ECO2143 Macroeconomic Theory II
final examination: April 26th 2019
University of Ottawa
Professor: Louis Hotte
Time allotted: 3 hours

Attention: *Not all questionnaires are the same. This is questionnaire* ***A****. On the answer sheet, you must indicate the letter of your questionnaire with the course's number as follows:* ***ECO2143A****. You must answer according to* ***the material seen in this course****. Read all answer choices before choosing your answer. Calculator permitted.* GOOD LUCK!

QUESTIONNAIRE A

I. MULTIPLE CHOICE QUESTIONS (2 points each)

II. 3 PROBLEMS

1. (40 points) Bond yields and expectations Suppose that the following financial data regarding the Canadian government's bond yields was published in the newspapers in March 2018 and December 2018 respectively:

Maturity (n years):	1	2	3	4	5
Yield to maturity ($i_{n,t}$%, t = mar):	1.0	1.5	2.0	2.25	2.4
Yield to maturity ($i_{n,t}$%, t = dec):	1.5	1.5	1.5	1.5	1.5

As we can see, the one-year interest rate are $i_{1,mar} = 1\%$ and $i_{1,dec} = 1.5\%$ for March and December 2018 respectively.

a) (10) Calculate the one-year interest rates that markets expected to prevail over the coming five years at each date and fill out the following table. **Show the details of the calculations for the case of $i^e_{1,mar+2}$ only.**

Expected one-year yield	$i_{1,t}$	$i^e_{1,t+1}$	$i^e_{1,t+2}$	$i^e_{1,t+3}$	$i^e_{1,t+4}$
t = mar (%):	1.0				
t = dec (%):	1.5				

ANSWER:

Expected one-year yield	$i_{1,t}$	$i^e_{1,t+1}$	$i^e_{1,t+2}$	$i^e_{1,t+3}$	$i^e_{1,t+4}$
t = mar (%):	1.0	2.0	3.0	3.0	3.0
t = dec (%):	1.5	1.5	1.5	1.5	1.5

Calculations for $i^e_{1,mar+2}$:

The relation between "yield to maturity" and the "one-year expected yields" is the following:

(1) $$i_{3,t} = \frac{1}{3}(i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2})$$

(2) $$i_{2,t} = \frac{1}{2}(i_{1,t} + i^e_{1,t+1})$$

This implies:

(3) $3i_{3,t} = i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2}$

(4) $2i_{2,t} = i_{1,t} + i^e_{1,t+1}$

Taking the difference on each sides gives:

$3i_{3,t} - 2i_{2,t} = i^e_{1,t+2}$

With $t = mar$, this gives $3(2.0) - 2(1.5) = i^e_{1,mar+2}$ and thus $i^e_{1,mar+2} = 3.0\%$.

b) (10) Given the bond yields that prevailed in March 2018 – i.e., the term structure of interest rates in March 2018 – provide an interpretation of the economic situation that likely prevailed in March 2018 (the short term). Discuss then how financial markets expected the economic situation to evolve over the coming five years **as of March 2018** (the long term). Justify.

ANSWER:

At 1.0%, the short term interest rates in March 2018 were quite low. This is likely due to the Bank of Canada (the Central Bank) setting low interest rates in order to stimulate an economy that must have been growing too slowly and suffering from an inflation rate considered too low.
In March 2018, markets were however optimistic about the future. This is seen from the fact that one-year interest rates were anticipated to increase from 1.0% to 3.0%. This suggests that markets expected the Central Bank to be induced to raise interest rates as the economy begins to grow faster and inflationary pressures set in.

c) (10) Given the bond yields that prevailed in December 2018 discuss how financial markets expected the economic situation to evolve over the coming five years **as of December 2018** (the long term). Justify.

ANSWER:

In December 2018, one-year interest rates were still quite low at 1.5% and the markets expected them to remain so for the coming five years. This suggests that markets were rather pessimistic about future economic growth. Indeed, markets expected the Central Bank to keep interest rates low, which is usually associated with slow growth and thus inflation that is too low.

d) (10) Provide an interpretation of what happened between March 2018 and December 2018 regarding the financial markets' outlook for the economy.

ANSWER:

The change in the bond yields between March and December 2018 suggests that financial markets went from being optimistic to pessimistic about future economic growth.

2.(40 points) "Obstacles" to Growth

Read the following excerpt from an article titled "India's Economy: India on Fire" published by *The Economist* on February 1st 2007 and answer the questions below.

> Another obstacle to growth in manufacturing is India's labour laws, which are among the most restrictive in the world. Firms employing more than 100 people cannot fire workers without government permission, which discourages expansion. Today's central government cannot scrap these laws because it relies on the support of the communist parties. In theory, the state governments can apply the laws more flexibly, especially in the special economic zones, but this is unlikely to lead to more flexible labour markets overnight.

In this course, we have considered half a dozen major factors suspected of explaining long-run economic growth and income differences between countries. The above article relates *precisely* to one of them.

a) (10) Identify which one and describe it briefly.

ANSWER:

This is a problem of inefficiency. Efficiency is defined as the ability with which technology and factors of production (inputs) are effectively used in order to produce outputs (GDP, goods and services).

b) (10) Assume that the per-capita output function of India is given by $y_t = A_t k_t^{\alpha} h_t^{1-\alpha}$, as defined in class. Which one of these variables would be affected by the problem mentioned in the article? Explain what that variable represents.

ANSWER:

Efficiency would be measured by variable A_t, which represents total factor productivity (TFP, productivity). TFP combines both technology and efficiency. Technology explains well long-run growth (across time) while efficiency explains well differences in TFP between countries (across countries).

c) (10) Suppose that the problem mentioned in the article can be represented by the way workers are allocated between two sectors, those of small firms (sector 1) and large firms (sector 2). Reproduce the graphical template of figure 1 below where MPL denotes the marginal product of labor per sector and describe the nature of the problem. Assume that the total amount of labor is equal to $\bar{L}$ which must be allocated between small firms (L_1) and large firms (L_2).

FIGURE 1. MPL in small and large firms

Explain how the situation reported may affect GDP through the allocation of labour in India. (A graphic may be useful.)

ANSWER:

If it is difficult for large firms to fire workers, then employers will be reluctant to hire new worker in the first place. This is true even if they expect a new worker's marginal productivity

to be higher than the salary that he or she must be paid. As can be seen in the accompanying graphic (`sol-graphic-final-exam2019-LONG2.pdf`), the resulting distribution of workers will be such that the marginal productivity of workers is higher in large firms than in small firms (points A_1 and A_2). This is another example of labour misallocation between sectors in the economy, the sectors being defined as large and small firms. Efficiency dictates that the marginal productivities be equalized between sectors; here, there are too many workers in small firms and too little in large firms.

d) (10) Explain why it may be politically difficult to solve the problem mentioned.

ANSWER:

This type of problem can prove difficult to correct from a political point of view. This is because workers already hired by large firms will benefit from such a law (the incumbents). This is true not only because they have job security, but also because they are likely to receive a higher wage than they would receive without such a law, due to their higher marginal productivity. The equilibrium without the law in question is at points B_1 and B_2, which corresponds to a lower marginal productivity for large firm workers but higher marginal productivity for small firm workers. Hence, workers outside large firms are likely to benefit from repealing such a law by receiving larger salaries. Per capita output in the economy will increase also. But large firm workers are likely to block such a change.

3. (40 points) Productivity, population size and immigration The following is an excerpt from an article that appeared in *The Economist* on April 17th 2019:

> Klaus Desmet of Southern Methodist University, David Krisztian Nagy of CREI, a research institute, and Esteban Rossi-Hansberg of Princeton University do just that. In a paper that last month won them the Robert Lucas prize, which recognises excellent research in political economy, they build a model that yokes economic performance to population size, within which they can run time forward by hundreds of years to watch the balance of economic power change. Long-run growth, they suggest, is driven by improvements in technology. And more populous countries should accumulate more innovation than smaller ones do because the return on developing a new technology is higher – there are more people to buy Edison's light bulb and to enrich Edison, and therefore more incentive to invent the light bulb in the first place.
>
> Leaning against this force, however, is migration. Right now, the richest places are not the most populous. Should it become relatively easy to migrate, people will move from countries that are populous but poor to others that are rich. As migration swells the population of rich places, their long-run dominance is assured because of the link between population size and innovation.

Let us try to analyse the link between population size, worker output and migration with the help of the Solow model as follows.

A country has a constant population size of L_0 and aggregate capital stock of K. Aggregate output is given by $Y = AK^{\alpha}L^{1-\alpha}$, where A and α are constant parameter values (i.e. they do not vary over time). The investment and capital depreciation rates are also constant over time and respectively given by $\gamma = 10\%$ and $\delta = 5\%$.

a) **(10)** Assuming that $A = 10$ and $\alpha = 1/3$, calculate the long-run per-capita income level y^{ss}. (Always make sure to show all the important steps involved in your calculations. The correction is based on the solution procedure, not the final answer.)

ANSWER:

We have $y = Ak^{\alpha}$ and $\Delta k = \gamma Ak^{\alpha} - \delta k$. In steady-state, we must have $\Delta k = 0$, which means $\gamma Ak^{\alpha} = \delta k$ or $0.1 * 10 * k^{1/3} = 0.05k$. Solving thru, we get $k^{ss} = 20^{3/2} = 89.44$. Inserting this value for k into the output function, we get $y^{ss} = 10 * 89.44^{1/3} = 44.72$.

b) The economy is presently at its steady-state equilibrium. Suppose that there is a one-time, sudden influx of immigrants such that the new *constant* population size L_1 is now twice as large, i.e. $L_1 = 2L_0$. Nothing else changes.

i) **(10 points)** Show that in the short-run, the immediate effect is to lower the per-capita capital stock by half and calculate the short-run, immediate effect on per-capita income. Is it also reduced by half? Why or why not?

ANSWER:

At any period t, we have $k_t = K_t/L$ (assuming L is constant over time). Since K_t does not change immediately, we have $k_t = K_t/L_0$ right before the immigration influx; and right after the influx, we have $k_t = K_t/L_1 = K_t/(2L_0)$. Hence, the immediate effect of doubling the population size is to reduce the per-capita capital stock by half.

Here, before the influx, we have $k_t = k^{ss} = 89.44$. Hence, right after the influx, we have $k_t = 89.44/2 = 44.72$. The influx will thus cause income per capita to immediately drop from $y^{ss} = 44.72$ to $y = 10(44.72)^{1/3} = 35.49$. This is an instance of capital dilution.

However, while the per-worker capital stock dropped by half, income dropped by less than half. (More precisely, the income drop is 20.64%.) The reason why income drops by less than the drop in the capital stock is due to the presence of decreasing returns to capital.

ii) **(10 points)** Calculate the long-run, steady-state effect of this immigration influx on per-capita income. Interpret.

ANSWER:

In the long run, we still have $y^{ss} = 44.72$. This is because the long-run per capita income is defined by $\gamma Ak^{\alpha} = \delta k$, which does not depend on the population size. Hence, the immigration influx does not affect the per-capita income in the long run.

c) **(10 points)** The article from *The Economist* argues that a larger population size has the advantage of increasing the creation and circulation of ideas. This would imply that with a larger population size, *all else equal*, each worker can do more with any given capital stock. For our purpose, this implies that the long-run value of A is a function of L. More concretely, let

us say that in the long run, we have:

$$A = 10 \quad \text{if} \quad L = L_0,$$
$$A = 20 \quad \text{if} \quad L = L_1.$$

Using those values for A, recalculate and compare the long-run, steady-state per-capita income levels with population sizes L_0 and L_1. By comparing the short-run and long-run effects of immigration on output, discuss why immigration policies are politically hard to implement.

ANSWER:

With $A = 20$ and using $\gamma A k^{\alpha} = \delta k$, we now have $0.1 * 20 * k^{1/3} = 0.05k$, which yields $k^{ss} = 252.98$ and $y^{ss} = 20 * 252.98^{1/3} = 126.5$. This implies that in the long run, the immigration influx has raised income per capita from $y^{ss} = 44.72$ to $y^{ss} = 126.5$ through its effect on the creation of new ideas (technology, knowledge, productivity), as suggested by the article in *The Economist*.

The lesson from this simple example is that if it is true that a larger population size increases the creation and circulation of ideas, then immigration will benefit all in the long run. However, this may come at a short-run cost for the local population because of a capital-dilution effect. This may make it difficult to adopt policies open to more immigration.