University of Western Ontario
Prof. Simona Cociuba
Fall 2013

Practice Problems: Midterm 1 from 2013

Abstract

Your solutions to these problems will not be graded. I will upload solutions to this old midterm on OWL on Monday, October 5th. I recommend that you only look at the solutions after you have tried to solve the questions on your own.

Instructions

- This is a 2-hour exam. There are 4 questions.
- This is a closed book, closed notes exam (i.e. formula sheets are **not** allowed!).
- You may use a non-graphing, non-programmable calculator. Cell phones with calculator apps cannot be used!
- Cell phones need to be off and in your backpacks. If you are caught with a cell phone in your pockets, you may receive a zero on the exam.
- All the answers need to be written in the separate exam booklet(s) provided. Any answers written on scrap paper are not graded.
- You must show all your derivations to obtain full credit.
- When you are asked to give intuition or briefly explain your statements or findings, you need to be clear, and address the question you are asked. You will be penalized for giving answers on unrelated topics.
- Write your name and student number on the front of all booklets.
- Please write your name in the format: LAST NAME, FIRST NAME.

1. GDP Measurement (30 points)

Consider an economy with two firms: a mango plantation and a restaurant. Both firms are owned by consumers.

The plantation harvests 5,000 mangoes, it sells 2,500 mangoes to the restaurant at \$2 each, it sells 500 mangoes to the consumers at \$2 each and it exports 1,500 mangoes at \$2.5 each. The remaining 500 mangoes are dried and put into inventory (note: mangoes are dried in the sun at no cost to the firm). Mangoes inventoried are valued at the current domestic market price of \$2 each and will be sold next year. The plantation pays taxes of \$800 to the government and pays gross wages to its workers in the amount of \$7,000.

The restaurant uses the 2,500 mangoes bought to produce mango ice cream and a drink called mango lassi, which are sold to consumers. The total revenue of the restaurant from selling these goods is \$18,000. The restaurant pays taxes to the government in the amount of \$1,200 and pays gross wages to its workers of \$5,500.

The government hires workers to provide national defence and pays them gross wages of \$3,500.

The consumers in this economy earn gross wages from working (either for one of the two firms or for the government) and pay taxes to the government in the amount of \$1,500. They also earn dividends from owning the firms (profits of firms are paid as dividends).

(1a). **(2 points)** Calculate after-tax profits for the mango plantation. Calculate after-tax profits for the restaurant.

(1b). **(4 points)** Compute GDP according to the income approach.

(1c). **(6 points)** Compute GDP according to the product approach.

(1d). **(8 points)** Compute GDP according to the expenditure approach.

(1e). **(5 points)** Assume that all of the inventories of dried mangoes are sold next year at the price of \$2. Will the sale of inventories affect GDP *next year*? If yes, show which components of GDP change in **one** of the three approaches (the income approach, the product approach or the expenditure approach). If no, explain why GDP does not change using **one** of the three approaches (the income approach, the product approach or the expenditure approach).

(1f). **(5 points)** Write down a general expression for the accounting identity which defines national savings. How much is national savings in this economy? Write down a general expression for the accounting identity which relates national savings to the current account. Is the current account in surplus or deficit in this economy? How large is the surplus/deficit?

2. Nominal GDP, Real GDP and Prices (20 points)

$(2a)$. **(2 points)** When calculating chained-weight real GDP Statistics Canada makes use of the so-called Fisher index. Write down the mathematical formula for computing the Fisher index between any two years, call them $t-1$ and t. Use p_{t-1} and p_t to denote the prices of period $t-1$ and period t, respectively. Use q_{t-1} and q_t to denote the quantities produced in period $t-1$ and period t, respectively.

$(2b)$. **(2 points)** Briefly explain what the Fisher index measures. "Brief" means that your explanation should be 1 to 3 sentences.

$(2c)$. **(2 points)** Write down the mathematical formula for computing chained-weight real GDP between any two years, call them $t-1$ and t.

For parts $(2d), (2e), (2f), (2g)$ use the data in the table.

	Year 1	Year 2	Year 3
Prices of good 1	6	7	8
Prices of good 2	5	4	3
Quantities of good 1	42	43	44
Quantities of good 2	30	35	40
Fisher index between years $(1,2) = 1.07115$			
Fisher index between years $(2,3) = 1.05621$			

Note: You don't need to show that the Fisher indices are equal to the numbers provided in the table.

$(2d)$. **(3 points)** Compute nominal GDP for all three years.

$(2e)$. **(6 points)** Compute chained-weight real GDP in **base year 2** for all three years.

$(2f)$. **(3 points)** Compute the implicit GDP price deflator for all three years.

$(2g)$. **(2 points)** Use the implicit GDP price deflator to determine the inflation rate in year 2 as well as the inflation rate in year 3.

3. Business Cycle Facts (20 points)

Table 1 below reports business cycle statistics for Krakozhia. For each series (GDP, residential investment and nonresidential investment), the natural logarithm was applied to the original data and then the cyclical component was obtained using the Hodrick-Prescott filter.

Table 1 reports the standard deviations of the cyclical component of each series. It also reports correlations of the cyclical component of GDP with the cyclical components of the other two variables denoted by x (residential investment and nonresidential investment). The table gives the contemporaneous correlations of GDP with each variable, as well as the correlations of GDP with past and future values of these variables.

Table 1. Business Cycle Statistics for Krakozhia

	Standard Deviation (in %)	Correlations of GDP with		
		$x\,(-1)$	x	$x\,(+1)$
GDP	1.72			
Residential Investment	10.70	0.74	0.63	0.39
Nonresidential Investment	5.11	0.57	0.79	0.88

(3a). **(1 point)** Write down the correlation between residential investment and future values of GDP. Note: You need to write down 1 number, no explanations are required.

(3b). **(4 points)** Give a definition of a leading variable. Give a definition of a lagging variable.

(3c). **(7.5 points)** Characterize the relationship between residential investment and GDP at business cycle frequencies. That is, answer the following:

(i) Is residential investment more or less volatile relative to GDP?

(ii) Is residential investment procyclical or countercyclical?

(iii) Does residential investment lead GDP, lag GDP or is residential investment a coincident variable?

Provide a brief explanation for each of your answers. This means, use statistics from the table to justify your answers for (3c) (i), (3c) (ii) and (3c) (iii).

(3d). **(7.5 points)** Characterize the relationship between nonresidential investment and GDP at business cycle frequencies. To answer (3d), use the same format as in part (3c).

4. Consumer Optimization (30 points)

Consider a representative consumer with preferences over consumption C and leisure l given by the utility function $U(C,l) = 3 \cdot C^{1/3} + l$. The consumer is endowed with h hours of time, works N^S hours and takes l hours of leisure. For each hour worked, the consumer receives wage rate w, which is taken as given. The consumer has no other sources of income and there is no government taxation. This means the consumer solves the following problem:

$$\begin{aligned} & \max_{C,l} 3 \cdot C^{\frac{1}{3}} + l \\ \text{subject to:} \quad & C = wN^S \\ & l + N^S = h \end{aligned}$$

(4*a*). **(5 points)** Illustrate graphically the optimal bundle of a consumer. Graph the budget constraint, one indifference curve and mark the optimal bundle. Briefly explain what is the key property of the optimal bundle.

(4*b*) . **(12 points)** Solve for the consumer's optimal choices of consumption and leisure.

(4*c*). **(3 points)** Solve for the consumer's labor supply. Is the consumer's labor supply curve downward sloping or upward sloping? Briefly show why, by taking the appropriate derivative.

(4*d*) . **(10 points)** Consider **a decrease** in the wage rate, w.

(*i*) **In your booklets** (not on the sheet with the exam questions!) make a table as shown below to indicate the changes that generally occur to consumption (C) and leisure (l) due to a decrease in the wage rate w. Provide your answer by using words like "increases", "decreases", "stays unchanged" or "effect is ambiguous". Use "does not apply" if either the income effect or the substitution effect does not occur.

Summary Table	consumption (C)	leisure (l)
Income effect	provide answer	provide answer
Substitution effect	provide answer	provide answer
Total effect (income + substitution)	provide answer	provide answer

(*ii*) Give a brief explanation of why C and l change the way you indicated in your table for the income effect and/or the substitution effect.

(*iii*) Next, go back to the optimization problem you solved in parts (*b*) and (*c*). Consider the income and/or substitution effects from the decrease in the wage rate, w, on the labor supply, N^S. Which effect dominates in this example?