**QUEEN'S UNIVERSITY**
**FACULTY OF ARTS AND SCIENCE**
**DEPARTMENT OF ECONOMICS**
**WINTER TERM**
**ECON222 001 AND 002**
**INSTRUCTORS M Kennedy and S Dolatabadi**
**FINAL EXAMINATION**
**April 12, 2018**

**INSTRUCTIONS TO STUDENTS:**

- This examination is **THREE HOURS** in length.
- Please answer all the questions in the answer booklets provided.

**The following aids are allowed:**
Non-programmable hand calculator (with a gold or blue sticker or a Casio 991 calculator). No other aids are allowed.

- The exam consists of two parts, **A** and **B.**
- Part A consists of short questions. **Do FOUR of the *five*** questions. Each question in Part A is worth 10 marks for a total of 40 marks.
- Part B consists of long questions. **Do THREE of the *five*** questions. Each question in Part B is worth 20 marks for a total of 60 marks.
- The total number of marks is 100.
- Please read the questions carefully.
- For questions that involve a numerical part be sure to show your calculations and intermediate steps.
- Put your student number on the front and all pages of all answer booklets.

**GOOD LUCK!**

**PLEASE NOTE:**
**Proctors are unable to respond to queries about the interpretation of exam questions. Do your best to answer exam questions as written.**

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## Part A: Short Questions
## Do four (4) out of five (5) for a total of 40 marks

### A.1 Long-run economic growth (10 marks)

Assume a closed economy that operates with the following production function:

$$Y = K^{\alpha} N^{\beta}$$

**a)** Under what conditions would the above production function exhibit constant returns to scale? Briefly explain the implications of constant returns to scale.

**b)** Assume now that there are constant returns to scale and that capital's share in output is 25%. Supposing that the saving rate is 20%, the depreciation rate is 3% and the population growth rate is 2%, calculate the steady-state level of capital per worker for this economy. Find as well the level of output per worker and consumption per worker in the steady state?

**c)** Based on the information given in part b) solve for the "Golden-Rule" level of capital per worker and then consumption per worker. How do these values compare to the level of steady-state capital and consumption per worker you found in part b). If the actual saving rate were to rise, would steady-state consumption per worker rise?

### A.2 Desired capital stock and investment (10 marks)

Suppose that the expected marginal product of capital is related to $K^d$, the desired level of capital stock, in the following way:

$$MPK^f = 20 - 5K^d$$

As well, suppose that real interest rate is $r$, the rate of depreciation is $d$, the effective tax rate is $\tau$ and the price of capital is $p_k$. The actual stock of capital currently in place, $K$, is equal to 2.

**a)** Derive an analytical expression for the desired stock of capital ($K^d$). Using the appropriate diagram, discuss briefly how the desired stock is determined. Based on the expression you found for $K^d$, derive an equation for desired investment ($I^d$) in terms of $r, d, p_K$ and $\tau$.

**b)** Using the following values $r = 4\%, \tau = 5\%, P_K = 1,$ and $d = 2\%$, calculate the desired level of capital stock. Based on your findings, find the current level of desired investment?

**c)** Now assume that the price of capital, the depreciation rate and the real rate of interest were constant. Analyze the effect of fall in the effective tax rate on desired capital stock by using the diagram you developed in part b). How does lowering the tax rate affect the level of investment?

**A.3 Foreign exchange rate (10 marks)**

As a Canadian saver, you have $500 Canadian dollars (CAD) and have a choice between investing in either Canada or the United Kingdom. The one-year nominal interest rate in Canada is 4%, while in the UK it is 3%. Assume that both economies have the same risk levels and liquidity and there are no transaction costs. The current nominal exchange rate is $e_{nom} = 0.55$ British pounds per Canadian dollar (1CAD = 0.55 GBP).

**a)** At the beginning of the year, you are expecting the Canadian dollar to depreciate by 3% over the coming year. Based on this forecast, which investing choice yields the higher return?

**b)** What would your expectation of the future CAD/GBP ($e^e_{nom}$) have to be in order to eliminate all arbitrage opportunities (that is, to leave you indifferent between investing in Canada or the UK)?

**c)** Using the definition of the real exchange rate, under what conditions would relative purchasing power parity (PPP) hold? Assuming flexible exchange rates and relative PPP, what would be the implication for the Canadian dollar if the inflation rate in Canada were 5% and that in the UK, 6%.

**A.4 IS-LM in an open economy (10 marks)**

Think of an open economy where for the moment we ignore whether or not we are talking about fixed or flexible exchange rates. The economy is small and it takes the world real rate of interest as given.

**a)** Now suppose that the economy experiences a positive productivity shock, such that the long-run supply curve shifts to the right.
   - **a.** Using just diagrams and assuming that the exchange rate is *fixed*, describe briefly the process by which the economy moves to its new long-run equilibrium. What has to happen to the real exchange rate and why?
   - **b.** Again, using just diagrams but assuming that the exchange rate is *flexible*, describe the process by which the economy moves to its new long-run equilibrium. In this case you can assume that the central bank wants to keep the price level constant. What is the effect on the real exchange rate?

**b)** For long-run equilibrium, does it matter whether the exchange rate regime is fixed or flexible? Does the exchange rate regime as well as the monetary policy assumptions matter for other variables in the economy? Briefly explain.

Note that you can use the same diagram to describe both adjustment processes.

**A.5 Labour market equilibrium with minimum wages**

The following is a simplified production function for an industry that employs minimum-wage workers.

$$Y = AN^{1-\alpha}$$

The supply of labour for this industry is given by:

$$N^s = w$$

**a)** Using the above two equations, find an equation for the demand for labour and then another equation for the wage rate. Given $A = 128$ and $\alpha = 0.5$, find the equilibrium demand for labour, the wage rate and the level of output.

Suppose that the level of output that you found in part a) represents the industry's total sales, which are fixed. In other words, the firm cannot increase sales beyond this amount. Its only option to improve its profitability is to rely on cost saving or productivity improvements.

**b)** You are now to consider the effect of the introduction of a minimum wage 5% higher than the equilibrium wage you found in part a). Calculate the effect on the demand for labour? If the labour supply equation remains unchanged, calculate the unemployment rate.

**c)** You will notice that the policy will create unemployment. In this case, the government decides to introduce measures to raise productivity so as to encourage firms to hire back the workers who became unemployed at the now higher wage. Use your model to develop an equation that will show by how much productivity would have to rise in order to achieve that result. Then calculate the desired increase in productivity. In percentage terms, by how much would productivity have to increase to achieve the goal?

**d)** Consider the unemployment rate that you calculated in part b). Suppose that the actual unemployment rate you observe is roughly half the rate you derived from your model. In words, what would explain the difference?

## Part A: Long Questions
## Do three (3) out of five (5) for a total of 60 marks

### B.1 Inter-temporal consumption (20 marks)

The consumer in this question lives for two periods, during which he has to decide how much to consume in the present and future ($c_1$ and $c_2$) given his budget constraint. During the first period he works, receiving an income of $y_1$, while in the second he is retired and lives off an employer-provided pension equal to 75% of his first-period income. The rate of interest in this economy is $r$.

**a)** Based on the above information, write out the consumer's budget constraint, showing the relationship between future consumption ($c_2$) and present consumption ($c_1$). Based on your budget constraint, write out an expression for the consumer's inter-temporal budget constraint.

**b)** Suppose that the consumer's utility function has the following form:

$$U(c_1, c_2) = \alpha \ln c_1 + (1-\alpha) \ln c_2$$

Above $\alpha$ is the weight that the consumer puts on present consumption. Remembering that $d \ln x = \frac{dx}{x}$, find first the slope of the utility function (that is: find $dc_2 / dc_1$) and then using the budget constraint find a relationship between future and present consumption. Using this latter relationship, derive an equation for present consumption as it relates to the present value of lifetime resources.

**c)** You are given the following values for $\alpha$ and the two variables in the model:

$$\alpha = 0.52;\ y_1 = 105;\ \text{and}\ r = 0.05$$

Based on this information, find the values of $c_1$ and $c_2$ and verify that they satisfy the inter-temporal budget constraint; that is, verify that the *PVLC* = *PVLR*.

**d)** Suppose now that the company for which he works has been quite successful and as a result it offers the employees a choice between a one-time payment today of 5% of their current income (note that this does not affect his current income level) versus a 5 percentage point increase in their pension from 75 to 80% of their current income, which the consumer will receive in the future. Use your equation to calculate the effect on present and future consumption of each option.

**e)** As the union representative, you are asked to evaluate these two options. Which one would you choose and why? Would your decision change if the weight on present consumption were less than that on future consumption or if the interest rate rose? [Note: no calculations are required].

**B.2 Long-run growth and productive government spending (20 marks)**
Suppose that the production function takes the following form:

$$Y_t = K_t^{\alpha} G_t^{\beta} N_t^{1-\alpha-\beta}$$

where $K_t$ denotes the capital stock, $N_t$ labour input and $G_t$ government expenditure. $G_t$ can be interpreted as infrastructure or other productive services. Assume that $\alpha > 0, \beta > 0$ and $\alpha + \beta < 1$. Note as well that capital depreciates at rate $d$ and the growth rate of labour is $n$.

Now assume that government spending is financed with a proportional income tax at a constant rate $\tau$, and savings are a fraction $s$ of after-tax income.

$$G_t = \tau Y_t$$

$$S_t = s(Y_t - G_t) = s(Y_t - \tau Y_t) = s(1-\tau)Y_t$$

The capital stock accumulates according to the following equation:

$$K_{t+1} - K_t = I_t - dK_t$$

**a)** Express aggregate output, $Y_t$, in terms of capital $(K_t)$ and the tax rate $(\tau)$ by substituting $G_t = \tau Y_t$ into the production function and solving for $Y_t$. [Note that your new production function will have capital, the tax rate and labour all on the right hand side.]

**b)** Write down the intensive form of the production function you derived in part a) by expressing the production function in per worker terms, that is define output per worker and capital per worker as $y_t = \frac{Y_t}{N_t}, k_t = \frac{K_t}{N_t}$. In deriving the intensive form of the production, you will find it useful to bear in mind that:

$$N_t^{\frac{1-\alpha-\beta}{1-\beta}} = N_t^{-\frac{\alpha}{1-\beta}} N_t^{\frac{1-\beta}{1-\beta}} = N_t^{-\frac{\alpha}{1-\beta}} N_t$$

**For the rest of the question, set $\frac{\alpha}{1-\beta} = a$ and $\frac{\beta}{1-\beta} = b$ in the intensive form version of the production function.**

**c)** Derive the law of motion of the capital stock showing how it evolves over time. [Hint: Start with the capital accumulation identity and divide both sides by $N_{t+1}$ using that $I_t = S_t$, and $N_{t+1} = (1+n)N_t$.]

**d)** Derive the steady-state level of capital per worker, $k^*$.

**e)** Find the rate of taxation, $\tau$, that can maximize the steady-state level of capital per worker, $k^*$.

**In the following three questions, which deal with the IS-LM model, the variables and equations are those familiar to you from the course and associated materials as well as the textbook. They will not be defined here.**

**B.3 The closed economy version of the IS-LM model (20 marks)**
Consider a closed economy with the following information:

$$C^d = 50 + 0.7(Y - T) - 500r$$
$$I^d = 20 - 300r$$
$$M/P = 0.5Y - 800(r + \pi^e)$$

**a)** Derive equations for the IS and the LM curves, with the real rate of interest on the left-hand side. As well, derive an equation for the aggregate demand curve, AD, with $Y$ on the left-hand side.

**b)** Given the following values, $G = 80, M = 50, P = 1$ and $\pi^e = 0$, and assuming the government budget is balanced, calculate the long-run equilibrium levels of $Y$ and $r$ for this economy. Find as well the level of $C^d$ and $I^d$ and verify that the components of GDP add up to the level of $Y$ you found.

**For what follows, you can consider the level of output you found in b) as equal to the economy's potential output.**

**c)** Suppose that instead of balancing its budget, the government decides to run a budget deficit equal to 5 by keeping its spending constant at $G = 80$ and lowering taxes. (Assume Ricardian Equivalence does <u>not</u> hold and all other variables are held constant.) Calculate the short-run and long-run effects that this would have on $Y, r$ and $P$. Find the values of $C^d$ and $I^d$ associated with new long-run equilibrium.

**d)** Assume that the government reverts to a balanced budget, $G = T = 80$. Suppose now that $\pi^e$ rises from 0 to 2%. Calculate the short-run effect that this would have on $Y, r$ and the nominal rate of interest. Calculate what would happen to the price level, $P$, in the long run if no policy actions were taken.

**e)** Suppose the government believes that it would take too much time for the price level to adjust. To return more quickly to long-run equilibrium after the increase in inflation expectations described in part d), calculate by how much government spending, G, would have to change, so that in the new long-run equilibrium, the price level remains unchanged at 1.

**B.4 An open economy with flexible exchange rates (20 marks)**
The model you are to consider consists of the following relationships:

$$C^d = 35 + 0.5(Y - T) - 250r^w$$
$$I^d = 40 - 250r^w$$
$$NX^d = 25.28 - 0.1Y - 2e$$
$$\frac{M}{P} = 8 + 0.8Y - 500r^w$$
$$e = \frac{e_{nom} P}{P_{For}}$$

**a)** Use the above relationships to write out the IS and LM equations for this economy with, in each case, the world real rate of interest on the left hand side.

**b)** Suppose now that government spending is 10, while the budget is balanced. The real and the nominal money supply are the same at 100, while the real world rate of interest ($r^w$) is 4%. Use this information to find the level of output ($Y$), the components of demand as well as the level of the real exchange rate ($e$). You are told as well that $P_{For} = 1.25$. Use this information to find the value of the nominal exchange rate ($e_{nom}$).

**c)** Suppose that the foreign economy becomes overheated with the result that the foreign price level increases from 1.25 to 1⅓. What would be the short and long-run effects on the economy? Find as well the new value of the nominal exchange rate. What phenomena are being illustrated by this question?

**d)** Go back to the situation where the foreign price level ($P_{For}$) is once again at 1.25. Now suppose that the central bank, worried that the economy may be overheating, decides to decrease the nominal money supply from 100 to 99.5. Calculate, using the above model, what would be the short-run and then the long-run equilibrium values for output ($Y$), the real exchange rate ($e$) and the nominal exchange rate ($e_{nom}$). What is the process that drives the economy back to equilibrium?

**B.5 The IS-LM model with fixed exchange rates (20 marks)**
The following are the key equations for the economy.

$$C^d = 9.5 + 0.8(Y - T) - 300r^w$$
$$I^d = 20 - 200r^w$$
$$NX^d = 13 - 0.1Y - 1.25e$$
$$\frac{M}{P} = 11.5 + 0.8Y - 300r^w$$
$$e = \frac{e_{nom}P}{P_{For}}$$

**a)** Your first task is to write out the IS and LM curves with the world rate of interest rate on the left-hand side.

**b)** Total taxes are 10 and the government is running a deficit of 5. The foreign price level ($P_{For}$) is 1.25 while the nominal exchange rate ($e_{nom}$) is 1.0. The real and nominal money supplies are equal to 100. If the world real rate of interest is 2½%, what would be the level of output ($Y$) and net exports ($NX$). Is this economy a user of foreign saving? Find as well consumption and investment and verify that the components of GDP add up to the value of $Y$ that you found.

**For what follows, you can consider the level of output you found in b) as equal to the economy's potential output.**

**c)** The government, wishing to boost its trade balance, considers two options:

a. A devaluation of the nominal exchange rate from 1 to 0.8; or
b. A reduction of government spending of 0.25.

In order to help the government make an informed decision, calculate separately the short- and long-run effects of each policy option.

[Hint: Make your comparisons to the original values of $Y$ and $NX$ that you found in part b.]

**d)** Based solely on the short-run effects on the economy and the trade balance, which policy would you recommend? Now considering only the long-run effects on the economy and the trade balance, which policy would you recommend? Be sure to support your answers with sound economic analysis. In the end, which policy would be the more successful?