

**QUEEN'S UNIVERSITY  
FACULTY OF ARTS AND SCIENCE  
DEPARTMENT OF ECONOMICS  
WINTER TERM  
ECON222 001 AND 002  
INSTRUCTORS M Kennedy and S Chilongo  
FINAL EXAMINATION  
20 April 2019**

**INSTRUCTIONS TO STUDENTS:**

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

**The following aid is allowed:**

Non-programmable hand calculator Casio 991. 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 and section number on the front and all pages of all answer booklets.
- **You are to hand in your exam paper with your 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 The demand and supply of labour (10 marks)**

The production function in this economy is given by:

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

To simplify your algebra, the usual terms in the production function,  $AK^\alpha$ , have been indexed to one.

- a) Based on the above, find an equation for the demand for labour ( $N^d$ ) and how it relates to the real wage ( $w$ ).
- b) While firms pay the real wage to workers, the workers themselves have to pay taxes on their earnings. This implies that the supply of labour is given by:

$$N^s = (1 - \tau)w$$

Use the above in conjunction with the demand for labour equation you found in part a) to find expressions to the equilibrium real wage.

- c) You are given the following:  $\alpha = 0.5$  and  $\tau = 0.25$ . Use this information to find the level of labour demand, the real wage and the level of output in this economy.
- d) The government has hired a number of "supply-side" economists who convince the finance minister to cut the income tax rate to 0.20 in an effort to increase employment and output. Use your model to find the levels of labour demand and output. Has this policy been effective in increasing employment and output?
- e) What has happened to the real wage paid by the employer and the after-tax real wage received by workers? Provide a brief explanation of your results focusing on supply and demand changes.

**A.2 Finding investment when depreciation rates can differ (10 marks)**

The production function and the user cost of capital for this economy are respectively:

$$Y_t = 5 + 6K_t - 0.25K_t^2$$

$$uc = r + d$$

Note that there are no taxes and the price of capital has been set equal to one.

- a) Using the above equations, find an expression for the desired stock of capital and how it relates to the user cost of capital. Based on the capital accumulation

identity, find an expression for gross investment ( $I_t$ ). Discuss briefly how depreciation affects gross investment.

- b)** You are given the following information:

$$K_t = 10; d = 10\%; \text{ and } r = 5\%$$

Use these values to find the desired level of the capital stock as well as gross investment.

- c)** Now suppose that the *new* capital that the firm is purchasing has a lower depreciation rate. You can think of this as new computers that have longer battery lives than the existing ones. For concreteness, suppose that the depreciation rate for new capital is 5%. Find the new levels of the desired capital stock and investment.
- d)** Continue to assume that new capital has a depreciation rate of 5%. At the same time, managers discover that the existing capital stock is actually in better shape than previously thought because of the effectiveness of past repairs. The result is that the depreciation rate on existing capital is now 9%. Based on this information (and still assuming that new capital's depreciation rate is 5%), find the new level of investment. How does it compare to the levels you found in parts **b)** and **c)**? What conclusions do you draw about the effect of each type of depreciation on investment?

### A.3 Monetary expansion in a closed economy IS-LM-FE framework (10 marks)

Suppose that the central bank decides to raise the nominal money supply,  $M$ . For simplicity, assume that the economy is initially in general equilibrium.

- a)** Show the initial general equilibrium point graphically. What is the short-run effect of expansionary monetary policy on output and the real interest rate? Also, show this graphically. Label the graph clearly.
- b)** Consider the economy's adjustment to the long-run equilibrium. What effect from the short-run triggers the long-run effects of the policy in the economy? Briefly describe how the economy adjusts to the long-run equilibrium and show the effects on output, the real interest rate and employment on the same diagram as part **a)**.
- c)** What can you conclude about how a change in the nominal money supply affects real economic variables? What is the economic term given to this scenario?

#### A.4 Equilibrium in the goods market for both small and open economy (10 marks)

The consumption ( $C^d$ ) and investment ( $I^d$ ) functions of this economy are:

$$C^d = 15 + 0.5(Y - T) - 100r$$

$$I^d = 20 - 50r$$

- a) Government spending is 25 and the budget is balanced. The real interest rate,  $r$ , is 5%. First assume a closed economy. What is the goods market equilibrium condition? What is the equilibrium level of GDP ( $Y$ ), consumption ( $C^d$ ) and investment ( $I^d$ )? Check that the components sum to GDP.
- b) Suppose now that the economy is a small open economy (i.e. it takes the world interest rate as given). Assume that  $r = r^w = 10\%$  and  $G = T = 30$  while other values remain unchanged. Also,  $Y$  is equal to the value you found in a). Find the level of savings, investment ( $I^d$ ) and net exports ( $NX$ ).
- c) Is the small open economy a borrower from or a lender to the world?

#### A.5 Equilibrium in the market for foreign exchange (10 marks)

You have the option of investing in a Canadian bond that is denominated in Canadian dollars and pays a nominal interest rate, ( $i$ ), in one year. The real interest rate is 1.5% and expected inflation is 1.0%. The other option is to invest in a comparable German bond that's is denominated in euros and pays a nominal interest rate, ( $i_{Ger}$ ), of 4.83% in one year. The nominal (spot) exchange rate,  $e_{nom}$ , is 1.10 EUR/\$.

- a) Which bond would be less attractive in the international financial markets? Do we observe an appreciation or a depreciation of the Canadian dollar against the euro and why?
- b) Based on your answer in part a), what is the effect on German net exports and Canadian net exports?
- c) The nominal interest parity is given as:

$$(1 + i) = (1 + i_{Ger}) \frac{e_{nom}}{e_f^{nom}}$$

What would be the forward exchange rate,  $e_f^{nom}$ , for the return on the bonds in the two countries to be equalized? Compared to the spot rates, what does this value tell you about the expectation of investors regarding the Canadian dollar against the euro? Give two necessary conditions or assumptions that should be met for interest rate parity to hold.

- d) Suppose  $e_f^{nom} = 1.10$  EUR/\$. What is  $e_{nom}$ , with the given nominal interest rate values?

**Part B: Long Questions****Do three (3) out of five (5) for a total of 60 marks****Note: Each question starts on a separate page****B.1 Inter-temporal consumption (20 marks)**

The household under consideration here lives for two periods and receives present and future income of  $y_1$  and  $y_2$ , respectively. While the household has no wealth, it can borrow or lend at the market rate of interest, represented by  $r$ .

- a)** Based on the above information, write out the household's budget constraint, showing the relationship between future consumption and present consumption. Using your budget constraint, derive the household's inter-temporal budget constraint.
- b)** The household's utility function is given by:

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

In the above equation,  $\alpha$  is the weight that the household places on present consumption ( $c_1$ ) and  $(1 - \alpha)$ , the weight on future consumption ( $c_2$ ).

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  $\alpha$ , income in each period, and the real rate of interest:

$$\alpha = 0.5; y_1 = 100; y_2 = 105; \text{ and } r = 5\%$$

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  $PVLC = PVLR$ . As well, find the level of saving for this household. What is unique about the levels of  $c_1$  and  $c_2$  that you found?

- d)** What would happen to present and future consumption if the real interest rate rose to 10%? What effect is operating here?
- e)** Go back to the situation prior to the change in interest rates (that is, assume that  $r = 5\%$ ). Find the effect on present consumption when the household has an initial level of wealth of 10. Suppose instead that the household received that wealth in the future; that is, initial wealth is now zero. Does the effect on present consumption differ and if so why?

## B.2 The IS-LM-AD model in a closed economy (20 marks)

The key equations for this economy are as follows:

$$\begin{aligned}\frac{M}{P} &= 10 + 0.5Y - 400r \\ C^d &= 5 + 0.8(Y - T) - 200r \\ I^d &= 35 + 200r \\ u - \bar{u} &= -0.3\left(\frac{Y - \bar{Y}}{\bar{Y}}\right)\end{aligned}$$

The variables and equations are familiar to you from class and the assignments.

- a) Using the first three equations, find the equations for the *IS* and *LM* curves for this economy. Then, based on those two relationships, derive an expression for the *AD* curve with output ( $Y$ ) on the left hand side.
- b) Government spending ( $G$ ) is 17 and the government has a budget surplus of 3. The real money supply is 60 and is equal to its nominal value of  $M$ . Based on this information find the level of output and then the real rate of interest ( $r$ ). Next find the levels of consumption and investment, and then verify that they add up to the level of output that you found. Finally, what is the price level in this economy?
- c) Consider the level of output that you found in part b) to be an initial, short-run equilibrium position. The government undertakes structural reforms that have the effect of raising potential output by 4% above the level you found in part b). In this economy the natural rate of unemployment,  $\bar{u}$ , is 5%. Find the actual level of unemployment ( $u$ ).
- d) Suppose that the central bank decides to keep the nominal money supply constant at the level mentioned in part b). Describe briefly the process by which the economy returns to equilibrium. Now find the new values of the real interest rate and the price level? In the new equilibrium, what has happened to the actual rate of unemployment?
- e) With the economy doing well in the wake of the structural reforms and an election looming, the government decides to balance the budget by lowering taxes. Find the *long-run effect* on the real rate of interest. What has happened to the price level compared with what you found in part d)? Suppose that the central bank wanted the price level to be at or below what you found in part b), should the central bank be concerned about the effect of lowering taxes?

### B.3 The *IS-LM-AD* open economy model with fixed exchange rates (20 marks)

The following equations describe an open economy with a fixed exchange rate:

$$C^d = 30 + 0.5(Y - T) - 200r^w$$

$$I^d = 40 + 200r^w$$

$$NX = 21.5 - 0.1Y - 5e$$

$$\frac{M}{P} = 15.5 + 0.6Y - 400r^w$$

$$e = \frac{\bar{e}_{nom} P}{P_{For}}$$

In the final equation, the variable  $\bar{e}_{nom}$  represents the fact that the nominal exchange rate is fixed.

- a) Using the first three equations, derive an expression for the *IS* curve for this economy, with  $r^w$  on the left hand side. Derive as well the *LM* curve, again with the  $r^w$  on the left hand side. Finally, derive the *AD* curve for the economy but write it out with the real exchange rate on the left hand side. Looking at the equation for the real exchange rate that you derived from the *AD* curve, describe how it responds to government spending and taxation?
- b) You are told that the real money supply ( $M/P$ ) is 79.5, output ( $Y$ ) is 130, government spending ( $G$ ) is 10 and the government's budget is balanced. Based on this information, find the world real interest rate ( $r^w$ ) as well as the real exchange rate ( $e$ ) for this economy. Use the values of  $Y$  and  $e$  in combination with the world real rate of interest to find the levels of consumption, investment and net exports. Verify that they add up to the values the level of  $Y$  that you found. Finally, find the value of  $\bar{e}_{nom}$  if the domestic price level ( $P$ ) is 1.5 and the foreign price level ( $P_{For}$ ) is 1.0.
- c) Assume that the values you calculated in part c) represent long-run equilibrium values. Based on your model, calculate what would happen in the short run if the foreign price level ( $P_{For}$ ) were to rise to 1.1. In particular, find the short-run levels of  $Y$ ,  $M/P$  and  $e$ . In the short run, there will be two competing effects on net exports; what are they? In the short run, do net exports rise or fall?
- d) In the long run, what happens to  $Y$ ,  $P$  and  $e$ ? Has the domestic economy been able to insulate itself from the foreign price level shock? What effect is being illustrated in this question?

## B.4 The Solow growth model (20 marks)

Consider the following production function:

$$Y_t = K_t^\alpha (A_t N_t)^{1-\alpha}$$

where  $Y_t$ , denotes output;  $K_t$ , the capital stock; and  $N_t$ , labour input. In this model  $A_t$  is labour-augmenting technical change because it affects aggregate output by increasing the effectiveness of labour. Consumers save a constant fraction  $s$  of disposable income. The growth rates of  $N_t$  and  $A_t$  are equal to  $n$  and  $z$ , respectively. The depreciation rate equals  $d$ .

- a) Derive the intensive form production function in terms of effective labour by dividing both sides of the production function by  $A_t N_t$ .

The capital stock evolves according to:

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

- b) Using the above evolution of capital equation, what is the steady state condition for this economy? Assume that the goods market is in equilibrium and that saving is  $sY_t$ . Also, assume that:

$$A_{t+1}N_{t+1} = (1 + z + n)A_t N_t$$

- c) Derive the steady state level of capital per effective unit of labour,  $k^*$ , in terms of  $s$ ,  $n$ ,  $d$  and  $z$ . Derive as well expressions for  $y^*$  and  $c^*$ .
- d) Solve for the Golden rule of capital per effective unit of labour,  $k_G$ . What is the saving rate needed to achieve  $k_G$  in the steady state?
- e) Suppose that the economy experienced a surge in population growth such that  $n$  increased. What is the effect of this change on the steady state level of capital per effective labour,  $k^*$ ,  $y^*$  and savings? Provide a brief explanation for your result.

### B.5 The *IS-LM-AD* small open economy model with flexible exchange rates (20 marks)

The following 4 equations describe the main behavioural relationships for a small open economy with flexible exchange rates:

$$\begin{aligned}\frac{M}{P} &= 5 + 0.5Y - 400r^w \\ C^d &= 25 + 0.8(Y - T) - 200r^w \\ I^d &= 30 - 200r^w \\ NX^d &= 20 - 0.1Y - 5e \\ e &= \frac{e_{nom} P}{P_{For}}\end{aligned}$$

The variables are as defined in class.

- a) Derive an expression for the *IS* curve for this economy with  $r^w$  on the left-hand side. Also, derive as well the *LM* curve with  $r^w$  on the left-hand side.
- b) You are given  $G = 10$  (and that the government's budget is balanced), full-employment  $Y = 100$ , the money supply ( $M$ ) = 100 and the domestic price level ( $P$ ) is 2. What is the world interest rate,  $r^w$ ? What is the value of the nominal exchange rate ( $e_{nom}$ ) when the foreign price level,  $P_{For}$  is 1? What is the value of net exports?
- c) Suppose consumer confidence falls in the economy and this is reflected by a decline in the constant term for desired consumption from 10 to 5. Which curve shifts as a result of the fall in consumer confidence? What are the new values for the real and nominal exchange rates in the short run? Did the nominal exchange rate appreciate or depreciate?
- d) What is the new level of net exports in the short run? Did net exports increase or decrease? Does the status of the country change in terms of being a net lender or borrower?
- e) Describe how the economy returns to its full employment level? Be sure to describe what happens to the *IS* curve. What is the economic term for this mechanism that exists in a small open economy with a flexible exchange rate regime and not in a closed economy?
- f) Suppose the government and central bank both wanted to intervene in response to the loss in consumer confidence. As an economist consulting the two institutions, which one would you advise to intervene in the economy and why?