HIGHER SCHOOL OF ECONOMICS
NATIONAL RESEARCH UNIVERSITY

Preliminary Exam with answers

INTRODUCTION TO ADVANCED MACROECONOMICS
September 2014

Duration: 120 min

Format of the mock examination

Section A. Multiple Choice Questions	(20 % of the total marks)
Section B. 'True/False? Briefly explain' Questions	(20 % of the total marks)
Section C. Problem set	(40 % of the total marks)
Section D. Open-end question	(20 % of the total marks)

Section A comprises 10 questions from which all 10 must be answered (accounting for 20% of the total marks). Each opening statement has four possible answers (a-d). There is only one correct answer to each question. Please clearly mark with 'X' sign the correct answer in the table belw. There will be no penalty for the wrong answer though guessing is strongly discouraged.

	A.1	A.2	A.3	A.4	A.5	A.6	A.7	A.8	A.9	A.10
a										
b										
c										
d										

Section B 'True or false? Briefly explain your answer' comprises 5 questions from which **4** must be answered (accounting for 20% of the total marks). You are expected not only to provide an answer but also briefly to justify it on the basis of the relevant theory. Full formal derivation of the relevant model is not expected, and often a graphic or descriptive (non-analytical) answer is sufficient. On average, only nine minutes should be allocated to any individual short question.

There will be TWO long questions (problems) in Section C that are subdivided into at least three parts. There is a mixture of essay-based questions and questions requiring a more analytical model-based approach. In this section you are to be as precise as possible in your answers, and often formally to derive the relevant models, possibly in addition to a graphical or descriptive approach.

Section D in an open-end essay-based question (accounting for 20% of the total marks). You are advised to limit your answer by 10 sentences. Ensure you can provide argumentation using both everyday AND professional language in order to be easily understood by non-economists.

Section A

1. Economy A with proportional taxes is closed and the government adjusts its spending to the level of taxes raised. Economy B is open and has lump-sum tax system. Comparing the balanced budget multipliers of the two economies one can conclude that:

(a) Mult A < Mult B;
(b) Mult A = Mult B;
(c) **Mult A > Mult B;**
(d) The multipliers can not be compared due to insufficient information.

2. A project yields £1500 every year for 2 years. What is the maximum disbursement you will agree to invest in the project had the interest rate been 5%:

(a) 2929;
(b) 2927;
(c) **2788;**
(d) 2790.

3. An unplanned decrease in stocks means:

(a) The economy is in equilibrium in the goods market;
(b) There is excess supply in the goods market;
(c) **There is excess demand in the goods market;**
(d) We cannot infer anything from this information.

4. Easy monetary policy brings about:

(a) An excess supply of bonds and their price will fall;
(b) An excess supply of bonds and the interest rate will fall;
(c) **An excess demand for bonds and their price will increase;**
(d) An excess demand for bonds and the interest rate will rise.

5. In a closed economy with fully flexible prices and wages, a balanced budget fiscal expansion will lead to:

(a) A crowding out of investment by exactly the amount of additional government expenditure;
(b) No changes in output and savings due to complete crowding out effect;
(c) An increase in output and a decline in investment due to partial crowding out effect;
(d) **None of the above.**

6. An increase in the economy wide marginal propensity to spend:

(a) Will make the IS flatter and therefore, the AD will be steeper;
(b) **Will make the IS flatter and therefore, the AD will be flatter;**
(c) Will make the IS steeper and therefore, the AD will be flatter;
(d) Will make the IS steeper and therefore, the AD will be steeper.

7. In an open economy with perfect capital mobility and a fixed but adjustable exchange rate, devaluation policy will:

(a) Have no effect on the economy;
(b) **Lead to an increase in output and an increase in the supply of liquid assets;**
(c) Lead to an increase in output and a fall in the supply of liquid assets;
(d) Lead to a fall in output and a decrease in the supply of liquid assets.

8. In an open economy with perfect capital mobility and a flexible exchange rate an increase in international interest rates will lead to:

(a) No changes in trade deficit;
(b) **An increase in net exports;**
(c) A decrease in net exports;
(d) An increase in domestic interest rates by monetary contraction.

9. In an open economy with no capital mobility and flexible exchange rate an increase in government spending will:

(a) Have no real effect;
(b) **Lead to an increase in output;**
(c) Lead to a recession;
(d) Lead to monetary contraction.

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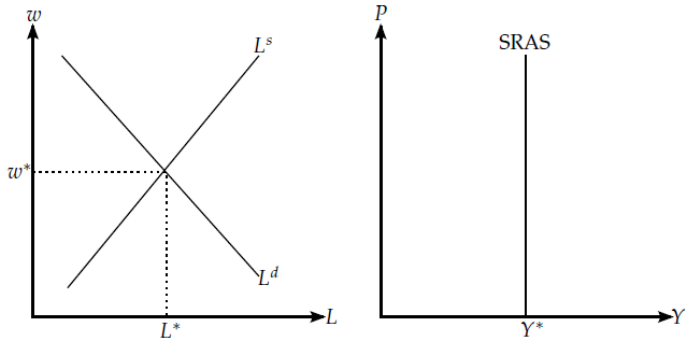
10. An increase labour supply would cause:
(a) **a decrease in nominal wages;**
(b) no change in nominal wages;
(c) an increase in nominal wages;
(d) uncertain effect on nominal wages.

Section B

B1. 'If all prices and wages are fully flexible in the short run then the aggregate supply (AS) curve is vertical.

It is possible to argue that this statement could be either **TRUE** or **FALSE**.

With flexible wages and prices, the labour market will adjust to a point where labour demand is equal to labour supply (there is an equilibrium real wage w = W/P). In the case where all agents have perfect information and do not suffer from money illusion, the equilibrium real wage and employment level will be independent of the price level P. With employment independent of P, the supply of output is also independent of P. This means the aggregate supply function is vertical.



When the information available to agents is imperfect, the aggregate supply function will be upward sloping even if wages and prices are fully flexible. For example, suppose workers do not observe the price level P, but firms do. In this case, workers must infer the real value of their nominal wage. This means the position of the labour supply curve depends on how the actual price level differs from workers' expectations (labour demand is unaffected if firms have full information). Given expectations, the price level changes equilibrium employment and hence output.

B2. 'An increase in a central bank's discount rate will reduce the monetary base.'

The statement is **TRUE**.

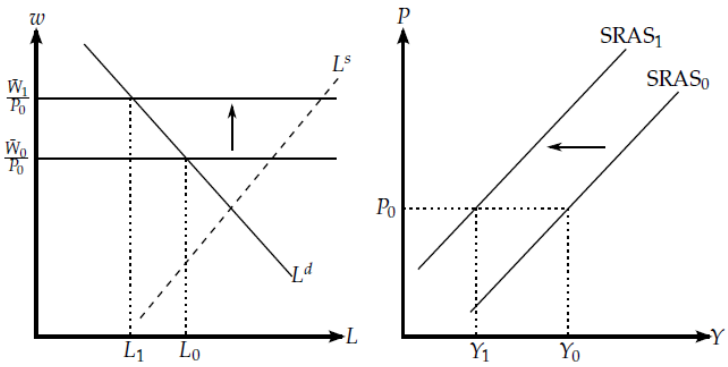
The discount rate is the interest rate charged by the central bank for loans of reserves. A higher discount rate discourages banks from borrowing reserves from the central bank through the discount window (because the amount they must repay has increased), thus fewer reserves will be created this way. Since reserves form part of the monetary base, the monetary base will be lower.

A good answer to this question would start by giving a definition of the monetary base (reserves plus cash) and then explain the basics of the 'discount window' (discount facility) offered by central banks. Candidates are encouraged to keep their answers to short questions as relevant and concise as possible. In particular, in this question, it is not necessary to mention or discuss other means of controlling the money supply such as open-market operations.

B3. 'An increase in the level of money wages implies the aggregate supply (AS) curve shifts to the right.'

The statement is **FALSE**.

For a given price level *P*, an increase in money wages *W* raises the real wage $w = W/P$. Firms' incentives to hire labour are thus reduced, and employment is lower, moving down the labour demand curve (workers are assumed not to be on their labour supply curve because wages are sticky, so the labour market does not clear). Lower employment leads to lower output. Output is therefore reduced for each and every price level, so the short-run aggregate supply curve (SRAS) shifts to the left, not to the right.



A full answer to this question requires an explanation of how the direction of the shift of the AS curve is determined. While it is not necessary to give a full derivation of the SRAS curve, it is helpful to have the labour-market diagram in the answer to provide a clear analysis.

B4. 'According to uncovered interest parity (UIP), a higher domestic nominal interest rate is associated with an expected depreciation of the domestic currency.'

The statement is **TRUE**.

Uncovered interest parity states that investors must receive the same expected return (adjusting for currency movements) whether they hold domestic or foreign bonds (because they are assumed to be risk neutral). The domestic-currency return on domestic bonds is i, while the foreign-currency return on foreign bonds is $i*$. Any appreciation of the domestic exchange rate $\Delta e/e$ (as a percentage) decreases the domestic-currency return on foreign bonds, which is therefore $i^* - \Delta e/e$. Mathematically, the UIP equation is

$$i = i^* - \frac{\Delta e}{e}.$$

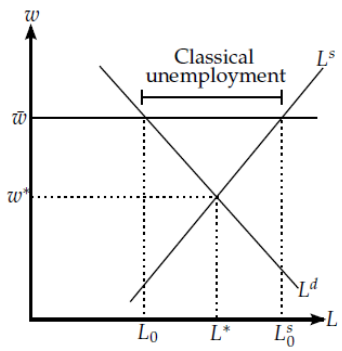
An expected depreciation is a negative value of $\Delta e/e$, which increases the domestic interest rate i.

The best approach to answering this question clearly and quickly is to write down the UIP equation and briefly explain what the equation represents. When writing down any equation, it is strongly advised that candidates define notation where there is a danger of ambiguity or misunderstanding. In particular, it should be made clear whether the exchange rate is the domestic price of foreign currency (as in the explanation above) or the foreign price of domestic currency.

B5. 'A minimum wage law can be a cause of classical unemployment.'

The statement is **TRUE**.

A minimum wage that is binding pushes up the real wage above its market-clearing level. This means that more individuals would like to work than the number of jobs firms have an incentive to create. In other words, at the minimum wage, desired labour supply exceeds labour demand. Without the minimum wage or other rigidities, the real wage would fall to bring demand and supply into line. But the minimum wage prevents this adjustment, so the excess of desired labour supply above labour demand is classical unemployment.



A good answer to this question would provide a clear definition of classical unemployment that distinguishes it from other types of unemployment. The most efficient way of explaining the effects of the minimum wage is to use a standard labour-market diagram, comparing the outcome with a market-clearing real wage to the outcome with the minimum wage.

Section C

Problem C.1. Consider a closed economy with fixed prices and wages.

(a) Suppose the demand for money is given by

$$M^d/P = m_0 + kY - hr,$$

where M^d is nominal money demand, P is the price level, Y is real income, and r is the interest rate. Assume the price level is fixed at $P = 1$. Suppose that the central bank fixes the money supply $M^s = M$.

Show that the slope of the LM curve (representing money-market equilibrium) is

$$dr/dY = k/h$$

Which values of the parameters k and h represent the case of money demand that is inelastic with respect to income? Using the equation above, deduce that the LM curve is horizontal in this case. (**7 marks**)

Money-market equilibrium (represented by the LM curve) is found using the equation $M^d = M^S$ with $P = 1$:

$$M = m_0 + kY - hr.$$

This equation can be rearranged as follows:

$$r = \frac{m_0 - M + kY}{h}.$$

Differentiating with respect to Y shows that the slope of the LM curve is k/h.

Money demand being inelastic with respect to income requires a zero response, hence $k = 0$. It follows that $k/h = 0$, so the LM curve has slope equal to zero, in other words, it is flat.

(b) Goods market equilibrium is where output is equal to the sum of consumption, investment, and government spending: $Y = C + I + G$. The consumption function is $C = C_0 + c_1(Y - T)$ and the investment function is: $I = I_0 - br$. Government spending $G = G_0$ and taxes $T = T_0$ are exogenous.

Consider an economy where the LM curve is horizontal, as in part (a). Suppose that households increase their desire to save, which can be interpreted as a fall in autonomous consumption C_0. What are the effects on output Y and national saving S_N? (Recall that national saving is defined as $S_N = (Y - T - C) + (T - G)$.) Explain your answer intuitively. (**7 marks**)

With a horizontal LM curve, the interest rate r must be the same no matter what is the level of output Y. Goods-market equilibrium (represented by the IS curve) is found using the following equation, which can be solved for output Y:

$$Y = C + I + G = C_0 + c_1(Y - T_0) + I_0 - br + G_o = c_1Y + (C_0 + I_0 + G_o - c_1T_0 - br).$$

Collecting all terms in Y on the left-hand side of the equation:

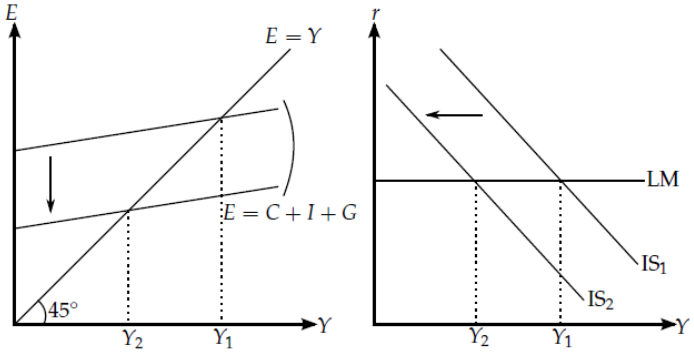
$$(1 - c_1)Y = C_0 + I_0 + G_o - c_1T_0 - br$$

and therefore equilibrium output is:

$$Y = \frac{C_0 + I_0 + G_o - c_1T_0 - br}{1 - c_1}.$$

From this equation, a fall in C_0 is seen to reduce Y.

Alternatively, this part of the answer can be explained using an IS/LM or expenditure/income diagram. Note that a greater desire to save implies a reduction in the autonomous component of consumption demand. Lower consumption demand means lower expenditure, hence the IS curve shifts to the left. Output is therefore lower.



Now consider national saving, defined as $S_N = Y - C - G$. The equilibrium level of national saving can be found using the consumption function:

$$S_N = Y - \big(C_0 + c_1(Y - T_0)\big) - G_o = (1 - c_1)Y - C_0 - G_o + c_1 T_0.$$

Substituting in the expression for (1 - c)Y derived earlier:

$$S_N = (C_0 + I_0 + G_o - c_1 T_0 - br) - C_0 - G_o + c_1 T_0 = I_0 - br.$$

Therefore, national saving is not affected by the increase in desired saving (the interest rate is constant because the LM curve is flat).

Alternatively, a simpler way of reaching this conclusion is to note $S_N = (C + I + G) - C - G = I$. Since $I = I_0 - br$ and as the interest rate is constant because of the horizontal LM curve, there is no change in investment, hence no change in national saving.

Intuitively, although households would like to save more, they do this by spending less, which reduces demand. Since interest rates cannot fall, investment cannot rise to compensate, thus demand is lower. With sticky prices, demand determines incomes, which then fall. With lower incomes, even if consumption is lower, actual saving can remain unchanged.

(c) Repeat the analysis of part (b) when investment depends positively on output, as implied by the equation

$$I = I_0 + aY - br$$

Explain the intuition for the differences you find compared with your answers to part (b). (**6 marks**)

In this case, following the same steps as in part (b), the expression for equilibrium output is:

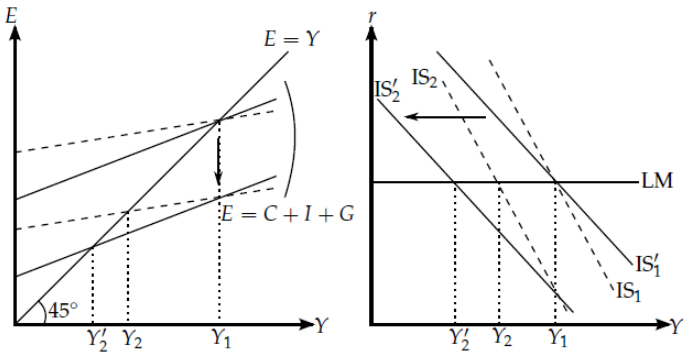
$$Y = \frac{C_0 + I_0 + G_o - c_1 T_0 - br}{1 - c_1 - a}.$$

Since $1/(1 - c_1 - a) > 1/(1 - c_1)$, the fall in C_0 leads to a larger reduction in output than in part (b).

Alternatively, the result can be explained using the expenditure/income diagram. When investment depends on income, the expenditure line is steeper. Thus, a given reduction in demand (shifting the expenditure line down by a given amount) now leads to a larger fall in output in equilibrium. This means that the IS curve shifts further to the left.

The intuition is that there is now an additional multiplier effect working through investment as well as consumption (lower demand reduces output, which further reduces demand for investment).

National saving is still equal to investment, and since Y falls while r remains constant, investment must fall. This means that national saving actually falls now.



Problem C.2. Consider the Solow model of economic growth. Assume the production function is

$$Y = K^{1/2}L^{1/2}$$

where Y is output, K is the capital stock, and L is the labour force. The labour force (assumed equal to the population) grows at a constant rate n. The capital stock depreciates at a constant rate δ. There is no exogenous technological progress ($g = 0$). The saving rate is s.

(a) Let $y = Y/L$ and $k = K/L$ denote output per person and capital per person. Show that the production function implies:

$$y = f(k) = k^{1/2}$$

The dynamics of the capital stock per person are described by the equation

$$\Delta k = s\,f(k) - (\delta + n)k$$

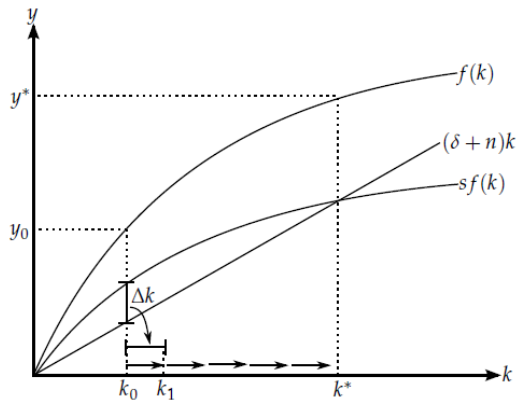
(you are not required to derive this equation). Show how the steady-state stock of capital per person is found using a diagram and explain why the economy will converge to this point in the long run.

Using the diagram, find the effects of a rise in the saving rate s on steady-state capital and output per person. Sketch a graph showing the path of capital and output per person over time during convergence to the new steady state. (7 **marks**)

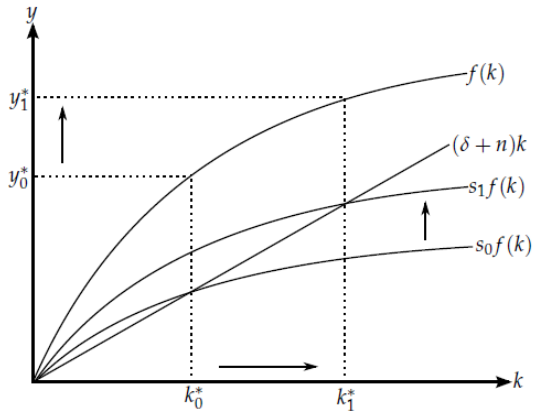
Divide the expression for output Y given by the production function by population L to obtain output per person:

$$y = \frac{Y}{L} = \frac{K^{1/2}L^{1/2}}{L} = \frac{K^{1/2}L^{1/2}}{L^{1/2}L^{1/2}} = \left(\frac{K}{L}\right)^{1/2} = \sqrt{k}.$$

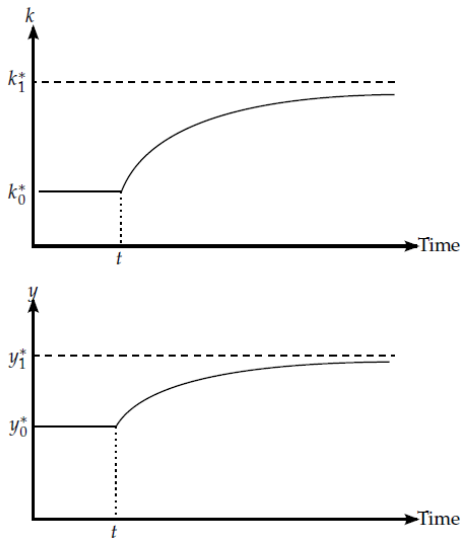
The steady state is the intersection between the upward-sloping and concave saving line $s\,f(k)$ and the straight 'depreciation' line $(\delta + n)k$. To the left of the intersection point, the saving line is above the depreciation line, so using the equation for Dk, the capital stock will increase, and similarly, capital will fall to the right of the intersection point. Therefore, the economy will converge to the intersection point in the long run.



An increase in the saving rate s shifts the saving line upwards. The intersection point with the depreciation line is now to the right, so steady-state capital per person will be higher. Moving up the unchanged production function $y = f(k)$, output per person will also be higher.



Convergence to the new steady state takes place gradually over time. There is no initial jump in either capital or output since the capital stock is predetermined (the existing capital stock is derived from past investment). Putting all these findings together and plotting the evolution of capital and output per person over time:



(b) Let $c = C/L$ denote consumption per person. Given the saving rate s, consumption per person is determined by the equation:

$$c = (1 - s)\, f(k)$$

The Golden-rule level of the capital stock k^* is the level that maximizes steady-state consumption per person. Using your diagram or using algebra, explain why the Golden-rule capital stock is the solution of the equation:

$$f'(k^*) = \delta + n$$

Assume that the capital stock is initially below the Golden-rule level. The saving rate is now increased to allow the economy to reach the Golden rule. Sketch a graph showing the path of consumption over time following this change in the saving rate. (7 **marks**)

The steady-state capital stock is such that the savings and depreciation lines have the same height, which can be written algebraically as the equation $s\, f(k) = (\delta + n)k$. This equation can be used to derive an expression for consumption in the steady state:

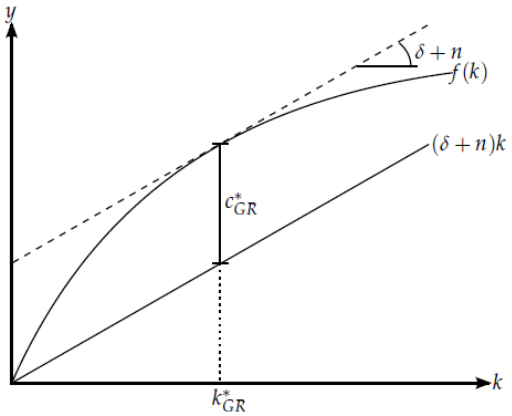
$$c = (1 - s)f(k) = f(k) - sf(k) = f(k) - (\delta + n)k.$$

The Golden-rule capital stock is the capital stock that maximises steady-state consumption. Differentiating with respect to k and setting the derivative equal to zero gives the first-order condition for the maximum:

$$\frac{\partial c}{\partial k} = f'(k) - (\delta + n) = 0.$$

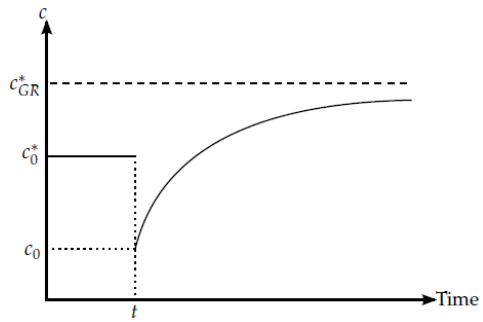
This equation implies that the Golden-rule capital stock must have a marginal product of capital $f'(k)$ equal to the sum of the depreciation and population growth rates.

The alternative graphical argument notes that steady-state consumption is the vertical distance between the production function and the depreciation line (because the saving line has the same height as the depreciation line in any steady state). Geometrically, this is at its greatest where the tangent to the production function (with slope $f'(k)$) has the same slope as that of the depreciation line (i.e. $\delta + n$).



It is important to note that the question explicitly calls for one of these arguments justifying the Golden-rule condition. A good answer therefore requires an explanation of why the Golden-rule capital stock satisfies the equation $f'(k) = (\delta + n)$, not simply a description of what the Golden rule means.

When the saving rate is increased, this immediately reduces consumption (since $c = (1 - s)f(k)$ and the capital stock k does not adjust immediately). In the long run, the economy will converge to the Golden-rule capital stock, so consumption will be higher than it was in the initial steady state (this follows from the definition of the Golden rule as the capital stock that maximises steady-state consumption). The results from part (a) show that capital and output will rise during the transition to the long run, so consumption, which is proportional to output ($c = (1 - s)y$) will be rising while convergence is taking place. This means that consumption will be below its initial value for some time.



The best answers were able to explain all the movements in consumption depicted in the diagram above. A significant number of candidates failed to account for there being two effects on consumption: a direct effect from changing the saving rate, and an indirect effect caused by the changes in output following the change to the saving rate (which affects capital accumulation). The key to understanding the dynamics of consumption is that once the saving rate has changed (which has an immediate effect on consumption), the subsequent movements in consumption will follow the movements in output.

(c) Suppose the saving rate is $s = 0.2$, population growth is $n = 0.01$, and the depreciation rate is $\delta = 0.09$. Calculate whether the economy described by these parameters requires a higher or a lower saving rate to reach the Golden-rule level of capital. (**6 marks**)

Substituting the parameters from the question into the equation $sf(k) = (\delta + n)k$ for the steady-state capital stock:

$$0.2\sqrt{k} = (0.09 + 0.01)k.$$

By dividing both sides by $0.1\sqrt{k}$, this equation implies

$$\sqrt{k} = \frac{0.2}{0.1} = 2$$

and therefore $k = 4$. The marginal product of capital $f'(k)$ can be obtained by differentiating the production function $f(k)$ with respect to capital k:

$$f'(k) = \frac{\partial\sqrt{k}}{\partial k} = \frac{1}{2\sqrt{k}}.$$

Evaluating this at k = 4 yields $f'(k)$ = 1/4 = 0.25. With the parameters in the question, $\delta + n$ = 0.1, so $f'(k) > \delta + n$. Since the marginal product of capital increases when the capital stock is lower (diminishing marginal returns to capital), this shows that the economy has too little capital, so the saving rate should be increased to reach the Golden rule.

A common mistake when answering this part of the question was not understanding that $f'(k)$ increases when k is lower. The diminishing marginal product of capital is one of the most important assumptions of the Solow growth model.

Section D

The December 14, 2010 issue of the Wall Street Journal ran an article entitled *Official Relieves Pressure on BOJ*. The article states:

> "The chief spokesman for Japan's government said additional monetary easing, including setting an inflation target, won't help Japan conquer deflation. He also suggests Tokyo won't press the Bank of Japan for more steps to prop up the economy anytime soon.
>
> Yoshito Sengoku said in an interview Japan has experienced continued price declines despite years of aggressive easing policies from both the monetary and fiscal sides, a phenomenon that convinces him that deflation is caused by the nation's proximity to lower-cost economies like China and the nations in South East Asia.
>
> 'Some people seem to believe the BOJ can generate an adequate level of inflation by just printing money. But I don't think that's the case,' said Mr. Sengoku, who serves as chief of staff to Prime Minister Naoto Kan."

a) Suppose one takes Mr. Sengoku's conjecture that lower-cost economies like China are causing deflation in Japan as operating through a reduction in P* in our model. In this case, does Mr. Sengoku's conjecture match with the long-run predictions of the small open economy flexible exchange rate model developed in class? (**10 marks**)

A fall in P* does nothing to the full employment level of output, the BB curve, or the LM curve. It shifts the IS curve back as demand is shifted away from domestic goods and towards foreign goods. To restore long-run equilibrium, the exchange rate must depreciate and shift IS back. The price of domestic goods cannot fall to push IS back because a change in domestic prices would shift LM, and that can't move. In other words, Mr. Sengoku's prediction is not consistent with the model.

b) Use the relevant model to evaluate Mr. Sengoku's claim that additional monetary easing won't help Japan conquer deflation. In particular, compare the long-run effect on the price of domestically produced goods of a permanent increase in the money supply in a closed economy and a small open economy with flexible exchange rates. (**10 marks**)

In either case P rises in equal percentage. Since changes in money supply have no long run effect on interest rates (with expected inflation held fixed) or output, prices must adjust to re-equilibrate the money market following an increase in supply, and that means an equal percentage increase in prices and money supply. This change in price will not spill over and affect a small open economy in the goods market because the exchange rate will offset any movement in prices.