed late, where $v'' < 0$; the company receives utility $T - r$. How do your answers to parts i. and ii. change?

8. Cambridge Cycle Company (CCC) has managed to monopolize the market for bikes in Cambridge. Cambridge residents are composed of two groups, Students and Professionals. Students form $\frac{3}{4}$ of the population. Each resident demands at most 1 bike. The monetary value that each student attaches to a bike is q, where q is the quality of the bike. The monetary value that each professional attaches to a bike is $2q$. CCC is profit-maximizing, and producing a bike of quality q costs q^2.

   (a) Initially CCC offers a special deal to students on presentation of a student card. What qualities of bikes will CCC sell and at what prices?

   (b) Professionals Against Discrimination successfully lobbies for a law against student deals. Now CCC is able to offer bikes intended for students and bikes intended for professionals, but each type is allowed to choose the deal intended for the other type. What qualities of bikes will CCC want to sell now and at what prices? (You should state any results that you need to use here but do not need to prove them.)

   (c) CCC anticipates that the number of professionals residing in Cambridge will rise on completion of the East-West rail link, while student numbers remain the same. How would you expect this to affect the qualities and prices of bikes on offer at CCC?

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT2
ECONOMICS TRIPOS PART IIA

Tuesday 2 June 2015 9:00am-12:00pm

Paper 2

MACROECONOMICS

This paper comprises three Sections, A, B and C.

Answer **ALL FIVE** questions from Section A.
Answer **ONE** question from Section B.
Answer **ONE** question from Section C.

Section A will carry 50% of the marks, with each question weighted equally.
Sections B and C will each carry 25% of the total marks for this paper.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

SECTION A

A.1 An economy is populated by $\bar{L}_p$ physicists and $\bar{L}_j$ janitors. A representative firm operates under perfect competition and maximises profits

$$\Pi = \max_{\{L_p, L_j\}} \{F(L_p, L_j) - w_p L_p - w_j L_j\},$$

where $F(L_p, L_j) = [\eta L_p^\gamma + (1-\eta) L_j^\gamma]^{\frac{1}{\gamma}}$ denotes the production function, and w_p and w_j denote the real wages for physicists and janitors, respectively. The parameters η and γ satisfy $\eta \in (0,1)$ and $\gamma \in (-\infty, 1)$.

Derive the firm's first order conditions. For $\eta > 0.5$, under which condition will janitors earn higher equilibrium wages than physicists? Intuitively explain why.

A.2 A representative household faces the following optimization problem,

$$\begin{aligned} &\max_{C_0, C_1, B_1} \{u(C_0) + u(C_1)\} \\ \text{subject to} \quad & C_0 + B_1 = (1 + r_0) B_0 + Y_0 - T_0 \\ & C_1 = (1 + r_1) B_1 + Y_1 - T_1, \end{aligned}$$

where C_t denotes consumption, B_t government bond holdings, Y_t labor income, T_t taxes, and r_t the real interest rate, where the subscript t indicates the time period, $t = 0, 1$. The utility function $u(\cdot)$ satisfies $u'(\cdot) > 0$ and $u''(\cdot) < 0$. Derive the Euler equation, and provide a brief intuitive explanation.

The government's budget constraints are given by

$$\begin{aligned} G_0 - D_1 &= T_0 - D_0(1 + r_0) \\ G_1 &= T_1 - D_1(1 + r_1), \end{aligned}$$

where G_t denotes government purchases and D_t government debt, $t = 0, 1$. Both Y_t and G_t are exogenous. In equilibrium $D_t = B_t$.

Using this equilibrium condition, substitute the government's budget constraint in period 0 into the representative household's budget constraint in period 0. Do the same for period 1. Substitute these results into the Euler equation to derive the equilibrium real interest rate. Interpret your results.

A.3 Consider the following Baumol-Tobin model of money demand. A representative economic agent can choose between two assets: cash M, which is required for spending, but earns zero nominal return; and bonds, which yield the nominal interest rate i. The agent receives a nominal income PY in the form of bonds at the beginning of the period and spends a fraction γ of it uniformly during the period. P denotes the aggregate price level, Y real income, and $\gamma \in (0, 1)$. The agent incurs a real transaction cost $c > 0$ each time she sells bonds.

Derive the average level of real money holdings M/P that minimises total costs for the agent, and the real money demand elasticities with respect to real income Y and the nominal interest rate i. How do the results depend on the fraction γ of income that is spent?

A.4 Suppose the central bank suddenly announces that it will perform a large outright open market purchase six weeks from now. Using the asset market model and assuming prices remain sticky for three months, analyze how this affects the nominal exchange rate at *(i)* the time of announcement, and *(ii)* the time of implementation.

A.5 Suppose a policymaker faces the constraint of the Phillips Curve

$$\pi_t =_{t-1} \pi_t^e + \alpha(y_t - \bar{y})$$

where y_t is output, $\bar{y}$ is potential output, so $y_t - \bar{y}$ is the output gap. π_t is the inflation rate, and ${}_{t-1}\pi_t^e$ is the rational expectation of inflation in period t formulated in period $t-1$. The policymaker sets output, y_t, to minimise the loss function

$$L_t = (y_t - y^T)^2 + \beta(\pi_t - \pi^T)^2.$$

It is assumed that $y^T \geq \bar{y}$.

Derive equilibrium inflation and output.

Suppose that you suspect that with probability ρ, y^T is equal to y^* which strictly exceeds $\bar{y}$, while with the complementary probability $(1-\rho)$, y^T is equal to $\bar{y}$. What is the *expected* inflation bias? Explain why.

SECTION B

B.1 The reservation wage, w_r, in McCall's search model is characterised by the equation

$$w_r - b = \frac{\beta}{1-\beta}\left(\int_{w_r}^{\infty}(w - w_r)dF(w)\right),$$

where b denotes unemployment benefits, $\beta \in (0,1)$ the discount factor, w wages, and and $F(w)$ denotes the cumulative distribution function (CDF) for wage offers.

(a) Intuitively explain how the reservation wage depends on both b and β.

(b) Suppose that b increases. What happens to the job finding rate, and what is the implication for the unemployment rate? What are the possible effects on output/welfare?

Let $V(w)$, denote the value of having a job paying a perpetual wage w,

$$V(w) = \frac{w}{1-\beta}.$$

Let U denote the value of not having a job,

$$U = b + \beta E[\max\{V(w), U\}],$$

where E denotes the expectations operator associated with the CDF above.

(c) For a given value of U, graphically illustrate the value

$$W = \max\{V(w), U\},$$

with w on the x-axis, and with W on the y-axis. Carefully mark out the reservation wage, w_r, in your graph, and explain.

(d) Suppose w has a uniform distribution with the following CDF

$$F(w) = \frac{w - \underline{w}}{\overline{w} - \underline{w}}, \quad w \in [\underline{w}, \overline{w}]$$

where the mean, μ_w, and variance, σ_w^2, are given by

$$\mu_w = \frac{1}{2}(\overline{w} + \underline{w}), \quad \sigma_w^2 = \frac{1}{12}(\overline{w} - \underline{w})^2.$$

Suppose now that $\overline{w}$ and $\underline{w}$ changes to $\overline{w}_{new} = \overline{w} + \varepsilon$ and $\underline{w}_{new} = \underline{w} - \varepsilon$, respectively, with $\varepsilon > 0$. What is the effect on the mean and the variance of the wage offer?

How do you think this change of the wage offer distribution will affect the reservation wage? Explain intuitively why.

B.2 Consider the following model of a small open economy (Home), which interacts with the rest of the world (Foreign):

$$\begin{aligned} i &= i^* + E[\mathbf{e}] - \mathbf{e} \\ \mathbf{M} - \mathbf{P} &= \mathbf{Y} - \frac{1}{2}i \\ \mathbf{Y} &= (\mathbf{e} + \mathbf{P}^* - \mathbf{P}) - \theta i \end{aligned}$$

where i is the Home nominal interest rate, i^* the Foreign nominal interest rate, $\mathbf{e}$ the nominal exchange rate expressed as the Home price of Foreign currency, $E[\mathbf{e}]$ the expected future exchange rate, $\mathbf{M}$ the Home money supply, $\mathbf{P}$ the Home aggregate price level, $\mathbf{P}^*$ the Foreign aggregate price level, $\mathbf{Y}$ Home aggregate output, and all boldface variables are in logs. The coefficient θ depends on the interest rate sensitivity of investment. People have rational expectations. In the short run, the aggregate price level $\mathbf{P}$ is fixed. In the long run, the price level $\mathbf{P}$ is flexible and output is at its natural rate $\bar{\mathbf{Y}}$. Suppose that $\mathbf{M} = \bar{\mathbf{M}}$, $\bar{\mathbf{Y}} = 0$, $\mathbf{P}^* = 0.05$ and $i^* = 0.10$, and assume initially that $\theta = 0$.

(a) Give an economic interpretation of the three equations displayed above.

(b) Compute the long run equilibrium values of i, $\mathbf{P}$, $\mathbf{e}$ and $E[\mathbf{e}]$. Explain how they are affected by the level of $\bar{\mathbf{M}}$.

(c) Suppose now that there suddenly is a permanent increase in the money supply $\bar{\mathbf{M}}$ from 0 to 0.25. Compute the short run equilibrium level of the nominal interest rate i, the nominal exchange rate $\mathbf{e}$ and output $\mathbf{Y}$. Analyze the short-run effects, both graphically and intuitively. Is there exchange rate overshooting in this case?

(d) Assume now that $\theta = 1$ and again analyze the short-run effects of a sudden, permanent increase in the money supply $\bar{\mathbf{M}}$ from 0 to 0.25. Compare the results to part (c).

SECTION C

C.1 In 2008, the Consumer Price Index (CPI) in the United States fell and has remained 4 percent below its trend. The unemployment rate in the United States rose to around 10 percent, and slowly declined over the course of six years. Is this pattern consistent with the NAIRU theory? (*Note.* The trend of CPI is defined as the level that would have materialised under an uninterrupted inflation rate of 2 percent per year.)

C.2 During the recent financial crisis, output, consumption, investment, *and* the real interest rate declined substantially. Which types of events/shocks can reconcile these facts with the predictions of the neoclassical intertemporal model? Which events/shocks cannot?

C.3 On 22 January 2015, the European Central Bank (ECB) announced a program of large-scale asset purchases, while its main refinancing rate was virtually zero. Analyze how this is likely to affect bond yields, equity prices, bank lending and economic activity in the euro area.

C.4 In the aftermath of the financial crisis, several central banks in advanced economies have engaged in 'quantitative easing'. This has lead to the allegation of a 'currency war' that negatively affects other countries. Analyze whether 'quantitative easing' is likely to have a detrimental effect on economic activity in other countries and discuss how these countries could adjust their macroeconomic policy to counter any negative effects.

C.5 In the Bank of England Act of 1998, the UK government formally delegated monetary policy to an independent Monetary Policy Committee. Why would the government want to restrict its policy options in this way?

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT2
ECONOMICS TRIPOS PART IIA

Wednesday 3 June 2015 1:30pm-4:30pm

Paper 3

THEORY AND PRACTICE OF ECONOMETRICS I

The paper is divided into two Sections A and B.

Answer **FOUR** questions from Section A and **TWO** questions from Section B.

Each Section carries equal weight.

Answers from each Section must be written in separate booklets with the letter of the Section written on each cover sheet.

Credit will be given for clear presentation of relevant statistics.

This written exam carries 60% of the marks for Paper 3.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 2
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator
Durbin Watson and Dickey Fuller Tables
New Cambridge Elementary Statistical Tables

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

SECTION A

A1 A researcher, who has access to a dataset containing observations on labour demand, capital, output and average wages for a sample of 569 firms, computes the following regressions using Ordinary Least Squares (OLS):

$$\begin{aligned} \log(labour) &= 6.177 + 0.990\log(output) - 0.004\log(capital) - 0.928\log(wage) + \widehat{u} \\ &\quad (0.071)\ (0.026) \qquad\qquad (0.019) \qquad\qquad (0.071) \\ SSR &= 122.24 \qquad SST = 779.09 \qquad R^2 = 0.8430 \end{aligned}$$

and

$$\begin{aligned} \hat{u}^2 &= 2.545 - 0.904\log(output) + 1.142\log(capital) - 1.299\log(wage) \\ &\quad (3.003)\ (0.560) \qquad\qquad (0.376) \qquad\qquad (1.753) \\ &\quad +0.138\left(\log(output)\right)^2 + 0.090\left(\log(capital)\right)^2 + 0.193\left(\log(wage)\right)^2 \\ &\quad\ (0.036) \qquad\qquad (0.014) \qquad\qquad (0.259) \\ &\quad -0.192\log(output) * \log(capital) + 0.138\log(output) * \log(wage) \\ &\quad\ (0.037) \qquad\qquad\qquad\qquad (0.163) \\ &\quad -0.252\log(capital) * \log(wage) + residual \\ &\quad\ (0.105) \\ SSR &= 404.53 \qquad SST = 450.93 \qquad R^2 = 0.1029 \end{aligned}$$

For each regression SSR is the residual sum of squares and SST is the total sum of squares. Figures in brackets are standard errors. The dependent variable $\hat{u}_i^2$ in the second regression is the squared residual from the first.

(a) Using this information, conduct a statistical test (at the 5% level) of the null hypothesis that the disturbances in the first of the two regressions above are homoscedastic. Explain the reasoning behind your choice of test statistic.

(b) What are the implications of the result which you obtained in part (a) for the properties of the OLS estimators in the first regression and their associated standard errors?

(c) Outline two alternative strategies which the researcher could adopt in response to a finding of heteroscedasticity.

A2 A researcher, who has access to monthly data on London house prices from February 1996 to December 2014 inclusive (227 observations), obtains the following estimates by OLS :

$$\begin{aligned} \Delta \log(\widehat{price}_t) &= 0.0539 + 0.00002t - 0.0089 \log(price_{t-1}) \\ &\quad (0.0230) \quad (0.00003) \quad (0.0048) \\ SSR &= 0.02411 \qquad SST = 0.02564 \qquad R^2 = 0.0599 \end{aligned}$$

$$\begin{aligned} \Delta \log(\widehat{price}_t) &= 0.0482 + 0.00005t - 0.0094 \log(price_{t-1}) \\ &\quad (0.0198) \quad (0.00003) \quad (0.0042) \\ &\quad + \textstyle\sum_{j=1}^{12} \widehat{\gamma}_j \Delta \log(price_{t-j}) \\ SSR &= 0.01584 \qquad SST = 0.02564 \qquad R^2 = 0.3825, \end{aligned}$$

where $\Delta \log(price_t)$ is the first difference of $\log(price)$, that is $\Delta \log(price_t) = \log(price_t) - \log(price_{t-1})$, and the $\widehat{\gamma}_j's$ in the second equation are (unreported) regression coefficients. For each regression, SSR is the residual sum of squares, SST the total sum of squares and figures in brackets are standard errors.

(a) Explain why the researcher has included both a constant and a trend term in the first equation.

(b) Explain why the researcher has included the additional lagged differences in the second equation. Are they statistically significant? (You may assume that the two regressions are estimated with the last 213 observations).

(c) Using your preferred equation, conduct a statistical test (at the 5% level) of the null hypothesis that the coefficient of lagged $\log(price_t)$ is zero. What do you conclude about the model specification?

A3 (a) State the conditions under which a univariate stochastic process, z_t, is stationary.

(b) Write out the moving average representation of the autoregressive process

$$z_t = \rho z_{t-1} + \varepsilon_t \ , \qquad \varepsilon_t \sim NID(0, \sigma^2),$$

where $NID(0, \sigma^2)$ denotes normally and independently distributed with mean zero and variance σ^2. Hence show it is stationary provided that $|\rho| < 1$.

A4 A researcher interested in the effect of military service in Vietnam on wages collects data from a random sample of 4000 workers aged 40 and runs an OLS regression on the model

$$y_i = \alpha + \beta x_i + u_i, \qquad i = 1, ..., 4000,$$

where y_i is the i-th worker's annual wage, x_i is a binary variable that is equal to 1 if the i^{th} individual served in the military and is equal to 0 otherwise, α and β are unknown parameters and u_i is an error term.

(a) Write down an expression for the OLS estimator $\widehat{\beta}$.

(b) During the Vietnam War there was a draft, where priority for the draft was determined by a national lottery based upon the day of birth, db, of the potential conscript ($1 \leq db \leq 365$).

For a given draft year, a variable $e_i = \mathbf{1}(db_i < \tau)$ was constructed and used as an instrument for x_i. The integer τ is chosen based upon the demand for conscripts in a given year. Setting $e_i = \mathbf{1}$ (0) indicates that the i^{th} individual is draft-eligible (ineligible).

i. Explain the requirements for e_i to be a valid instrument.

ii. Show that the IV estimator of β may be written as

$$\widehat{\beta}_{IV} = (\bar{y}^e - \bar{y}^n)/(\hat{p}^e - \hat{p}^n),$$

where $\bar{y}^e$ ($\bar{y}^n$) is mean earnings for the draft-eligible (ineligible) sample and $\hat{p}^e$ ($\hat{p}^n$) is the probability of being a veteran conditional upon being draft-eligible.

A5 A regression model, which uses panel data with T observations for each of N individuals, seeks to explain the total variation of a set of observations, y_{it}, $i = 1, .., N$, $t = 1, ..., T$ around a global mean $\overline{y}$. The total variation can be written:

$$\begin{aligned} T_{yy} &= \sum_{i=1}^{N}\sum_{t=1}^{T}(y_{it} - \overline{y})^2 \\ &= \underbrace{\sum_{i=1}^{N}\sum_{t=1}^{T}(y_{it} - \overline{y}_i)^2}_{T_{wy}} + \underbrace{\sum_{i=1}^{N}\sum_{t=1}^{T}(\overline{y}_i - \overline{y})^2}_{T_{by}} \end{aligned}$$

(a) With reference to the above decomposition, explain the rationale for basing alternative panel data estimators on variation in T_{yy} and T_{wy}.

(b) For the panel data estimator based solely on T_{wy}, explain the rationale for discarding T_{by}. In what sense is there a cost to excluding this variation?

A6 Suppose a researcher is interested in using time series data to understand how private consumption expenditures (C_t) are affected by aggregate disposable income (Y_t). In particular the researcher wants to know the long run effect on consumption of a permanent change in income. The researcher initially considers the following ADL(1,1) model:

$$c_t = \beta_0 + \beta_1 y_t + \beta_2 y_{t-1} + \beta_3 c_{t-1} + \varepsilon_t,$$

where c_t and y_t are the natural logarithms of C_t and Y_t, respectively and ε_t is a disturbance term.

(a) Show that the ADL(1,1) model under consideration can be equivalently represented by an Error-Correction Model (ECM). Which parameter in your ECM representation gives the long-run effect the researcher is interested in? Explain.

(b) Despite overwhelming evidence for non-stationarity of consumption and income, the researcher is considering simply regressing c_t on y_t in order to estimate the long-run relationship between them. Under what conditions would this strategy be valid? Give an economic reason that makes this condition more likely to be met and briefly discuss one way to test for it.

A7 Suppose a researcher is trying to estimate whether the price of electricity, p_t, responds to the price of oil in world markets, o_t. The researcher has access to time series data and finds that both series are stationary in first differences, but not in levels. Therefore the researcher decides to estimate the following equation relating the growth in electricity price to the growth in oil prices:

$$\Delta p_t = \alpha + \beta \Delta o_t + \varepsilon_t,$$

where ε_t is assumed to be an independently and identically distributed disturbance with mean zero and variance σ^2.

(a) Having estimated the model by OLS, the researcher is concerned that the residuals might be serially correlated. If this is the case, what are the consequences for OLS estimation and inference? How can the researcher formally test for this serial correlation?

(b) Suppose that, when making their pricing decisions, electricity firms would prefer responding fully to current oil prices changes. However, adjusting electricity prices is costly because it breaks legal contracts with households who have signed a fixed-price agreement based on prices last period. Suppose therefore that firms set their price by minimizing the quadratic cost function

$$C_t = \lambda(\Delta p_t - \Delta p_t^*)^2 + (1-\lambda)(\Delta p_t - \Delta p_{t-1})^2,$$

where Δp_t^* is the profit maximizing price-growth rule, assumed to be given by $\Delta p_t^* = \alpha + \beta \Delta o_t$. Show that the solution to the cost-minimization problem implies an Autoregressive Distributed Lag (ADL) model. Give a brief economic interpretation of this model.

SECTION B

B1 An investigator analysing the determinants of earnings in Belgium has access to a dataset containing information on 1472 individuals (579 females, 893 males). The investigator starts by estimating the following regression using OLS:

$$\begin{aligned} \widehat{\ln(wage)} &= 5.0123 + 0.1145male + 0.1643educ + 0.0343exper - 0.00049exper^2 \\ &\quad (0.0347)\ (0.0153) \qquad (0.0064) \qquad (0.0025) \qquad (0.00006) \\ SSR &= 116.15 \qquad SST = 193.34 \qquad R^2 = 0.3992 \end{aligned}$$

where the variables are defined as follows:

wage	hourly wage rate
male	dummy variable - 1 if male, 0 female
educ	educational level attained (1 is lowest, 5 highest)
exper	work experience in years

SSR is the residual sum of squares, SST is the total sum of squares and figures in brackets are standard errors.

(a) Using these results, compute the marginal effect of an extra year of experience on the wage of a worker with 20 years of experience. What is the number of years after which this marginal effect becomes negative?

(b) The investigator now wishes to assess whether the determinants of earnings are different for males and females and so estimates the regression

$$\widehat{\ln(wage)} = \widehat{\beta}_0 + \widehat{\beta}_1 educ + \widehat{\beta}_2 exper + \widehat{\beta}_3 exper^2$$

for the whole sample, and for males and females separately. The table below gives summary statistics (coefficients and standard errors are not reported). Using these results test, at the 5% significance level, the null hypothesis that the determinants of earnings are the same for males and females.

	All	*Males*	*Females*
SSR	120.5958	70.3979	44.5082
SST	193.5958	117.7076	71.2538
R^2	0.3762	0.4019	0.3754
Observations	1472	893	579

(c) Explain carefully how you would conduct a test of the hypothesis that the effect of education on earnings differs between males and females, while the effect of experience is the same for both genders. You should give a detailed algebraic specification of any regressions you would conduct, and state the distribution of any test statistic you would use.

(d) Another researcher suggests that the education variable is misspecified, in that there is no reason to assume that an individual who has attained level 5 has five times as much 'educational capital' as someone who has only attained level 1. Explain how you could modify the specification of

the original equation so that it incorporates a more general model of the returns to education, and indicate how you would chose between the two specifications.

(e) Comment on the design of the investigator's research, indicating in particular any additional data which you would wish to collect in order to improve the reliability of the parameter estimates.

B2 We are interested in the causal effect of fertility on the labour force participation of women. The population comprises married women and is restricted to couples who have at least two children, were married at the time of the 2000 Census, married only once, and married at the time of their first birth. The transition from two to three or more children is substantive - there are 38% of women with a third child in the sample; it is also likely to impart an impact on labour force participation.

The response variable, y_1, is binary, equal to 1 (0) if the woman was (not) working at the time of the survey. The key variable of interest, MOREKIDS, is unity if a woman has three or more children, and zero otherwise. Other controls used are: mother's age, AGEM, age at first birth, AGE FIRST, years of education of mother, EDUCM, first birth is a boy, BOY1ST, and second birth is a boy, BOY2ND. Race and ethnic dummy variables are also included; these are BLACK, HISP, and OTHERRACE.

(a) Write down a model for the probability of having more than two children conditional upon the available data. Do this assuming firstly that the effect of a change in any given regressor on the probability of having more than two children is constant, and then for the probit model, where the partial effects are individual specific.

(b) i. For the probit model write down an expression for the likelihood and log-likelihood for the i^{th} individual.

ii. Show that the partial effects for the probit model are heterogenesous. In what sense does this represent an advantage over the linear probability model?

iii. Write down an expression for the partial effect of a discrete and continuous variable on the probability of having more than two children.

(c) i. Summarise the principal findings in Table 1 overleaf. Why is the distinction between parameter estimates and marginal effects redundant in the case of the OLS estimator?

ii. Why might the OLS estimates be unreliable?

Table 1: Parameter Estimates

	OLS $\widehat{\beta}_{ols}$	Probit $\widehat{\beta}_{p}$	Marginal Effects
MOREKIDS	-0.161**	-0.422**	-0.160**
	(-78.77)	(-77.00)	(-79.91)
AGEM	0.0227**	0.0600**	0.0226**
	(72.40)	(70.69)	(72.92)
AGE FIRST	-0.0380**	-0.101**	-0.0380**
	(-96.04)	(-90.83)	(-95.80)
BOY1ST	0.000524	0.00139	0.000523
	(0.27)	(0.27)	(0.27)
BOY2ND	-0.00525**	-0.0139**	-0.00524**
	(-2.74)	(-2.73)	(-2.73)
BLACK	0.188**	0.521**	0.197**
	(46.87)	(42.94)	(43.41)
HISP	0.0477**	0.127**	0.0481**
	(11.34)	(11.34)	(11.35)
OTHERRACE	0.0602**	0.158**	0.0598**
	(12.95)	(12.77)	(12.78)
EDUCM	0.0272**	0.0726**	0.0274**
	(59.59)	(56.99)	(58.17)
Sample size	254654	254654	254654
R^2	0.0631		

t statistics in parentheses

$^{+}p < 0.10$, $^{**}p < 0.05$

B3 A Central Bank is interested in understanding the historical effect of money supply on inflation. Researcher A at the Central Bank proposes an Autoregressive Distributed Lag, ADL(1,1), model:

$$\Delta p_t = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta m_{t-1} + \beta_3 \Delta p_{t-1} + u_t,$$

where Δp_t is the quarterly growth rate of the GDP deflator (that is, inflation), Δm_t is the quarterly growth rate of money supply and u_t is a zero mean disturbance with variance σ_u^2. This disturbance is assumed by Researcher A to be conditionally independent with respect to current money supply growth and past money growth and inflation. Researcher B at the Central Bank proposes instead the following bivariate Vector Autoregression Model (VAR) approach:

$$\begin{aligned} \Delta p_t &= \alpha_{p0} + \alpha_{p1} \Delta m_t + \alpha_{p2} \Delta p_{t-1} + \alpha_{p3} \Delta m_{t-1} + \varepsilon_{pt} \\ \Delta m_t &= \alpha_{m0} + \alpha_{m1} \Delta p_t + \alpha_{m2} \Delta p_{t-1} + \alpha_{m3} \Delta m_{t-1} + \varepsilon_{mt} \end{aligned}$$

where Δp_t and Δm_t are as in the ADL model and ε_{pt} and ε_{mt} are assumed to be zero mean disturbances with variances σ_p^2 and σ_m^2 respectively and covariance σ_{pm}. In both cases, disturbances are assumed to be independent of past disturbances and realizations of money growth and inflation. Additionally, both researchers have tested for non-stationarity and agree that Δp_t and Δm_t are stationary series.

(a) Researcher B claims that, if his VAR model for inflation and money supply growth is correct, the ADL(1,1) model for inflation proposed by Researcher A cannot possibly deliver consistent estimates of $\beta_0, \beta_1, \beta_2$. Under what condition on the Δm_t equation in the VAR is Researcher B's claim false? Justify your answer.

(b) Researcher A, in turn, claims that the parameters in the VAR - as proposed by Researcher B - cannot be estimated consistently by OLS either. Discuss (without proving) why Researcher A's claim is valid. If Researcher B is solely interested in forecasting inflation and money growth, is there a transformation of Researcher B's VAR that can be estimated consistently by OLS? If so, derive this transformation and justify why OLS estimates are now consistent.

(c) The Central Bank now discloses to the researchers that it will be using their model estimates to answer the following policy question: "If the Central Bank raises money supply growth by 2% permanently today what is the effect on long-run inflation?" Researcher B now claims that, if his VAR model for inflation and money supply growth is correct, the ADL model will not provide the correct answer to this question (even if B's previous concern in (a) is shown not to be valid). Under what condition on Δm_t is B's new claim invalid?

(d) Researcher B gathered data on quarterly inflation and money growth, estimated a reduced form VAR and obtained the following estimates:

$$\begin{aligned}
\widehat{\Delta p_t} &= \underset{(0.03)}{0.02} + \underset{(0.11)}{0.65}\Delta p_{t-1} + \underset{(0.12)}{0.32}\Delta m_{t-1} \\
\widehat{\Delta m_t} &= \underset{(0.01)}{0.01} + \underset{(0.09)}{0.35}\Delta p_{t-1} + \underset{(0.17)}{0.51}\Delta m_{t-1},
\end{aligned}$$

where the numbers in the equations are OLS estimates and the numbers in parenthesis give the associated OLS standard errors. Given these estimates, test whether Researcher B's claim described in question (c) is valid.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT2
ECONOMICS TRIPOS PART IIA

10:00am Thursday 30 April 2015 to 3:00pm Tuesday 12 May 2015

Paper 3

THEORY AND PRACTICE OF ECONOMETRICS 1

PROJECT

This project carries 40% of the mark for Paper 3.

Select **ONE** project for analysis.

Your project report should not exceed 2000 words. It may include up to a total of **eight** tables and/or graphs.

Notes on data sources for each project are given at the end.

The data files provided are intended to help with the projects. Each file is not necessarily definitive or inclusive. You may extend and augment the data file for the project you select. Make sure that you justify the use and give the sources of any new data that you bring in.

Credit will be given for ingenuity of model building and data collection and selection, and for insight in interpretation.

Make sure the project number and title appear on your title page.

Put your **candidate number** (not your name) on the title page of your project.

1. *Deflation and recession in Japan*

Measure and explain the relationship between real GDP growth and movements in the general level of prices in Japan between 1980 and 2013.

How relevant to your analysis is the New Keynesian Phillips Curve?

In the light of your findings, assess the likely impact of Quantitative Easing (QE) on future economic growth and inflation in Japan.

2. *Productivity growth in the UK*

Using the data supplied and any other as appropriate, examine and explain the inter-industry variations in the contribution of multi-factor productivity (MFP) to productivity growth in the UK between 1998 and 2013.

3. *UK house prices*

Examine and explain regional variations in house prices in the UK between 1983Q1 and 2014Q4.

4. *Share prices, market valuations and shocks*

Analyse and explain movements in the share price of Tesco PLC on the London Stock Exchange between 1 January 2012 and 1 February 2015 in relation to:

a) Other peers in the food and drug retail sector;

b) The FTSE100;

c) consumer spending;

d) media events (press releases, etc.).

5. *Economics and the Research Excellence Framework 2014*

With reference to the UK Research Excellence Framework (REF) assessment 2014, investigate whether membership of the Russell Group of UK universities is systematically related to a significantly higher proportion of research output submitted for Economics (Assessment Unit 18) being graded at 4* overall than is the case for non-Russell Group members.

What other factors may contribute to the outcome and how important are they?

Compare your findings with the results of a similar analysis of REF grades for Business and Management (Assessment Unit 19).

NOTES ON DATA SOURCES

1. *Deflation and recession in Japan*

   GDP, CPI and other major economic indicators for Japan are at:
   https://data.oecd.org/japan.htm#profile-economy

   The official database for Japanese GDP is at:
   http://www.esri.cao.go.jp/en/sna/sokuhou/sokuhou_top.html

   Japan Statistical Yearbook is at:
   www.stat.go.jp/english/data/nenkan/index.htm

2. *Productivity growth in the UK*

   Data are at:
   http://www.econ.cam.ac.uk/intranet/projects/part2a/datasets2015/
   ONS_Productivity_data.xlsx

   The data supplied are from Connors, E. and M. Franklin (2015). 'Multi-factor Productivity (experimental), Estimates to 2013', Office for National Statistics, 23 January 2015. Available at: http://www.ons.gov.uk/ons/dcp171766_392139.pdf

3. *UK house prices*

   Regional and national house price data for the UK are available at:

   http://www.nationwide.co.uk/about/house-price-index/download-data#tab:Downloaddata, and
   http://www.lloydsbankinggroup.com/media/economic-insight/regional-house-prices/

4. *Share prices, market valuations and shocks*

   Tesco daily share price data from 40/02/2005 to 03/02/2015 are given at:
   http://www.econ.cam.ac.uk/intranet/projects/part2a/datasets2015/
   Tesco-share-price-2005-2015.xlsx

   Consumer trends time series data are at:
   http://www.econ.cam.ac.uk/intranet/projects/part2a/datasets2015/
   ONS_Consumer-trends-data-2014Q3.xlsx

   General economic data are at: www.ons.gov.uk/

   Company information is at: www.tescoplc.com

5. *Economics and the Research Excellence Framework 2014*

Research Excellence Framework data are at: www.ref.ac.uk

END OF PROJECT

UNIVERSITY OF CAMBRIDGE

ECT2
ECONOMICS TRIPOS PART IIA

Friday 5 June 2015 9:00am-12:00pm

Paper 4

ECONOMIC DEVELOPMENT

Answer **FOUR** questions only.

Each question will carry equal weight.

Write your **candidate number** (not your name) on the cover sheet of **each** booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

1. 'The key to development lies in a Big Push'.
   (a) Explain the role of coordination problems and externalities in producing development traps where some countries are unable to move from subsistence agriculture to an industrialised economy.
   (b) What role might foreign aid play in resolving the coordination problems of the 'Big Push'? Explain.
   (c) Does the Millennium Villages Project offer any evidence in support of the 'Big Push' model? Discuss.

2. 'The returns to education at the micro level are high while those at the aggregate level are very low.'
   (a) Explain how returns to education at the aggregate and micro levels are calculated.
   (b) What are the potential explanations for the difference in estimated returns?
   (c) What are the implications of finding such divergence in returns to education for the productivity gap between rich and poor countries?

3. Please answer all parts of this question.
   (a) Discuss the tariff policies of Canada, Australia and Argentina from the 1870s to 1970s.
   (b) Do the 'Settler Economies' provide evidence to support the existence of a Tariff-Growth paradox? Explain.
   (c) What policy lessons are there for modern developers in the evidence above?

4. Please answer all parts of this question.
   (a) You are hired by the World Bank to analyse the extent of protection in a developing country. You know the nominal tariffs on all goods and are given all the relevant prices and the values of all inputs by good. Explain in brief why it is useful to compute the effective rate of protection for each industry.
   (b) You find that in some industries the value added seems to be negative. Would you advise the government to close down these industries? Explain.
   (c) Many developing countries are sceptical of the benefits of free trade and have chosen to follow various import-substituting policies. Discuss potential reasons for the 'export pessimism' that provided a rationale for these policies.

5. Please answer both parts of this question.
   (a) What were the key institutional differences between Canada, Argentina and Australia? Discuss.
   (b) Do you believe the relative success of Canada supports the view that institutions rule? Explain.

6. Please answer all parts of this question.
   (a) The transition from high to low fertility is a global phenomenon. What are the key factors driving this transition according to economic theories of fertility? Explain the relevant models.
   (b) How do mortality declines enter into the theories discussed in (a)?
   (c) If our interest is in explaining recent sharp declines in fertility in developing countries over short periods of time, is access to contraceptives entirely irrelevant to these fertility outcomes? Explain.

7. The experiences of the developing economies, including the East Asian 'miracle' economies, after the Second World War show that infant industry protection is a necessary but not a sufficient condition for economic development. Discuss.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT2
ECONOMICS TRIPOS PART IIA

Thursday 4 June 2015 9:00am-12:00pm

Paper 6

MATHEMATICS & STATISTICS FOR ECONOMISTS

This paper consists of two Sections - A and B. Each Section carries equal weight.

Section A is divided into three sub-sections and candidates are required to answer a total of **SIX** questions, **with at least one** question from each sub-section.

Section B is divided into three sub-sections and candidates are required to answer a total of **THREE** questions, **with one** question from each sub-section.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

SECTION A

Sub-section A.I: Answer at least one question from this sub-section

1. Answer all parts.
   (a) Find an $a \in \mathbb{R}$ such that the following matrix A is singular:

$$A = \begin{pmatrix} a & a & -1 \\ -2 & 2 & 0 \\ 7 & 3 & -5 \end{pmatrix}$$

   (b) Are the following sets of vectors linearly independent?

$$S_1 = \left\{ \begin{pmatrix} 1 \\ 0 \\ 5 \end{pmatrix}, \begin{pmatrix} 1 \\ 2 \\ -5 \end{pmatrix}, \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix} \right\}, \quad S_2 = \left\{ \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \begin{pmatrix} -2 \\ 1 \end{pmatrix}, \begin{pmatrix} 0 \\ -5 \end{pmatrix} \right\}$$

   (c) What is the rank of the following matrix?

$$B = \begin{pmatrix} 1 & 2 & 1 \\ 0 & 3 & 2 \\ 5 & -1 & -5 \end{pmatrix}$$

2. Which of the following are vector spaces? Justify your answers carefully.
   (a) $V_1 = \mathbb{Z}$, i.e. all integers, with standard addition and scalar multiplication.
   (b) $V_2 = \{f \in C^0 \text{ with } f : [0,1] \to \mathbb{R}\}$, i.e. the set of all continuous functions from $[0,1]$ to $\mathbb{R}$, with the standard addition and scalar multiplication.
   (c) $V_3 = \mathbb{R}^2$, with the standard addition and the following scalar multiplication:

$$\lambda \begin{pmatrix} v_1 \\ v_2 \end{pmatrix} = \begin{pmatrix} 0 \\ \lambda v_2 \end{pmatrix}, \lambda \in \mathbb{R}.$$

3. Let A be an $n \times n$ matrix and λ be an eigenvalue of A.
   (a) Show that λ^2 is an eigenvalue of A^2. More generally, are the eigenvalues of the product of two matrices the same as the product of the eigenvalues of the two matrices?
   (b) Show that $\lambda + \lambda$ is an eigenvalue of $A + A$. More generally, are the eigenvalues of the sum of two matrices the same as the sums of the eigenvalues of the two matrices?

Sub-section A.II: Answer at least one question from this sub-section

4. Answer both parts.

   (a) Let X denote a random variable with finite mean τ and variance σ^2. Show that for any $k > 0$

   $$P\{|X - \tau| \geq k\} \leq \frac{\sigma^2}{k^2}$$

   (b) A post office handles 10,000 letters per day with variance of 2,000 letters. What can be said about the probability that this post office handles between 8,000 and 12,000 letters tomorrow?
   What about the probability that more than 15,000 letters come in?

5. A research program studies the human health risk from recreational contact with water contaminated with pathogenic microbiological material. Water samples were taken from sites identified as having a heavy environmental impact from birds.

   (a) Let π be the true probability that a one-litre water sample from this type of site contains pathogenic material. What is the distribution of y, the number of samples containing the pathogenic material?

   (b) Out of $n = 116$ one litre water samples, $y = 17$ samples contained the pathogenic material. Using a *Beta* (1,2) prior for π, find $g(\pi|y)$, the posterior distribution of π given y.

   (c) Find the *normal* approximation to this posterior distribution.

   N.B. A random variable $X \sim Beta(\alpha, \beta)$ if its probability density function has the form

   $$f_X(x) \propto \left\{ \begin{array}{ll} x^{\alpha-1}(1-x)^{\beta-1} & 0 \leq x \leq 1 \\ 0 & elsewhere \end{array} \right\}$$

   Furthermore $E(X) = \frac{\alpha}{\alpha+\beta}$ and $Var(X) = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$.

6. Given a sample of size n from the Bernoulli (point binomial) distribution

   $$f(x;\theta) = \theta^x(1-\theta)^{1-x}, \qquad x = 0, 1,$$

   show that $\overline{X}$ is a sufficient statistic for θ. Is it efficient?

Sub-section A.III: Answer at least one question from this sub-section

7. Let $f : (1, \infty) \to \mathbb{R}$ be the function defined by $f(x) = (\ln x)^{\exp x}$. Let A and B be constants such that $y = Ax + B$ is the equation of the line tangent to the graph of this function at the point $(e, f(e))$, where $e = \exp(1)$ is the mathematical constant.
   (a) Evaluate A and B.
   (b) Draw this line on an xy-coordinate plane, and evaluate the area of the triangle formed by this line, the x-axis and the y-axis.

8. Suppose that temperature varies continuously on a circle. Show that there must be two antipodal points on this circle at which the temperature is identical.

9. There are two firms A and B who engage in quantity competition, with firm A choosing production quantity first.
   (a) Firm B chooses a production quantity r (having observed firm A's production quantity q) to maximize profits $\Pi^B = (10 - q - r)\, r - \delta r$. Assume that there is a strictly positive solution $r^*(q, \delta)$. Show that $\Pi^B_{rr} < 0$ and find $\frac{\partial r^*}{\partial q}$ and $\frac{\partial r^*}{\partial \delta}$.
   (b) Knowing that firm B will respond as above, firm A chooses q to maximize $\Pi^A = (10 - q - r^*(q, \delta))\, q - c(q, \gamma)$, where $c_q > 0$, $c_{qq} > 0$, and $c_{q\gamma} < 0$. What might γ represent? Assume that there is a strictly positive solution $q^*(\gamma, \delta)$. Show that $\Pi^A_{qq} < 0$ and find the signs of $\frac{\partial q^*}{\partial \gamma}$ and $\frac{\partial q^*}{\partial \delta}$.

SECTION B

Sub-section B.I: Answer only one question from this sub-section

10. Answer all parts.

(a) Let V be a vector subspace of $\mathbb{R}^n$ with an orthogonal basis $\{v_1, ..., v_p\}$, and let $\{w_1, ..., w_q\}$ be an orthogonal basis of $V^{\perp}$. Show that the set $\{v_1, ..., v_p, w_1, ..., w_q\}$ is an orthogonal set.

(b) Let

$$\tilde{v}_1 = \begin{pmatrix} 3 \\ -1 \\ 2 \end{pmatrix}, \ \tilde{v}_2 = \begin{pmatrix} 1 \\ -1 \\ -2 \end{pmatrix}$$

and let $\tilde{V} = Span\{\tilde{v}_1, \tilde{v}_2\}$. Find a set of vector(s) $\{\tilde{w}_1, ..., \tilde{w}_q\}$ that span $\tilde{V}^{\perp}$.

(c) Is the set $\{\tilde{v}_1, \tilde{v}_2, \tilde{w}_1, ..., \tilde{w}_q\}$ an orthogonal basis for $\mathbb{R}^3$? Explain your reasoning carefully. Comment on the relationship of the dimensions of $\tilde{V}$, $\tilde{V}^{\perp}$ and $\mathbb{R}^3$.

11. Imagine an online retailer with two types of customers: *one-time* customers and *repeat* customers. Let the number of one-time and repeat customers in month t be o_t and r_t, respectively. Any given customer is either a one-time or a repeat, but no customer is both in a given month. A one-time customer can become a repeat customer. Data from the retailer shows that each month 40% of one-time customers remain one-time customers (i.e. they have not placed any additional orders since the first time they have used the retailer) and that there is a 90% chance that repeat customers continue to buy the retailer's goods.

(a) Write the evolution of the retailer's customers over time as a system of difference equations.

(b) Show that in the long run this retailer will not have enough business to survive.

(c) The retailer is now considering introducing a referal incentive scheme that will encourage its repeat customers to get a friend of theirs to try the retailer. What is the minimum per-month referal success rate ρ from the repeat customers that will keep the retailer afloat in the long run? What proportion of one time to repeat customers will the retailer have in the long run for such a referal rate ρ?

Sub-section B.II: Answer only one question from this sub-section

12. Let E, C, and M, represent three binary random variables denoting, respectively, recovery from an illness, whether a drug was taken, and gender. Eighty individuals suffering from a given disease were randomly sampled from a population of sufferers. Table 1 (on the next page) shows some summary statistics on the joint distribution, $f(E, C, M)$, by treatment, recovery and gender.

(a) We observe that

$$\begin{aligned} \widehat{\mu}_{E|C} &> \widehat{\mu}_{E|\bar{C}} \\ \widehat{\mu}_{E|C,M} &< \widehat{\mu}_{E|\bar{C},M} \\ \widehat{\mu}_{E|C,\bar{M}} &< \widehat{\mu}_{E|\bar{C},\bar{M}} \end{aligned}$$

where $\widehat{\mu}_{E|C} > \widehat{\mu}_{E|\bar{C}}$ indicates that recovery rate for patients taking the drugs exceeds that of the control. Explain these paradoxical results.

(b) The joint distribution of the two random variables E and C is:

$$f_{E,C}(e, c) = f_{E|C}(e|c) f_C(c)$$

By considering this joint distribution in conjunction with the full distribution $f(E, C, M)$, demonstrate that the paradox arises from a problem of endogeneity.

(c) An analyst has access to the data on the eighty individuals that were used in the study. In examining the relationship between recovery and treatment he specifies the following regression equation:

$$E_i = \alpha + \beta C_i + \varepsilon_i,$$

α and β are unknown parameters and $\varepsilon_i \sim i.i.d(0, \sigma_2)$. How might this equation be modified to control for endogeneity?

Table 1: Combined (Males and Females)

	E	$\bar{E}$	Total
Drug (C)	20	20	40
$\bar{C}$	16	24	40

Males

	E	$\bar{E}$	Total
Drug (C)	18	12	30
$\bar{C}$	7	3	10

Females

	E	$\bar{E}$	Total
Drug (C)	2	8	10
$\bar{C}$	9	21	30

13. The pdf for a Pareto distribution is

$$f(y) = \alpha y^{-(\alpha+1)}, \quad 0 < \alpha < \infty, \; y \geq 1$$

(a) Obtain the quantile function. What is the value of the median when $\alpha = 1$?

(b) Show that the mean only exists for $\alpha > 1$. Given a random sample of size n, find a simple method of moments estimator for α.

(c) Derive the ML estimator for α and find its asymptotic variance. What advantages might the ML estimator have over the simple MM estimator?

(d) Suppose we reparameterize by setting $\alpha = \exp(\theta)$ and maximize the likelihood function with respect to θ, where $-\infty < \theta < \infty$. What is the 95% confidence interval for θ?

(e) Construct a (large sample) likelihood ratio (LR) test of the null hypothesis that $\alpha = 1$ against the alternative $\alpha \neq 1$. Would the LR test of $\theta = 0$ give the same result?

Sub-section B.III: Answer only one question from this sub-section

14. Answer all parts.

(a) What does it mean for a production function $f : \mathbb{R}^3 \to \mathbb{R}$ with three inputs to have *constant returns to scale*? Define carefully.

(b) Suppose that $g : \mathbb{R}^3 \to \mathbb{R}$ has continuous partial derivatives with respect to all three of its variables. If x, y, and z are differentiable functions from $\mathbb{R}$ to $\mathbb{R}$, then express $\frac{d}{dt}g(x(t), y(t), z(t))$ using the chain rule.

(c) Let $f : \mathbb{R}^3 \to \mathbb{R}$ be a *constant returns to scale* production function with three inputs: *capital*, *labour*, and *technology*. Prove that

$$f_{21}(K, L, T)K + f_{22}(K, L, T)L + f_{23}(K, L, T)T = 0.$$

Recall that f_i denotes the partial derivative of f with respect to its ith variable.

15. Answer all parts.

(a) Find the solution to the differential equation $\frac{d^2y}{dx^2} = y$ which satisfies the initial conditions $y(0) = 3$ and $y'(0) = 1$.

(b) This differential equation can be written in the form $z' = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} z$ where $z = \binom{y}{y'}$. The Euler approximation with step size δ to $z(\delta n)$ is $z_n = \binom{y_n}{y'_n}$, where $z_0 = \binom{3}{1}$ and $z_{n+1} = z_n + \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} z_n\delta$. Here y_n is the approximation to $y(\delta n)$ and y'_n is the approximation to $y'(\delta n)$. Find z_n and hence the approximation y_n to $y(\delta n)$.

(c) Given that $\lim_{x\to 0} \frac{\log(1+\alpha x)}{x} = \alpha$, find $\lim_{n\to\infty} n \log\left(1 + \frac{\alpha}{n}\right)$ and hence show that $\left(1 + \frac{\alpha}{n}\right)^n \to e^\alpha$, as $n \to \infty$.

(d) Given a particular value of $x > 0$, give the Euler approximation to $y(x)$ using n steps of size $\delta = \frac{x}{n}$. Show that this converges to $y(x)$ as $n \to \infty$.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT2
ECONOMICS TRIPOS PART IIA

Friday 5 June 2015 1:30pm-4:30pm

Paper 7

LABOUR

Answer **FOUR** questions only.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

1. In most countries, education is subsidised, either by fellowships for the cost of living or by subsidies for the direct cost of education (teacher salaries, classrooms and lecture halls). Using the implications of various theoretical models to support your arguments, briefly discuss the following arguments surrounding the subsidisation of education:

   (a) When and why might education be left to the market?

   (b) When might education be subsidised? Distinguish between efficiency and distributional arguments. Use relevant empirical evidence to illustrate your answer.

   (c) Is there an argument for taxing education? Again, distinguish between efficiency (either Pareto or Hicks-Kaldor) and distributional arguments and cite relevant empirical evidence.

2. In a duopsonistic labour market, both firms have constant marginal product but firm B has a higher marginal product than firm A.

   (a) What are the consequences of this differential productivity on the equilibrium market outcomes?

   (b) What happens to these equilibrium outcomes if the transport cost goes up?

3. In the UK there is about a 60 point gap in test scores between 15 year olds whose mothers have high and low levels of education (this is based on PISA test scores, and international assessment of skills and knowledge). The government is considering basing school accountability on average growth in achievement of students in the school rather than the current system that is based on the proportion of students who get a C or better on 5 of their GCSEs.

   (a) Explain the potential tradeoffs between these two systems.

   (b) Is there a way you might modify the government's proposed strategy to narrow the achievement gaps? Explain.

4. "Globalisation is not responsible for rising wage inequality because the Heckscher-Ohlin model has been rejected by empirical studies." True or false? Explain your answer.

5. The small country of Islandia produces two goods: cellphones and appliances. Islandia is a price-taker on world markets and the relative price of cellphones to appliances is equal to 1. The country is inhabited by three types of people: unskilled workers (L), skilled workers (S) and capital owners (K). Unskilled workers can work in either sector. Skilled workers are only productive in the cellphone industry. Each capital owner owns one unit of capital which is useful in the production of appliances. The output of cellphones (Q_c) and appliances (Q_a) takes place according to the following production technologies:

$$\begin{aligned} Q_c &= L_c^{0.5} S^{0.5} \\ Q_a &= L_a^{0.5} K^{0.5} \end{aligned}$$

where, under full employment of unskilled workers, $L_c + L_a = L$. There are 440 million unskilled workers, 60 million skilled workers, and 50 million capital owners living in Islandia.

(a) Derive the demand curve for unskilled labour in each sector of the economy, find the equilibrium allocation of unskilled labour, the equilibrium level of output in each sector, the wage of unskilled workers and the wage of skilled workers.

(b) Islandia does not allow immigration. Wages of both skilled and unskilled workers in Islandia are high relative to a neighbouring economy. The government in Islandia is considering two immigration policy proposals. Proposal A would allow immigration of 110 million unskilled workers, but no immigration of skilled workers. Proposal B would allow immigration of 40 million skilled workers, but no immigration of unskilled workers. Which residents of Islandia, if any, will support proposal A and which will oppose it? Which residents of Islandia, if any, will support proposal B and which will oppose it? Justify your answer. Suppose an objective of immigration policy is to reduce inequality in Islandia. Discuss whether the proposals under consideration could achieve this goal.

(c) An alternative proposal to maintain immigration restrictions but allow the outsourcing of tasks to a foreign economy is put forward. What can you say about the welfare consequences of this alternative proposal for the residents of Islandia? Clearly state any assumptions you need to make to support your conclusions.

6. Consider a unionised firm with a linear labour demand curve $L = a - bW$. The market wage is equal to $\overline{W}$. The firm has no fixed cost, so its profit is equal to its producer surplus.

   (a) State the employment level that would prevail without a union.

   (b) The union has a membership greater than this level of employment. It strives to maximise the total amount of rent for its members. Give an expression for this total amount of rent. The bargaining between the union and the firm follows the right-to-manage model. Calculate both the wage level and employment.

   (c) Draw a diagram showing the total rent for the union, the firm's profit and the efficiency loss under this right-to-manage model. Give expressions for these amounts.

   (d) Suppose that the union and the firm meet and agree to switch to the efficient-bargaining model and decide to share the efficiency gain compared to the outcome under the right-to-manage model equally. What will be the level of employment and why? What are the profits of the firm? And what is the wage level?

   (e) Describe how the results for wage levels and employment would differ in the right-to-manage model analysed in (b) above if the union only cared about the insiders, those currently employed by the firm, denoted M, if (i) $M > L^{\text{right to manage}}$ and (ii) $M < L^{\text{right to manage}}$.

   (f) Now suppose that a fixed fraction of the workforce leaves the firm for retirement every period. What is the implication for the evolution of both employment by the firm and union membership?

7. Since 1970 the UK has introduced legislation aimed at reducing gender inequalities within the labour market.

   (a) Outline the provisions of the main pieces of relevant legislation.

   (b) Evaluate how successful the legislation has been in achieving this goal.

   (c) Discuss the form that any further intervention required might take.

8. There is a contradiction inherent in the use of deferred compensation to motivate effort and in recent pension reforms.

   (a) How might deferred compensation be used to motivate effort? Use a diagram to illustrate this motivational effect.

   (b) Discuss the contradictions that motivating effort through deferred compensation might pose with recent pension reforms.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Thursday 21 May 2015 9:00-12:00

Paper 1

MICROECONOMIC PRINCIPLES AND PROBLEMS

Answer **FOUR** questions only.
Answer all parts to the question.
Each question carries equal weight.
Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

1. The Social Mobility and Child Poverty Commission wants to "restart the twin engines of social mobility: Education and Housing" to increase social mobility in the United Kingdom. Based on the evidence from the United States, evaluate critically how this can best be done.

2. Much of the blame for the recent financial crisis has been placed on the contracts that bankers had. The government is considering two policy options:
   (a) Restricting the use of bonus pay for bankers
   (b) Forcing bankers to bear the consequences of their losses

   What might the govenment's objectives be in considering these policies? What are the likely impacts of each policy on the behaviour of bankers? Why have these two features of contracts not been introduced already by shareholders?

3. A government agency needs to establish the shadow price of an input to an infrastructure project. The input is traded in a competitive market. The producers of the input receive a unit subsidy:
   (a) Suppose that the economy is closed. The project is expected to have a big effect on the market price of the input. Show how to determine the shadow price of the input?
   (b) Explain carefully why a small price effect can be ignored in the calculation of shadow prices. Suppose the price effect of the project is small. What is the shadow price now?
   (c) Suppose that the economy is small and open to international trade. The economy is a net exporter of the input. What is the shadow price of the input?

4. (a) Explain the difference between the utility and the consumption discount rate. Is the consumption discount rate always larger than the utility discount rate? Explain.
   (b) Suppose that a public sector project which enables higher consumption in the future leads to a fall in private investment in the present. Under which conditions would it be appropriate to use the consumption discount rate as the social discount rate?

5. A government official investigates the expected consequences of a new subsidy to producers of good x. The official concludes that the industry is competitive and that the good is a normal good.
   (a) Suppose that the production technology exhibits constant returns to scale. What is the fiscal cost of the subsidy? Who would the subsidy primarily benefit? What is the deadweight cost of the subsidy?
   (b) Will it make a difference to your conclusions in (a) if the supply of x is perfectly inelastic? Explain carefully.
   (c) Suppose that the marginal cost of public funds is greater than 1. Explain how this affects the evaluation of the efficiency cost of the subsidy.

6. (a) Why is so much health care provided by governments in rich as well as in poor countries when most of the benefits are private?

   (b) In 2011, average life expectancy at birth in the US was 78.7 years compared to the OECD average of 80.1 despite the fact that US per capita health care spending was 2.5 times the OECD average. To what extent can information asymmetries help explain these facts?

7. Collective bargaining enables trade unions to share profits with firms. As a consequence, the wage in the unionised sector (eg. manufacturing) increases relative to the wage paid in the non-unionised sector (eg. services).

   (a) Does collective bargaining cause production inefficiencies?

   (b) What are the conditions for the Diamond-Mirrlees production efficiency result? Can the production efficiency result be applied to advocate restrictions on workers' rights to organise trade unions? If so, how?

   (c) Could it be optimal for a government to impose specific taxes or subsidies on non-labour inputs in the unionised sector of the economy? If so, at what level should they be set?

8. Please indicate whether each of the following statements is true, false or uncertain and explain your answer. No credit will be given for answers without explanations.

   (a) An advantage of quasiexperimental methods (eg. difference-in-differences, regression discontinuity and instrumental variables) relative to randomized control trials is greater generalizability.

   (b) You have data on school performance in an area that experienced an earthquake. The damage to schools from the earthquake depended on the distance from the centre of the earthquake. Distance of the school from the earthquake would provide a good instrument for determining the effect of number of school days missed on student performance.

   (c) In an effort to improve student achievement, the government implements a policy in which students have to perform above a given threshold on tests in order to be promoted to the next school year. Those that perform below the threshold will be retained (meaning they have to repeat the grade). Given data on wages at age 25 and performance on the exam used to determine whether the student is promoted or retained, a regression discontinuity estimator would provide a good estimate of the effect of grade retention on wages.

9. You have data for a nationally representative sample of kindergarteners in the US that follows them until third grade (an excerpt of the Early Childhood Longitudinal Survey of Kindergarteners). You are interested in determining the effect of teacher quality on behavioural test scores. Results from some regressions are reported in table 1 below (more details on the data are included in the footnote of the table).

   (a) Column (1) reports an OLS regression of the student's behavioural test score (a measure of self control) on student characteristics and teacher quality, measured through teacher experience and whether the teacher has a master's degree. Column (2) adds in the lagged behavioral test score of the student. Interpret estimates of the effect of teacher quality and compare estimates across columns (1) and (2). Is it useful to control for the lagged behavioural test score? Explain.

   (b) Column (3) includes school fixed effects. How do results compare to columns (1) and (2)? Explain whether this matches your intuition. Do these estimates help provide information about the effects of teacher experience and teachers having a master's degree on student behaviour?

   (c) Now suppose that some states decide to require that all teachers have a masters' degree in order to be able to teach. You have longitudinal data on average student behavioural test scores across states both before and after these policies were introduced. Can you use this information to improve upon your estimates of the effect of teachers having a masters' degree? Explain in detail how you could use this information and the assumptions needed for your strategy to provide an unbiased estimate of the effect of teachers having a masters' degree.

Table 1: Effect of Teachers on Behavioural Test Scores

	(1) Whole	(2) Whole	(3) Whole/FE
Male	-0.3389	-0.2201	-0.2010
	[0.0152]	[0.0206]	[0.0213]
white	0.0018	-0.0589	-0.0780
	[0.0271]	[0.0375]	[0.0470]
black	-0.3052	-0.3020	-.2978
	[0.0349]	[0.0492]	[0.0669]
Hispanic	-0.0134	-0.0305	-0.0667
	[0.0339]	[0.0477]	[0.0596]
age	0.0156	0.0041	0.0014
	[0.0057]	[0.0100]	[0.0105]
Socioeconomic status	0.1296	0.0988	0.0872
	[0.0104]	[0.0141]	[0.0177]
Class Size	0.0051	0.0033	0.0041
	[0.0017]	[0.0025]	[0.0049]
Teacher Experience	0.0097	0.0081	0.0026
	[0.0030]	[0.0039]	[0.0047]
Teacher Experience^2	-0.0004	-0.0003	-0.0002
	[0.0001]	[0.0001]	[0.0001]
Teacher has Master's degree	0.0669	0.0868	0.0807
	[0.0164]	[0.0219]	[0.0273]
Lagged behavioural test score		0.3670	0.3483
		[0.0109]	[0.0116]
Constant	-0.033	0.0434	0.0992
	[0.0597]	[0.1010]	[0.1379]
Observations	15233	7363	7363
R-squared	0.0586	0.191	0.3153

Standard errors in brackets. Data Source: Early Childhood Longitudinal Survey of Kindergarteners in 1998/99. The data surveys a cohort of kindergarteners in 1998/99 and follows them over time. There are 3 observations for each student in the sample used for this table, taken at the end of kindergarten, end of first grade and end of third grade. Dependent variable is taken from behavioural test measuring a student's self control. Along with teacher characteristics (experience and master's degree) and class size, controls include whether the student is male, white, black or Hispanic, as well as the age and socioeconomic status of the student.

(TURN OVER)

10. In a country educated workers can be either doctors (denoted d) or engineers (e). Doctors require 2 periods of education and engineers 4 periods. Assume that inhabitants devote 10 periods of their life to education and work and that prior to educating themselves all workers are identical except for their gender, with half of the workers being men and half being women. In addition, wages for the educated are strictly decreasing in labour supply and capital markets are perfect with a zero interest rate. The lifetime utilities U of workers are given by

$$U = \sum_{t=1}^{10} \ln\left(1 + c_{i,t}\right)$$

where $c_{i,t}$ is consumption in period $t = 1, ..., 10$ for an individual in occupation $i \in \{0, e, d\}$, where 0 denotes other workers who have no education. Analogously, $w_{i,t}$ is wage in period t for an individual i. Finally, over their lifetime workers cannot consume more than their income:

$$\sum_{t=1}^{10} c_{i,t} \leq \sum_{t=1}^{10} w_{i,t}$$

(a) If there is an equilibrium where workers overall are equally distributed across the three occupations and where $w_0 = 60$, then what are the wages of doctors w_d and engineers w_e?

(b) If women only devote 8 periods of their life to education and work instead of 10. What will happen to w_d and w_e if demand for uneducated labour is perfectly elastic at $w_0 = 60$ and demand for doctors and engineers is strictly positive at any wage? What does the gender distribution across occupations look like?

(c) Assume in addition there are complementarities for women between being a doctor and time not spent in education and work (eg if there are non-wage benefits of being a doctor). Explain qualitatively how your answer in (b) might change.

(d) Empirically the distribution of men and women across occupations differs and the returns to schooling are typically higher for men than for women. Could your answers above help to explain these observations?

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Friday 22 May 2015 2:00-5:00

Paper 2

MACROECONOMIC PRINCIPLES AND PROBLEMS

Candidates are required to answer **FOUR** questions only.

Each question will carry equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

1 'The Euro Area falls so far short of being an Optimal Currency Area that it will require radical reforms to governance in Europe if the Euro is to be a long run success.' Discuss this statement in the context of proposals for reform since the financial crisis.

2 Thomas Piketty in his book, '*Capital in the Twenty-First Century*', has documented that the wealth-income ratio in rich countries has increased from roughly 200-300% in 1970 to 400-600% in 2010. He uses standard analytical results of the Solow growth model to make predictions about inequality (i.e., the division of income between labour and capital) in the future. Evaluate these findings and predictions.

3 The US has long been earning a higher return on its foreign assets than it pays on its foreign liabilities - according to conservative estimates, the difference is about 1.5 percentage points for the period post 1973.
What can explain this 'exorbitant privilege' of the US?

4 In the Real Business Cycle model random fluctuations in productivity induce persistent movements (through time) in aggregate output, investment and consumption.
Discuss the two sources of persistence in output fluctuations present in this model. Make sure:
(i) you clearly state what assumptions - on model primitives like household preferences and/or production technology - are necessary for each source of persistence to be present and:
(ii) explain the mechanism through which each assumption delivers persistent movements in aggregate output.

5 Consider a continuous time Solow growth model. There is a large set of identical firms indexed by 'i'. The production technology of firm i is represented by:

$$Y^i(t) = A^i(t)K^i(t)^\alpha L^i(t)^{1-\alpha}, \ \alpha \in (0,1),$$

where $Y^i(t)$ corresponds to the output of firm i, $K^i(t)$ is the capital stock used by firm i, and $L^i(t)$ is labour employed by firm i. A productivity factor is given by $A^i(t) = Y(t)^\phi$, where $Y(t)$ is aggregate output and $\phi \in (0,1)$. Moreover, $\phi + \alpha < 1$. The labour force grows at a constant rate n and households save a fraction $s \in (0,1)$ of income. Assume that investment equals savings. Aggregate capital stock evolves according to the following equation of motion:

$$\dot{K}(t) = I(t) - \delta K(t), \ \delta > 0,$$

where $I(t)$ denotes investment and δ is the depreciation of the capital stock.

(a) What is the intuition behind $A^i(t) = Y(t)^\phi$?
(b) Show that the economy exhibits a balanced growth path with a positive long-run growth rate in output per worker.
(c) Does the economy converge to this balanced growth path equilibrium? Explain.
(d) Suppose that the economy is initially on a balanced growth path equilibrium. Consider a change in immigration laws such that it is harder for immigrants to move from another country, so the economy's underlying labour force growth rate decreases ($n' < n$). Describe the effects of such a policy on the dynamics of output per worker of this economy. Be sure to distinguish between short-run and long-run effects.

6 Consider a small open economy lasting for two periods, populated by identical agents with expected utility:

$$\mathcal{W} = U(C) + E_t U(C_1)$$

C is consumption in the first period and C_1 is consumption in the second period. Preferences are such that marginal utility $U'()$ is strictly convex. Output, Y, is exogenous. Residents can borrow or lend in an international market at a given rate, R.

In the initial period $Y = 8$. In the second period, according to available forecasts:

$$Y_1 = \begin{cases} Y_{1H} = 12 & \textit{probability } 0.6 \\ Y_{1L} = 7 & \textit{probability } 0.4 \end{cases}$$

A revision of the above forecasts yields:

$$\widetilde{Y}_1 = \begin{cases} \widetilde{Y}_{1H} = 15 & \textit{probability } 0.5 \\ \widetilde{Y}_{1L} = 5 & \textit{probability } 0.5 \end{cases}$$

where $\widetilde{Y}_1$ denotes revised figures.

(a) Define the real interest rate under financial autarky $\mathcal{R}^{FA}$.

(b) How would the real interest rate in financial autarky change with the *revision* of the output forecasts? I.e., how does $\widetilde{\mathcal{R}}^{FA}$ (after the revision) compare with the pre-revision $\mathcal{R}^{FA}$?

(c) What are the implications of the revision for the current account of the country in the initial period? Explain.

(d) According to the former chairman of the Federal Reserve Board, Ben Bernanke, the US current account deficit in the last two decades is caused by a 'saving glut' at world level. In light of the evidence on 'global imbalances,' briefly explain how the above model can help us to understand the 'saving glut' hypothesis by Bernanke.

(e) Suppose that the residents of the country have the following preferences:

$$U(C) = 30C - C^2$$

Using these preferences, can you verify numerically your answer to (b) above? Why or why not?

7 It is 1810 and Albion is at war with Francia. The national debt of Albion is 200% of nominal income. Government expenditure is 15 % of nominal income and taxes raise 5% of income. Assume that the Government always pays an interest rate of 3% on its borrowings. The outcome of the war is uncertain. Assume inflation is zero.

(a) Describe a model of government expenditure, debt and sustainability to show how debt evolves over time.

(b) Describe a possible path for national debt using a diagram when:

(i) The real interest rate is greater than the growth rate of the economy.

(ii) The real interest rate is less than the growth rate of the economy.

In 1814 Francia is finally defeated at the Battle of Kings Cross and the Albion Government cuts military expenditure, so now government expenditure is reduced to 5% of national income. Taxes remains the same.

(c) Now describe a new path for national debt when:

(i) The real interest rate is greater than the growth rate of the economy.

(ii) The real interest rate is less than the growth rate of the economy.

(d) We know that the debt-income ratio of Albion declined to about 30% by 1914. Why have we not observed similar declines in European debt-income ratios since the 1970s?

8 Output and inflation are determined by:

$$y_t = -\lambda r_t + \eta_t,$$

$$\pi_t = \pi_t^e + \beta y_t + \varepsilon_t$$

where y_t is the output gap, $r_t = i_t - \pi_t^e$ is the real interest rate, i_t is the nominal interest rate and π_t^e is the expected inflation rate. The random shocks η_t and ε_t are mean zero, independent and serially uncorrelated with variances σ_ε^2 and σ_η^2. Assume that the Central Bank can observe the shocks perfectly.
The Central Bank minimises a quadratic loss function

$$L_t = \delta[y_t^2] + (\pi_t - \pi^*)^2$$

Assume that the inflation target, $\pi^* = 0$, and expectations are rational.

(a) What is the optimal feedback rule for the nominal interest rate? Discuss the properties of this rule.
(b) What does this rule imply for the equilibrium processes for output and inflation?
(c) What does this rule imply for the volatilities of output and inflation?

Assume now that the shock to demand, η_t, is no longer observed perfectly. Instead the Central Bank relies on its own estimates of the demand shock and an average of forecasts produced outside of the central bank. These unbiased estimates are:

$$\widetilde{\eta}_{1t} = \eta_t + \zeta_t$$

$$\widetilde{\eta}_{2t} = \eta_t + \psi_t$$

$\widetilde{\eta}_{1t}$ is the Central Bank's forecasts and $\widetilde{\eta}_{2t}$ is the average of outside forecasts. ζ_t and ψ_t are mean zero, independent and serially uncorrelated with variances σ_ζ^2 and σ_ψ^2 which measure the degree of precision of the two forecasts. The Central Bank combines these estimates using a weighted average of the two estimates of the form

$$\eta_t^c = (1-\kappa)\widetilde{\eta}_{1t} + \kappa\widetilde{\eta}_{2t}$$

(d) How should the Central Bank determine the relative weight, κ?
(e) How does this affect the feedback rule?

9 Consider the following model.

Technology: There exists a representative firm which operates a production technology given by a constant returns to scale Cobb-Douglas function:

$$Y_t = F(Z_t, K_t, L_t) = Z_t K_t^{\alpha} L_t^{1-\alpha}$$

where Y_t is output at time t, K_t is the capital input rented by the firm at time t and L_t is the total amount of labour input hired by the firm at time t. α is a real number such that $\alpha \in (0, 1)$, and Z_t is a random variable determining the total factor productivity of the representative firm at time t.

Households: There exists an infinitely lived representative household whose expected lifetime utility is given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \log(C_t)$$

where β is a discount factor such that $0 < \beta < 1$, C_t is the consumption of the household at time t and $\log(.)$ is the natural logarithm. The household owns the factors of production, K_t and L_t, and rents them out to the firms at prices r_t (the rental rate of capital) and w_t (the wage rate) every period. The proceeds from renting the factors of production form the income of the household at period t. This income is spent on consumption, C_t, or on investment, I_t, in the capital stock. The capital stock depreciates every period at rate δ, such that:

$$K_{t+1} = I_t + (1 - \delta)K_t$$

(a) Solve the maximization problem of the household, giving the optimal choices of capital and labour at every period t, and show that its solution implies an Euler equation linking consumption in consecutive periods. Briefly interpret this Euler equation.

Assume that the representative firm takes input prices as given and cannot influence them. The firm's maximization problem is

$$\max_{K_t, L_t} \left[Z_t K_t^{\alpha} L_t^{1-\alpha} - w_t L_t - r_t K_t \right]$$

with first order conditions:

$$\begin{aligned} \frac{\partial \Pi_t}{\partial K_t} &= \alpha Z_t K_t^{\alpha-1} L_t^{1-\alpha} - r_t = 0 \\ \frac{\partial \Pi_t}{\partial L_t} &= (1-\alpha) Z_t K_t^{\alpha} L_t^{-\alpha} - w_t = 0 \end{aligned}$$

(b) Briefly interpret the first order conditions.

(c) Assume that the total labour endowment, at every period, is given by $L_t = 1$ and that capital depreciates fully every period, i.e. $\delta = 1$. Show now that the conditions in (b) imply that in equilibrium the law of motion for capital is given by:

$$K_{t+1} = \alpha \beta Z_t K_t^{\alpha}$$

(d) Assume that the log of total factor productivity evolves according to the following stationary first order autoregressive, AR(1), process:

$$\log(Z_t) = z_t = \mu z_{t-1} + \varepsilon_t$$

where ε_t is an i.i.d. disturbance.
Show that given:

(i) the assumption $L_t = 1$;

(ii) the expression for capital in part (c) and;

(iii) the production function;

that this together implies that the log of output follows an AR(2) process in equilibrium. Based on this briefly discuss why and when the above model can be expected to generate an hump-shaped impulse response to a one-time shock to total factor productivity.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Wednesday 27 May 2015 9:00-12:00

Paper 4

ECONOMIC THEORY AND ANALYSIS

Answer **FOUR** questions only.

Answer all parts to the question.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

1. (a) Consider the following two-player game, where 1 is the row player and 2 is the column player:

	A_2	B_2	C_2
A_1	a, b	$1, 2$	c, d
B_1	$1, 1$	$0, 0$	$1, 1$
C_1	e, f	$1, 2$	g, h

where a, b, c, d, e, f, g, h are payoffs such that $2a+e > 3, 2c+g > 3, b+2d > 6$, and $f + 2h > 6$.

i. Show that for each player, strategy B is strictly dominated by another strategy (possibly a mixed one).

ii. Find conditions (inequalities) on a, b, c, d, e, f, g, h such that no player has a dominant strategy.

iii. When the conditions in part (ii) above are satisfied, find the mixed strategy Nash equilibria of the game.

(b) By means of an example or otherwise show that rational players do not necessarily choose a Nash equilibrium in normal form games.

(c) Discuss the role of common beliefs and common knowledge of beliefs in justifying the concept of Nash equilibrium in complete information normal form games.

2. (a) Consider the 2-player game G described by

	A_2	B_2	C_2
A_1	$4,4$	$-1,5$	$-1,0$
B_1	$0,-1$	$-1,-1$	$2,0$
C_1	$5,1$	$0,2$	$0,0$

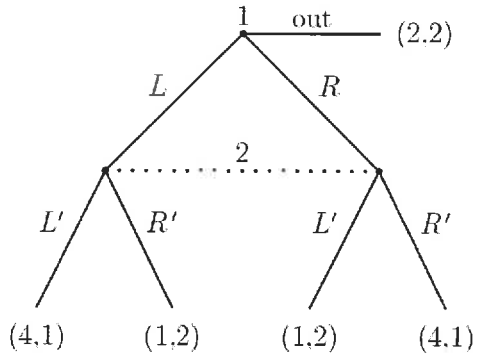
i. Suppose that players choose pure strategies. Compute the Nash equilibria and the minmax payoffs for each player.

Suppose G is played infinitely often, players have a common discount factor $\delta < 1$, players choose pure strategies and there is perfect monitoring.

ii. Describe a strategy profile that is a subgame perfect equilibrium for *every* discount factor δ.

iii. Show that the payoff vector $(4,4)$ can be sustained as a subgame perfect equilibrium average payoff profile *if and only if* $\delta \geq 1/5$.

(b) Consider the following extensive form game:



i. Describe the set of all mixed strategy perfect Bayesian equilibria of the game. Are any of the equilibria pure?

ii. Describe the set of all mixed strategy perfect Bayesian equilibria if we modify the game by changing the outcome associated with playing (L, L') to $(1,1)$ (instead of $(4,1)$). Are there any pure strategy equilibria in this case?

3. (a) Describe the two-sided, many-to-one matching environment with strict preferences. (Use the firms-workers terminology.) Give the formal definition of a stable matching.

   (b) Do stable matchings always exist? If yes, prove it. If not, give an example which does not admit any stable matching.

   (c) State the *rural hospitals theorem* and prove it.

   (d) If we allow weak preferences, do your answers to the above questions change? If not, explain why not. If yes, give an example which illustrates how the conclusions might change.

4. Consider the first price auction for a single indivisible object between two bidders $i = 1, 2$. Each bidder i draws an independent signal t_i which is uniformly distributed on the unit interval. Given signals t_i and t_j, the valuations of the bidders are

$$\begin{aligned} v_1 &= 2t_1 + t_2 \\ v_2 &= 2t_2 + t_1. \end{aligned}$$

   If bidder i receives the object and pays p, her utility is $2t_i + t_j - p$. Each bidder knows her own signal, but not the other's.

   (a) What is the expected value of the item to a bidder with type t_i?

   (b) Assume a symmetric equilibrium of the sort $b(t_i) = kt_i + m$, and solve for k and m.

   Now, suppose that the bidders' valuations are given by $v_i = 2t_i + \frac{1}{2}$.

   (c) Compare the expected revenue of the first price auction in this case to the expected revenue of the first price auction in part (b).

   (d) Alternatively, the seller considers selling the object with a fixed posted price. That is, he posts a price q, and if any of the bidders wants to buy the object at that price, they do so. If both want to buy it at that price, the seller decides randomly whom he will trade with, again at that price q. If the seller wants to maximise his expected revenue from this form of sale, what is his optimal choice of q? What is the associated revenue?

5. There are 5 towns and M workers. In each town there is a single firm which produces the unique consumption good using labour as an input. All firms have the same concave production function f, and all workers are mobile. Now suppose that the central government undertakes an experiment in which it imposes a tax t on labour in the towns in $S = \{1, 2, 3\}$.

   (a) Write down the equilibrium conditions for the economy.

   (b) How do wages change in response to the tax? Justify your answer.

   (c) How does labour demand in the towns in S change in response to the tax? Justify your answer.

   (d) How does labour demand in the towns in $N = \{4, 5\}$ change in response to the tax? Justify your answer.

   (e) How do the profits of firms change in towns in S and in N?

   (f) Comment carefully on your answers to parts (b)-(e).

6. There are two investors, two dates and two states of the world. Investor 1 has utility function

$$v(c_{10}) + \pi_1 v(c_{11}) + \pi_2 v(c_{12})$$

   and endowment $e_1 = (5, 4, 1)$, where c_{10} is her consumption at date 0, c_{11} is her consumption at date 1 in state 1, c_{12} is her consumption at date 1 in state 2 and $\pi = (\frac{2}{3}, \frac{1}{3})$. Similarly, investor 2 has utility function

$$v(c_{20}) + \pi_1 v(c_{21}) + \pi_2 v(c_{22})$$

   and endowment $e_2 = (5, 1, 4)$. There is a single real asset with payoff $(1, 0)$.

   (a) Comment carefully on the model.

   (b) Explain carefully what is meant by an equilibrium of this economy.

   (c) Assuming that $v = \log$ (the natural logarithm), find:

      i. the demand for date-0 consumption of each investor;

      ii. the demand for the asset of each investor;

      iii. the date-1 consumption of each investor.

   (d) What is meant by the state-price vector of an investor?

   (e) Find the state price vector of each investor. Comment carefully on these vectors.

7. Consider a model of network formation with undirected networks and heterogeneous costs. The set $N = \{1, \ldots, n\}$ of agents is partitioned into K groups of equal size $J \geq 3$. If agents i and j belong to the same group, then each of them needs to incur a cost of c to form a link between them. If agents i and j belong to different groups, then each needs to incur a cost $C > c > 0$ to form a link.

   The payoff of an agent i in network $\mathbf{g}$ is

$$u_i(\mathbf{g}) = \sum_{j \neq i} \delta^{d(i,j)-1} - \sum_{j: g_{ij} \in \mathbf{g}} c$$

   where $0 < \delta < 1$, and $d(i,j)$ is the geodesic distance between i and j.

   Assume that $c < 1 - \delta$. Prove the following statements:

   (a) If $C < 1 - \delta$ then the unique efficient network is the complete network.

   (b) If $1 - \delta < C < 1 - \delta^2$, and $K = 2$, then the efficient networks have exactly J links between the two groups and in at least one group each player is involved in exactly one of the J links.

   (c) Assume $K = 3$. Show, by means of an example, that all pairwise stable networks might be inefficient. (Provide specific values of C and δ.)

8. (a) Describe the set-up of the standard one-shot public good game experiment, the equilibrium of this game, and the Pareto optimal action profile.

   (b) Now consider public good game experiments with repetition. What do "partners" and "strangers" treatments mean? What is the evidence on how subjects' behaviour differ in the two types of treatment?

   (c) Palfrey and Prisbey (1997) modify the standard public good game set-up by using the following payoff function:

$$\pi_i = r_i(y - x_i) + m \sum_{j \in G} x_j$$

   where y is the initial endowment given to each subject, and $x_i \in [0, y]$ is subject i's contribution decision.

   Give an interpretation of the parameters m and r_i. Briefly describe their experimental design and how their design helps the authors to differentiate among different explanations for contribution patterns.

   (d) What happens to contribution patterns if one introduces the possibility for subjects to punish others? Do the results differ in strangers and partners treatments?

[END OF PAPER]

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Friday 29 May 2015 9:00-12:00

Paper 6

BANKING, MONEY AND FINANCE

This paper is divided into two Sections - A and B.

Candidates are required to answer a total of **SIX** questions:
FOUR out of five questions (one from each course) from Section A
TWO out of five questions (one from each course) from Section B

Each Section carries equal weight.

Unless directed otherwise, answer all parts of the question.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

SECTION A

1 In the spirit of Jevons' double coincidence of wants problem, consider an individual who faces a choice between monetary exchange or direct barter in a world of J goods, where there are 3α search costs for each monetary exchange and α search costs for barter exchange. Solve for the expected search costs faced by this individual in both cases. At what point, in terms of J, will an individual be indifferent between monetary and barter exchange?

2 Explain the factors that may determine the ratio of cash to deposits held in a household's balance sheet. Sketch, using an appropriate model, the impact on this ratio of (i) a positive shock to the marginal efficiency of capital and (ii) a financial crisis.

3 Consider an entrepreneur with no cash but some illiquid asset worth a, who would like to undertake a project, which can take on two values, $R > 0$ ("Success") and 0 ("Failure") with probability $e \in [0, 1]$ and $1 - e$, respectively. The entrepreneur chooses e (effort), which costs her $c(e) = \frac{1}{2}ce^2$, where c is a constant $c > R$. The entrepreneur needs to borrow one unit of capital to undertake her project. This entrepreneur maximises income and her opportunity cost of undertaking this project is $w > 0$. The lender is risk neutral and faces a limited liability constraint. Her payoff is r, the gross loan interest rate, when the project return is high; and a when the project return is low. The opportunity cost of funding this project is $\rho > 0$, which corresponds to a return on a risk-free project. Lenders compete for borrowers, which drives their profits to zero. What is the optimal lending contract when effort is private information of the borrower? Comment on the properties of this contract.

4 As of 2014 some 34 countries have adopted Inflation Targeting.

(a) Why is Inflation Targeting so attractive?
(b) How has Inflation Targeting performed since the financial crisis of 2007/8?
(c) How does Inflation Targeting compare to other policy regimes such as price level targeting and nominal income targeting?

5 You are given the following information about three assets, where μ_j is the mean and σ_j is the standard deviation of asset j:

Asset:	μ_j	σ_j
1	5%	9%
2	10%	40%
3	12%	10%

The risk-free interest rate, r_0, equals 4%.

(a) Calculate and interpret the *Sharpe ratio* for each of the three assets.
(b) Suppose that the risk (standard deviation) of a benchmark portfolio is given by 25%. What, if anything, does this imply about the comparative performance of the assets in terms of risk-adjusted performance (RAP)?
(c) You are now told that a mean-variance efficient portfolio, E, is available with $\mu_E = 8\%$ and $\sigma_E = 8\%$. What inferences can you draw from this information?

SECTION B

6 Vincent Company (VCo) has assets with a market value of \$600 million, \$70 million of which are cash. It has debt of \$250 million, and 20 million shares outstanding. Assume perfect capital markets.

(a) Find VCo's current share price.
(b) Assume that VCo distributes the \$70 million as a dividend. Calculate the stock price after the dividend has been paid.
(c) Assume that VCo distributes the \$70 million as a share repurchase. Calculate the stock price after the share repurchase.
(d) Find the debt-to-equity ratio of VCo if it distributes the \$70 million as a dividend and if it distributes it as a share repurchase.

7 Carefully discuss the microfoundations of credit constraints and how the government could intervene in the credit market to improve its functioning. Then discuss the empirical evidence on which credit friction seems to be more relevant in practice and the implication of this for policies.

8 What are the main predictions of the Capital Asset Pricing Model (CAPM)? Discuss the role and significance of the assumptions needed to obtain the predictions. Finally comment on the empirical success of this model.

9 Consider an economy with a continuum of agents of measure one and a unique good and three dates, with a storage technology that yields a zero net interest and a long-run technology that yields $R > 1$ units with certainty at time $t = 2$ but yields only $L \leq 1$ if prematurely liquidated at time $t = 1$. Both technologies are available to any agent. Each agent is endowed with one unit of the consumption good at time $t = 0$. Of these agents, a proportion π will prefer to consume at time $t = 1$, and the complementary proportion $1 - \pi$ will prefer to consume at time $t = 2$. The agents are *ex-ante* identical but subject to consumption uncertainty: with probability π an agent will want to consume only in period 1 (type 1 consumers), and with probability $1 - \pi$ she can get utility from consuming in either period 1 or period 2 (type 2 consumers). More specifically, utility is:

$$\begin{cases} \ln c_1^1 & \text{for impatient consumers} \\ \beta \ln (c_1^2 + c_2^2) & \text{for patient consumers,} \end{cases}$$

where β is the time discount factor, $0 < \beta < 1$. The *ex-ante* expected utility is

$$\pi \ln c_1 + \beta(1 - \pi) \ln(c_1 + c_2)$$

Assume that $R\beta > 1$.

(a) Explain why the outcome in which agents cannot trade with each other (i.e., autarky) is inefficient.
(b) Find the optimal allocation for this economy.
(c) Consider a banking contract in which a depositor's type is private information. Explain how such a contract can implement the optimal outcome.
(d) What is a bank run? Why is the deposit contract sometimes vulnerable to bank runs?

10 Consider the Phillips curve

$$y = \theta(\pi_t - \pi_t^e) + \epsilon_t$$

where y is the output gap, π_t is the inflation rate, π_t^e is rationally expected inflation and ϵ_t is an iid random process with variance σ_ϵ^2. Assume that $\theta = 1$. The Central Bank's loss function is

$$L = E_t\{\pi^2 + \delta(y - y^*)^2\}$$

The target rate of output, y^*, is higher than the actual level of output.

(a) What equilibrium does this model give for inflation and output?
(b) What are the volatilities of inflation and output?

Suppose transparency is measured by the extent to which the public is sure of the value of δ. In particular, assume that the public observes the value of δ as $\delta' = \delta + \eta_t$, where $\eta_t \sim N(0, \sigma_\eta^2)$. Also assume that η_t and ϵ_t are uncorrelated.

(c) What is the new equilibrium for inflation and output?
(d) What does this imply for the volatilities of inflation and output?
(e) How can the Central Bank improve its transparency when the public is uncertain of the value of δ?

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Monday 25 May 2015 9:00-12:00

Paper 7

PUBLIC ECONOMICS

Answer **FOUR** questions only.

Unless otherwise directed, answer all parts of the question.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

1 In a town with a continuum of voters (of measure 1) decisions about income taxation and spending on a public good are made by direct voting and any voter can propose a tax rate and a level of spending. The preferences of voter i are $W_i = (1-\tau)y_i + \gamma g$, where $\tau \in [0,1]$ is the income tax rate, g is the public good, and y_i is the income of voter i. The income distribution is uniform on the interval between zero and one. The parameter $\gamma \neq 1$ represents the (constant) marginal value of the public good. The town has to balance its budget.

(a) Suppose that decisions are made with the majority rule. Which tax rate and what level of spending will the town adopt? What role does γ play? Explain carefully whether you can apply the median voter theorem to answer this question.

(b) Let $\gamma > 1$. Is the policy outcome in (a) a political failure? Explain carefully.

(c) Suppose that decisions are made with the unanimity rule and that $\gamma > 1$. Which tax rate and what level of spending will the town adopt? Is there a political failure in this case? Explain carefully.

(d) Based on your answers to the previous questions, evaluate the case for using the unanimity rule to make public choices.

2 (a) Why might legislative procedures have a critical influence on policy outcomes?

(b) Compare different legislative procedures with respect to efficiencies in the policy outcomes that they induce.

3 (a) When will a market for tradable pollution permits achieve an efficient allocation?

(b) Suppose that an existing market for tradable carbon dioxide (CO_2) permits covers the entire electricity producing sector. Given that, would it be optimal for a social planner to subsidise electricity generation from renewable energy sources?

4 (a) Green taxes are often levied as a mark-up on existing taxes on, for example, energy consumption or road use. Explain how the optimal green mark-up on a good that is already subject to a tax is determined.

(b) Why have green taxes become popular at the expense of command-and-control instruments in recent decades?

5 (a) There is a well-established positive correlation between height and earnings. Why might this be problematic when trying to explain the reasons governments resort to distortionary income taxation?

(b) 'Observed labour supply elasticities are higher for high earners than middle earners. High earners should therefore face lower marginal tax rates.' Do you agree?

6 'When realistic assumptions are made about the life cycle, the zero capital tax result no longer goes through.' Discuss.

7 (a) What factors does a multinational enterprise (MNE) take into consideration when trying to decide how best to satisfy demand for its output in a foreign market? A complete answer should discuss the empirical evidence regarding the decision to serve a market through exports versus foreign direct investment.

(b) Suppose that significant factor endowment differences exist across markets so that exports and foreign direct investment are complements in the production function of an MNE rather than substitutes. What factors might affect an MNE's decision to engage in foreign direct investment?

8 'The terms of trade argument [for tariff setting] is of little practical importance.' Krugman and Obstfeld (1997). Discuss.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Wednesday 27 May 2015 9:00-12:00

Paper 8

THE ECONOMICS OF DEVELOPING COUNTRIES

Answer **FOUR** questions only.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS

20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION

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

1 (a) There are three types of farm-plots in rural India: owner operated plots, plots on which a tenant pays a fixed rent to the owner, and plots on which a sharecropper keeps a share of the output and the owner takes the rest. It is not unusual to find the same farmer cultivating multiple plots of different types; e.g. owned and rented or owned and sharecropped. Sharecroppers have a reduced incentive to exert effort because they only get to keep a share of the output. Provide an economic explanation for why sharecropping is still observed and indicate what types of individuals are most likely to become sharecroppers and which types of plots are most likely to be sharecropped.

(b) A researcher compares effort, measured by the hours of labour per unit of land, on sharecropped and owner operated plots in a village. She finds that effort is greater on owner operated than on sharecropped plots. Discuss possible explanations for this result and describe how you would control for alternative explanations when testing for the incentive effect.

2 (a) Let the wage, W, received by a worker at the beginning of each period be described by $W=\lambda N^{1/2}$. λ is the level of social connectedness in the worker's community and N is the number of community members working as a group for the same employer. Let the cost of effort that must be exerted by each member of the group in each period be C. If a worker shirks in any period, he will be fired and subsequently remain unemployed forever. Derive the relationship between social connectedness, λ, and the size of the largest stable group, N^*.

(b) The counties in Mississippi where plantation crops were grown in the past witnessed the greatest outflow of blacks to northern cities during the Great Migration, and there is evidence that this outflow was supported by exceptionally strong networks. These counties have lower levels of social capital in the black population today. Is this a contradiction or is there a consistent explanation? Explain.

3 (a) Millions of Europeans moved to the United States between 1850 and 1910. Historical evidence indicates that migrants from the same village in Europe often ended up in the same U.S. city and in the same occupation. Provide two explanations for this phenomenon.

(b) The communities set up by European migrants flourished through much of the twentieth century. However, the working class occupations that their members were engaged in began to disappear in the 1980s. Nevertheless, a working-class "culture" that discouraged occupational and spatial mobility persisted in these communities, with negative economic consequences for their members. Explain why this culture emerged and why it persisted.

4 (a) The transition from trade to manufacturing is a key step in the development process. Pioneers in manufacturing typically had high ability and the resources to invest in the fixed capital that is needed for manufacturing production. Would this transition occur earlier or later in an economy in which trade was controlled by a small number of business communities? Discuss.

(b) Studies of productivity across firms find large differences ranging from 2:1 across firms in the USA and 5: 1 in China and India. Explain how this evidence might be consistent with mis-allocation of resources, ruling out alternative explanations such as mis-measured prices.

5 The difficulties of measuring GDP, particularly in poor countries, have led to alternative approaches to measuring the standard of living.

(a) One approach is to measure a nation's welfare, as a consumption equivalent measure. Assuming an additive, separable utility function defined over consumption, health and inequality, explain how such a measure might be constructed and how standards of living can be compared using an equivalent variation.

(b) Explain how the measure above would change if we used compensating rather than equivalent variation. Explain whether the distinction matters for poor countries and why.

6 Political scientists often use the overall tax rate in an economy as a measure of government accountability.

(a) Explain the rationale for this assumption and explain why the tax rate might be similar to a public good.

(b) Suppose politicians attempt to stay in power by exerting patronage through the distribution of government revenues. Let t denote the tax rate, Y denote taxable income, e, the fraction of tax revenue that is embezzled, and P denote the total amount available for patronage. Assume that politicians wish to maximise P subject to e(t), where $e'(t) < 0$. Let $e = \alpha(1-t)$, where α = rate of embezzlement.

i) Obtain the optimal amount of revenue available for patronage by politicians and explain why all the resources are not embezzled.

ii) Suppose that the country now discovers large natural gas resources, of the order rY, where r is the proportion of income from natural gas. Re-examine your answer in i) above and explain why the provision of public goods might worsen with increased incomes from natural gas resources.

TURN OVER

7 The measurement of individual well-being usually relies on survey data.

(a) Survey data and National Accounts data differ substantially both in terms of measurement of levels and of growth in per-capita consumption. Explain why they differ and discuss the implications for the measurement of growth and inequality.

(b) Explain what the International Comparison Project does and why the results in 2011 differ from those in 2005.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Tuesday 26 May 2015 9:00-12:00

Paper 9

INDUSTRY

This paper is divided into two Sections - A and B.

Answer **THREE** questions in total:
ONE question from Section A
TWO questions form Section B.

Unless otherwise directed, answer all parts of the question.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator

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

SECTION A

1 Consider a multi layer principal-agent contract. The utility U and V of the agent and the middle manager read

$$\begin{aligned} U &= \mathrm{E}[W] - \frac{1}{2\eta}e^2 - \frac{1}{2}\theta \mathrm{Var}[W] \\ V &= \mathrm{E}[S-W] - \frac{1}{2}\psi \mathrm{Var}[S-W] \end{aligned}$$

with e = effort of the agent, W = wage of the agent, S = salary of the middle managers, while η, θ, and ψ are positive parameters. The principal is risk neutral, the outside option of the agent is $\overline{U} = 0$. Output x satisfies

$$x = e + v$$

where v is a normally distributed error term $N(0, \sigma^2)$. The price at which the principal can sell x is equal to unity.

(a) What is the first best level of effort that would prevail under perfect information on the side of the principal and the middle manager?

(b) However, e and v are unobservable to the principal and the middle manager. They observe only x. The middle manager offers a linear performance contract to the agent $W = a + bx$, and the principal offers a linear contract to the middle manager, $S = c + dx$, where a, b, c, and d are the parameters of the contract. What level of effort e will the agent set, taking his contract as given?

(c) What value for the piece rate b will the middle manager set?

(d) In a simple principal agent model with a risk neutral principal and a risk averse agent, the piece rate set by the principal is $b = \eta/(\eta + \theta\sigma^2)$. The current piece rate differs for two reasons. Discuss these reasons. Is there an interrelation between these two reasons?

2 Consider a world with two countries, 1 and 2, with distinct market sizes. The market in country 1 is small, in the sense that it can only accommodate the entry of one firm, while that of country 2 is larger, in the sense that it can accommodate two firms. Firm A is active in its home market (country 1) and exports to country 2. Firm B sells its output in country 2 only. In country 1, inverse demand is given by:

$$q_{A1} = a - p_{A1}$$

In country 2, the goods produced by firm A and firm B are regarded as imperfect substitutes by consumers and inverse demands are given by:

$$\begin{aligned} q_{A2} &= \frac{2}{3}(1620 - 2p_{A2} + p_{B2}) \\ q_{B2} &= \frac{2}{3}(1620 - 2p_{B2} + p_{A2}) \end{aligned}$$

where, q_{ij} is the quantity demanded from firm $i = A, B$ in country $j = 1, 2$ and p_{ij} is the price of the good sold by firm firm $i = A, B$ in country $j = 1, 2$. To capture the idea that country 1 is smaller than country 2, assume $a < 1620$. Assume that both firms produce at zero marginal cost.

(a) Suppose that the markets in country 1 and 2 are segmented in the sense that price arbitrage across international markets is not allowed. Firms compete on price. Solve for the profit-maximizing prices and quantities of firm A and firm B and compute the equilibrium profits of each firm.

(b) Suppose that country 2 has an antidumping law. Under this law, the importing country's government will impose a specific tariff of τ on imports if the price at which the foreign firm sells the good in country 2 is lower than the price at which it sells the good in its domestic market. This law implies that if $p_{A2} \geq p_{A1}$, then the tariff will be set to zero. What is firm A's profit maximizing strategy under this law?

(c) What are the welfare effects of the specific tariff in part (b) on country 2? Is this specific tariff a rent-shifting tariff? Explain why or why not. (You might wish to make reference to the nature of competition in your explanation).

SECTION B

3 A worker and a firm have an employment relation, which benefits both partners. Both make unverifiable investments in their outside options and in their mutual relation.

(a) Give an example for each of the four types of investment that can be made, i.e. in the relation and the outside option, for both the worker and the firm.

(b) The worker and the firm have an argument about the best way to organize their relation. The firm proposes just to agree to start the relation and to settle the distribution of the gains after they both have made their investments. The worker argues that it is better for the firm to hire the worker for a fixed wage, because that would improve incentives. Explain for each of the four types of investment whether a fixed wage reduces or increases incentives for the investment relative to the proposal by the firm. Explain whether that change in investment is a welfare improvement or not, and why this is the case.

(c) The firm argues that this argument is mistaken. By using a fixed wage contract, the firm would be the residual claimant (getting what is left over of the surplus after paying the wage, and hence bearing all the risk). It would be better to make the worker the residual claimant. What type of contract could both partners use to make the worker the residual claimant? When would that be a better solution than a fixed wage contract?

(d) The worker argues against this solution. He says that he does not need contractual monetary incentives, because the worker and the firm can negotiate an implicit contract about the worker's investment. The worker argues that this contract works, because they have a long-standing relation. If the worker does not perform, the firm can always fire the worker. Explain why the worker might be right. Can this mechanism implement the first best?

4 Conglomerates diversify by investing in a wide range of activities, which are only weakly related. There is a dispute on whether this is a good or a bad phenomenon, both from the perspective of the firm and of society at large.

(a) Discuss briefly four reasons why companies might diversify. For each of these reasons, discuss in one sentence if this reason benefits i) shareholders; and ii) society at large.

(b) The fact that one or more of the reasons for the formation of conglomerates are at the expense of their shareholders suggests that there is a principal-agent problem.

(i) Who is the principal, who is the agent? What is the nature of this principal-agent problem?

(ii) Explain why firms with concentrated shareholdership, like family firms, are less vulnerable to this problem.

(iii) Give a reason why society at large might choose to side with the principal (think of the efficiency of the allocation of capital).

(c) One might expect that the management of a conglomerate might be better informed about the quality of individual investment projects than the outside market and hence that conglomerates have an advantage in allocating investment funds. Explain why the outside market might nevertheless be more efficient.

5 "When there are fixed costs to firms of entering a market, allowing for free entry into a market ensures an efficient outcome." Discuss whether this statement is true or false. Specify your assumptions about consumer preferences, market structure and market size.

6 Consider an economy in which consumers have constant elasticity of substitution preferences over n goods and firms must pay a fixed cost in order to enter a market. Initially, this economy is in autarky. Discuss the impact on this economy if it signs a free trade agreement with an economy with the same consumer preferences and population size under two different sets of assumptions:

(a) all firms have the same productivity and can sell in any location under the free trade agreement (i.e., there are no transport costs, tariffs or foreign market entry costs under the free trade agreement);

(b) firms in both countries differ in their productivities and can sell in their trading partner's market under the free trade agreement if they pay a fixed cost to enter their trading partner's market.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Thursday 28 May 2015 9:00-12:00

Paper 10

THEORY AND PRACTICE OF ECONOMETRICS II

This paper is divided into two Sections - A and B.
Answer **FIVE** questions in total:
FOUR questions from Section A
ONE question from Section B.

Unless otherwise directed, answer all parts to the question.

Each question of section A carries equal weight.
Section A is worth two thirds of the allocation of marks.
Section B is worth one third of the allocation of marks.

Write your **candidate number** (not your name) on the cover of each booklet.

Answers from each Section must be written in a separate booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 2
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION
Calculator - students are permitted to bring an approved calculator
Durbin Watson and Dickey Fuller Tables
New Cambridge Elementary Statistical Tables

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

SECTION A

1 In their 1983 Journal of Political Economy paper, Hansen and Singleton derive the following relationship between the consumption growth, Δc_t, and the rate of return, r_t, on a financial asset:

$$r_t - \gamma \Delta c_t = \alpha + \varepsilon_t,$$

where γ is the coefficient of relative risk aversion, and $E(\varepsilon_t | I_{t-1}) = 0$ with I_{t-1} representing the information available at time $t-1$.

(a) Explain why running the OLS regression of r_t on a constant and Δc_t is not appropriate for estimation of γ.

(b) A researcher proposes to use Δc_{t-1} and r_{t-1} as instruments for Δc_t in the regression of r_t on a constant and Δc_t. Discuss this choice of instruments.

(c) 2SLS that implements the proposal described in (b) yields the following result (based on 237 observations)

$$\hat{r}_t = \underset{(0.005)}{0.0002} + \underset{(2.061)}{0.851} \Delta c_t, \qquad R^2 = 0.0331.$$

The corresponding first stage regression yields

$$\widehat{\Delta c_t} = \underset{(0.0003)}{0.0025} + \underset{(0.0069)}{0.0039} r_{t-1} - \underset{(0.0640)}{0.2928} \Delta c_{t-1}, \qquad R^2 = 0.0752.$$

For both results, the estimates of the standard errors are reported in the parentheses. To test the null hypothesis that the coefficient of relative risk aversion equals 5, a researcher computes the t-statistic based on the 2SLS result. The value of the statistic is -2.01, so the researcher decides to reject the null. Explain why you might remain skeptical. Could you suggest an alternative testing strategy?

2 Suppose that you have a large random sample of electricity producing firms, each of which is a price taker, cost minimiser, produces electricity on demand, and uses labour, capital, and fuel as the factors of production. You would like to estimate a labour cost share equation

$$S_{L,i} = \alpha_L + \gamma_L \log P_{L,i} + \gamma_K \log P_{K,i} + \gamma_F \log P_{F,i} + \gamma_Q \log Q_i + \varepsilon_i,$$

where $S_{L,i}$ is the labour share in the i-th firm's cost of producing output Q_i, and $P_{L,i}$, $P_{K,i}$, and $P_{F,i}$ are the labour, capital and fuel prices, respectively.

(a) Your colleague suspects that the conditional variance of ε_i is some non-linear function of $\log Q_i$. Describe a Lagrange Multiplier test procedure for testing a hypothesis that the conditional variance of ε_i is, in fact, constant.

(b) You were asked to also estimate the capital cost share equation

$$S_{K,i} = \alpha_K + \beta_L \log P_{L,i} + \beta_K \log P_{K,i} + \beta_F \log P_{F,i} + \beta_Q \log Q_i + \eta_i.$$

Assume that both this equation and the labour cost share equation are homoscedastic. Would the joint estimation of the two equations be useful in this situation? Explain your answer.

(c) Micro theory suggests that $\gamma_K = \beta_L$. Propose a method that can be used to estimate the parameters of the labour and capital cost share equations subject to this constraint.

3 A standard model for estimating the effects of job training on subsequent wages may be written as

$$\log(wage_{it}) = \mathbf{z}'_{it}\gamma + prog_{it}\delta + \varepsilon_{it}, \tag{1}$$

where $i = 1, ..., N$ indexes individuals and $t = 1, ..., T$ indexes time periods; $wage_{it}$ denotes a measure of wages; $prog_{it}$ is a binary indicator for participation in a job training program; and $\mathbf{z}_{it}$ is a vector of observable characteristics that affect wages and may also be correlated with program participation. The composite error term is given by $\varepsilon_{it} = \theta_t + c_i + u_{it}$, where θ_t and c_i denote, respectively, unobserved time and individual specific effects, and u_{it} represents unobserved factors that vary over i and t.

(a) An analyst estimates the parameters of (1) using the fixed effects estimator. Information on $\mathbf{z}_{it}$ is available. Write down the necessary assumptions for a consistent estimator of δ. Explain what is meant by the strict exogeneity assumption and why this might be violated in this particular case.

(b) Now assume that the analyst considers a different model

$$\log(wage_{it}) = \rho \log(wage_{it-1}) + \mathbf{z}'_{it}\gamma + prog_{it}\delta + \varepsilon_{it}.$$

Demonstrate that the presense of a lagged dependent variable precludes the use of a fixed effects estimator unless T is large. Show how a first difference transformation facilitates the use of an estimator that exploits a weak exogeneity assumption.

(c) Show how it is possible to generalise (1) in the presence of both $T > 2$ and multiple training programs.

4 An outcome variable y is binary. An analyst has available a vector of covariates $\mathbf{x}$, where one of the covariates of interest, say l, is binary.

(a) Write down a probit model for y. Explain why the partial effects of the components of $\mathbf{x}$ on the probability that $y = 1$ are heterogeneous by construction.

(b) For the probit model we assume that the error terms, say ε_i, are i.i.d. $N(0,1)$. Suppose instead that we have assumed more generally that ε_i are i.i.d. $N(\mu, \sigma^2)$. Demonstrate that the restrictions $\mu = 0$ and $\sigma^2 = 1$ are identifying assumptions.

(c) You are interested in determining the effect of l on y. Explain in detail how you would estimate this effect using average partial effect (APE) and partial effect at the mean (PEA). Explain how you would estimate the precision of your PEA estimate.

5 Time series variables x_{1t} and x_{2t} satisfy the VAR equation

$$\begin{pmatrix} x_{1t} \\ x_{2t} \end{pmatrix} = \begin{pmatrix} 0.5 & -1.0 \\ -0.25 & 0.5 \end{pmatrix} \begin{pmatrix} x_{1t-1} \\ x_{2t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix},$$

where $\varepsilon_t = \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix}$ is a serially uncorrelated stationary process. Let

$$A = \begin{pmatrix} 0.5 & -1.0 \\ -0.25 & 0.5 \end{pmatrix} \text{ and } C = \begin{pmatrix} 1 & -2 \\ 0.5 & 1 \end{pmatrix}.$$

Note that $CAC^{-1} = \Lambda = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}$.

(a) Show that if we define $\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = C \begin{pmatrix} x_{1t} \\ x_{2t} \end{pmatrix}$ then $\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix}$ satisfies the VAR

$$\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = \Lambda \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \end{pmatrix} + C \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix}$$

and hence show that x_{1t} and x_{2t} are $I(1)$ variables.

(b) Define $\Pi = A - I$ (where I is a 2×2 identity matrix). Show that $det(\Pi) = 0$ and further that we may write

$$\Pi = \alpha\beta'$$

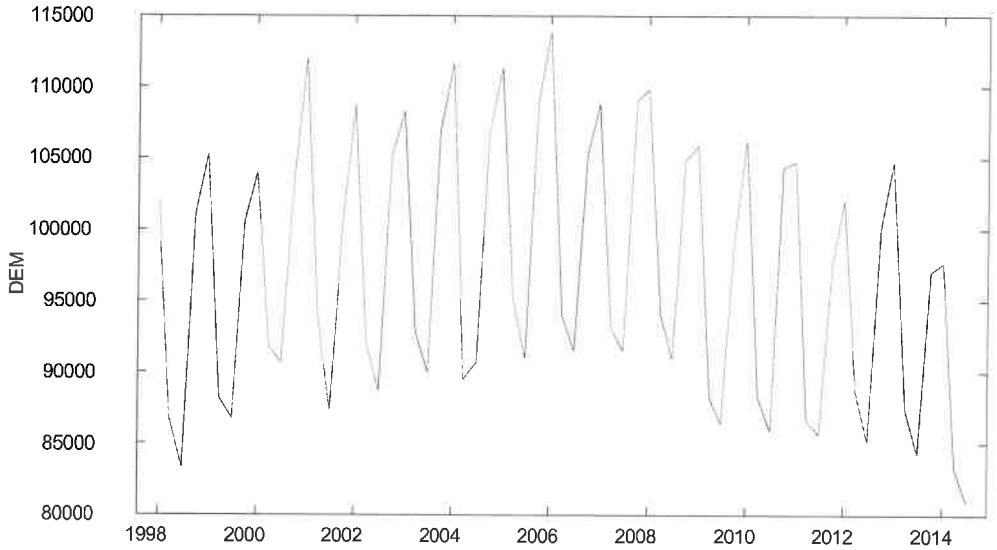
where $\alpha = \begin{pmatrix} -0.5 \\ -0.25 \end{pmatrix}$ and $\beta = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$.

(c) Show that if we write $x_t = \begin{pmatrix} x_{1t} \\ x_{2t} \end{pmatrix}$ then $\beta' x_t$ satisfies the equation

$$\beta' x_t = \beta' \varepsilon_t$$

Explain what this means for the variables x_{1t} and x_{2t}.

6 The figure below shows quarterly UK electricity demand (measured in Gigawatt hours) from 1998Q1 to 2014Q3 (from DECC Energy Trends).



Econometricians wish to produce a forecasting model for UK electricity demand (dem_t). To produce a forecast model they first estimate the following, where Δ is the first difference operator ($\Delta = 1 - L$) and 'time' a time trend

$$\widehat{\Delta\text{dem}_t} = \underset{(12862.)}{29632.5} - \underset{(21.862)}{53.9941}\,\text{time} - \underset{(0.12928)}{0.285923}\,\text{dem}_{t-1} + \underset{(0.073133)}{0.113146}\,\Delta\text{dem}_{t-1} - \underset{(0.071540)}{0.820524}\,\Delta\text{dem}_{t-2}$$

$$T = 64 \quad \bar{R}^2 = 0.9334$$

(standard errors in parentheses)

(a) Does this provide evidence that demand is an $I(1)$ variable?

(b) They decide that demand is best modelled as an $I(1)$ variable and then estimate the following model (Model 1)

$$\widehat{\Delta_4\text{dem}_t} = \underset{(864.62)}{1422.98} - \underset{(21.766)}{45.1086}\,\text{time} + \underset{(0.12232)}{0.341583}\,\Delta_4\text{dem}_{t-1}$$

$$T = 62 \quad \bar{R}^2 = 0.2228 \quad DW = 1.99$$

(standard errors in parentheses)

where $\Delta_4 = 1 - L^4$ gives fourth differences. Explain why the 4th difference model might be used for this data. What can be deduced from the Durbin-Watson statistic?

(c) Examination of the correlogram of the residuals from Model 1 shows the autocorrelations are (approximately) $\gamma_0 = 1, \gamma_1 = 0, \gamma_2 = 0, \gamma_3 = 0, \gamma_4 = -0.5$ and zero thereafter. What does this pattern of residuals suggest? How does this relate to your answer to (b)?

(d) An alternative strategy estimates the following model (Model 2), where Q1,Q2,Q3 and Q4 are seasonal dummies

$$\widehat{\text{dem}}_t = \underset{(12320.)}{65315.5}\,\text{Q1} + \underset{(12835.)}{47050.3}\,\text{Q2} + \underset{(10763.)}{51069.5}\,\text{Q3} + \underset{(10464.)}{66884.2}\,\text{Q4}$$
$$+ \underset{(0.12483)}{0.383250}\,\text{dem}_{t-1} + \underset{(89.901)}{288.831}\,\text{time} - \underset{(1.3345)}{4.94084}\,\text{time}^2$$
$$T = 62 \quad \bar{R}^2 = 0.9545$$
(standard errors in parentheses)

To what extent does Model 2 help explain the earlier results?

SECTION B

7 Explain what makes GMM a particularly useful econometric technique. Provide details and examples to strengthen your arguments.

8 Economic theory implies equilibrium relationships that constrain the behaviour of time series variables and a modelling strategy that incorporates those relationships will consequently outperform univariate methods. Discuss with relevant examples.

9 The canonical form of regressions estimated with panel data consists of model specifications which utilise within-unit time, between-unit time and between-time components of variation. With reference to one or more applications, discuss how the exploitation of these different components of variation, provides the analyst with the ability to both entertain alternative hypotheses and accommodate endogeneity where there may be a limited number of external instruments.

END OF PAPER

UNIVERSITY OF CAMBRIDGE

ECT3
ECONOMICS TRIPOS PART IIB

Thursday 28 May 2015 9:00-12:00

Paper 14

WORLD DEPRESSION IN THE INTERWAR YEARS

Answer **FOUR** questions only.

Answer all parts to the question.

Each question carries equal weight.

Write your **candidate number** (not your name) on the cover of each booklet.

Write legibly.

STATIONERY REQUIREMENTS
20 Page booklet x 1
Rough work pads
Tags

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION

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

1 Compare and contrast the 1930s economic recovery in two countries chosen among: Australia; Canada; Argentina and Japan. Did deliberate policies play a role in their recovery profiles?

2 Economic historians argue that a set of important developments in the 1920s helped to set the stage for the Great Depression of the 1930s. What were those developments? How did they set the stage and shape the Depression that followed?

3 Discuss the role of investment, rearmament, and public works in the growth of the German economy between 1933 and 1939.

4 Compare and contrast the regulatory outcomes of the interwar banking crises in at least three countries chosen among: Canada; Germany; Italy; Sweden and the USA.

5 Was the German "crisis-before-the-crisis" of the late 1920s the inevitable result of the stabilization of 1923/24?

6 In contrast to the pre-1913 period we observe a synchronised international business cycle during the interwar period. Analyse the causes of this change and consider the implications for interwar economies.

7 'The formation of trading blocs and discriminatory bilateral trading agreements resulted in a world trading structure that caused the collapse of world trade during the 1930s'. Discuss.

8 Examine the relationship between trade policy and economic recovery in the 1930s drawing on evidence from two countries.

9 'Economic recovery during the 1930s was delayed until the introduction of new underlying policy regimes'. Discuss.

10 Evaluate the effect of exchange rate policies on economic growth during the 1920s.

END OF PAPER