

ECO 305  
Spring 2021  
Prof. Marina Azzimonti

## Exam # 1

Due Date: Friday March 5th, 7:00am ET

### Exercises

1. **GDP Measurement (20 points)** Consider a small agricultural economy, which grows only potatoes. There is a potato producer in the economy, which grows 9 million pounds of potatoes each year, out of which:
  - 6.5 million pounds are sold to domestic consumers at \$2 per pound,
  - 2 million pounds are exported (at the same price) and the remaining
  - 0.5 million pounds are stored for the next period (in order to replant potatoes again).

In order to grow these potatoes, the potato producer must use fertilizer which is only produced abroad. Suppose that the potato producer buys 0.4 million pounds of fertilizer from a foreign producer at the price of \$5 per pound. It also pays \$8 million in wages to its employees and \$3 million in taxes to the government. The profit of the potato producer is paid to the consumers in form of dividends.

The government collects taxes from the potato producer and the consumers and uses the total tax revenue in order to finance the supply of utilities (water, electricity and heating), which are provided to the economy's consumers for free. The government pays \$3 million in wages to the workers employed in the utility services (who take care of all repairs of plumbing, cables, etc and other maintenance) and buys from abroad one million gallons of gas at a price of \$2 per gallon in order to provide heating.

- (a) For each of the three agents in this economy, list all revenues and expenditures. All the budgets must be balanced (i.e. revenues = expenditures for each agent). Note that you have to calculate yourself the amount of dividends paid to the consumers as well as the amount of taxes that consumers pay to the government.

- (b) Calculate annual GDP of this economy using the *value-added approach*.
- (c) Calculate annual GDP of this economy using the *expenditure approach*.
- (d) Calculate annual GDP of this economy using the *income approach*.

2. **Inflation (20 points)** The economy produces 2 types of goods. Between 2018 and 2020, the BEA collected the following information:

	2018		2019		2020	
	P	Q	P	Q	P	Q
Apples	5	20	6	20	7	21
Bananas	70	40	71	45	73	45

- (a) Compute Nominal GDP in 2019 and 2020 and the Nominal GDP growth rate between those two years.
- (b) Compute Real GDP in 2019 and 2020 and the Real GDP growth rate between those two years. Use 2018 as the base year.
- (c) Compute the GDP deflator in 2019 and 2020 and the growth in the deflator between those two years.

## Data Analysis

(60 points) For this set of questions, you need to upload your written answers to each question and Excel file with computations (or some other Spreadsheet). Your answers can be typed in a word processor or written by hand, and then uploaded as a PDF.

1. Your first task is to download the data from FRED. You will need to download three GDP series, labeled *Gross Domestic Product by Expenditure in Constant Prices: Total Gross Domestic Product* for United States, Canada, and Korea. The data must be *Seasonally Adjusted* and at a *Quarterly* frequency. The time horizon is 1961:Q1 and 2020:Q3 (here Q1 means 1st quarter and Q3 means 3rd quarter). We will call each series  $Y_{i,t}$  where  $i$  denotes the country, so  $i = \{US, CA, RK\}$  and  $t$  denotes the period (composed by a year:quarter pair). Save these results in a spreadsheet.

- (a) De-trend each series using the linear regression method. For each country  $i$ , you need to compute and report the intercepts  $\alpha_i$  and slopes  $\beta_i$  of the regression equation

$$\ln(Y_{i,t}) = \alpha_i + \beta_i t + \epsilon_{i,t},$$

where  $i$  denotes the country, and  $\epsilon_{i,t}$  represents the error term. Please show intermediate steps on your spreadsheet, and clearly indicate where the intercepts and slopes were computed. You should report one intercept and one slope for each country.

- (b) Using the results from the previous step, what can you say about the *annual* long-run growth rates of these three countries? Be as precise as possible (e.g. use computed numbers, not just anecdotal evidence). *Hint:* make sure to compute your quarterly growth rate to an annual one).
- (c) Using the results from part (a), compute the deviations from trend (e.g. the difference between the actual GDP values and the fitted values in each country, see class notes for details) in your spreadsheet. These will represent GDP fluctuations and be used to characterize business cycles of these countries in the next questions.
- (d) In one figure, plot the GDP fluctuations over time for each country (that is, you will have three lines that move over time). To the best of your ability, explain what you see.
- (e) Which country has the largest volatility of output over the business cycle? Be as precise as possible (e.g. use statistics on GDP fluctuations and not just eye-ball the plot).
- (f) How correlated are the business cycles of Canada and US? How correlated are the business cycles of Korea and US? (again, present statistics using the GDP fluctuations). Explain intuitively.
- (g) If you were to invest in any of these countries, which one would you choose to put your money on and why?

2. We now want to see how sensitive our results are to an alternative de-trending method. To do this, download the same data from FRED, but expressed as *Percent Change from Year Ago* and answer the following:

- (a) What can you say about the *annual* long-run growth rates of these three countries? Be as precise as possible How does it compare to the rates computed before?
  - (b) In one figure, plot the evolution of YoY growth rates over time for each country (that is, you will have three lines that move over time). Compare to what you found in part (d) of question 1.
  - (c) Compute the standard deviation for each country, and compare to the volatility measures obtained before. Why are they different?
  - (d) How correlated are the YoY growth rates of Canada and US? How correlated are the YoY growth rates of Korea and US? (again, present statistics).
  - (e) Which de-trending method would be more appropriate? Explain
3. Canada, Korea, and the US were all significantly affected by COVID-19 in terms of the number of infections and the decline in economic activity. Comparing the behavior of YoY GDP growth rates over the sample to the value observed during the second quarter of 2020, which country would you say has been affected the most? Justify your answer.