Midterm 1 – ECON 3311, Fall 2024   Name:_____

                                              Student ID: _____

*__*Show your work. Make sure to provide explanations to your answers for full credit.__*

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1. **Suppose you are an economist working at the International Monetary Fund, and that the production function for countries is given by $y = \bar{A}k^{1/2}$. Where y is equal to output per person, k is equal to capital per person, and $\bar{A}$ represents total factor productivity.**

    a. **If capital per person in Brazil is 0.3446 and per capita GDP is 0.148, what is the predicted total factor productivity ($\bar{A}$) for Brazil? Show your work. (8 points)**

    We can plug the values from the question into the production function to find $\bar{A}$:

    $$y = \bar{A}k^{1/2} \;\rightarrow\; 0.148 = \bar{A}(0.3446)^{1/2} \rightarrow\; 0.148 = \bar{A}(0.587)$$

    $$\bar{A} = 0.252$$

    b. **Suppose that the predicted $\bar{A}$ for Japan is 0.734. We discussed several theories in class for why there may be differences in Total Factor Productivity ($\bar{A}$) across countries. Briefly explain why it would be hard to assess whether differences in institutions is the cause of the difference in TFP between Brazil and Japan. (8 points)**

    If we want to compare the effect of a certain factor (e.g. institutions) on outcomes, we need to compare two groups (e.g. countries) that are nearly identical in every aspect other than adopting different institutions. If we just pick any two countries that have different institutions and different outcomes, they may be different in many other ways as well, and not just in the different institutions. For the case of Brazil and Japan, there are other salient differences that may obscure the comparison.

2. **Gross Domestic Product (GDP) is an important indicator of the economic well-being of a country.**

    a. **Suppose that the stock of inventories in a country increased from $10 billion at the end of 2022 to $12 billion at the end of 2023. How would this alter the GDP calculation for 2023? What problem do we run into when we <u>do not</u> adjust for changes in inventories? (6 points)**

    An increase in inventories at the end of the year compared to the beginning of the year means that a country has produced more than it has sold. The amount that is sold is counted as part of C, G, I, or EX, but there are $2 billion that are produced and not sold that need to be accounted for. Not accounting for an increase in inventories will lead to an understatement of GDP for that year.

b. If exports are products that are produced by country A and sold to country B, why are they included when measuring GDP for country A? Briefly explain. (5 points)

Exports need to be included in GDP because GDP represents the value of goods and services produced domestically. What matters for inclusion in GDP is where a product is produced and not where it is sold, and exports are produced domestically.

The following graph represents real and nominal GDP from 2012 to 2022 in a hypothetical country. Use this graph for parts 'c' and 'd'.
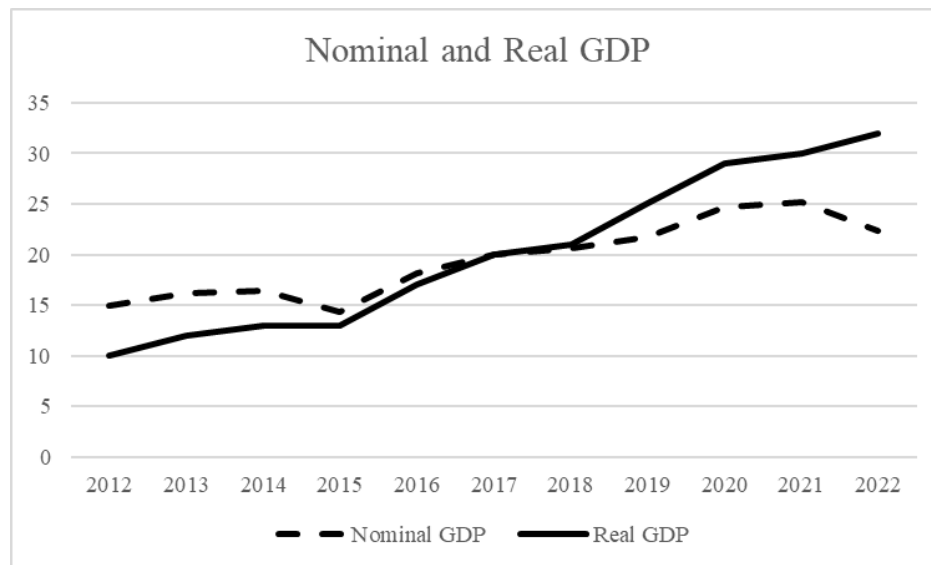
c. Why is this graph different from the usual relationship that we expect to see between nominal GDP and real GDP? What is the reason for this difference? Briefly explain. (8 points)

Usually we expect prices to increase over time. This means that nominal GDP will rise faster than real GDP. This will cause nominal GDP to be below real GDP before the base year and be higher than real GDP after the base year. In this case, the opposite occurs. Nominal GDP is above real GDP before the base year and below real GDP after the base year. This occurs because prices are decreasing.

d. The dashed line representing nominal GDP has a couple of instances where it is decreasing. Does this mean that this country is producing a lower quantity of goods and services than the year before? Briefly explain. (8 points)

Nominal GDP depends on both how many goods and services are produced but also the price level. Whether a country is producing more or fewer goods and services can be inferred from the real GDP and not nominal GDP. Because real GDP is always increasing, the country is producing more goods and services over time.

e. **When comparing the purchasing power of GDP between two countries, we need to make two adjustments. One of these is that the two countries use different currencies (e.g. dollar in the US and peso in Mexico). What other adjustment do we need to make? Briefly explain. (5 points)**

Different countries have different price levels. Usually, countries with higher wages have higher prices as well. In other words, a dollar in the US purchases more than an equivalent of a dollar in Mexico, so we need to take price levels into account when comparing purchasing power.

3. **Production functions in economics are used to depict the relationship between different inputs (e.g. K and L) and output (Y). Suppose that a production function displays increasing returns to scale. If the amount of capital (K) doubles, while the amount of labor (L) stays the same, which of the following statements is true for certain (assume there are no other inputs). Explain how you arrived at your answer. (8 points)**

   a. **Output more than doubles**
   b. **Output doubles**
   c. **Output increases, but less than double**
   d. **Output increases, but it cannot be determined by how much**
   e. **Output may decrease**

   If the production function displays increasing returns to scale, then output will more than double if both capital and labor double. That is, the change in production is greater than the proportional change in capital and labor. Here, however, only the amount of capital increases, so we do not have enough information to determine by how much production will increase (correct answer: d). We are certain production will increase because output must increase when either K or L increase.

4. **We discussed inflation (changes in the CPI) and the quantity theory of money in class.**

   a. **The quantity theory of money equation ($M_t V_t = P_t Y_t$) can be used to depict what causes inflation. Convert the quantity theory of money equation to growth rates ($\bar{g}_M, \bar{g}_P, \bar{g}_Y$) and explain how it can be used to calculate inflation (assume $\bar{g}_V = 0$) (8 points)**

   The quantity theory of money equation can be written in terms of growth rates by using the fact that the growth rate of a product is equal to the sum of their individual growth rates:

   $$\bar{g}_M + \bar{g}_V = g_P + \bar{g}_Y \rightarrow \bar{g}_M + 0 = g_P + \bar{g}_Y \rightarrow g_P = \bar{g}_M - \bar{g}_Y$$

   The growth rate of prices g_P is equal to the inflation rate, so the inflation rate is equal to the growth rate of money minus the growth rate of real GDP.

   Similarly, one can solve for P_t in the original equation and then express it in growth rates which now would imply subtracting the growth rate of real GDP as it is in the denominator.

b. **Suppose ticket prices for the local team's NBA games have gone up from $20 to $50 between 2015 and 2023. Your friend notes that "the price of milk went up during that same time period from $2 to $4, so the tickets to games are going up to by more than the CPI." Is your friend correct? Briefly explain why or why not. If not, do you think he is overstating or understating the CPI? Or is there not enough information to determine. (8 points)**

Your friend is not correct. The CPI measures the change in prices for a typical basket of goods and services and not one particular product like milk. While it may be the case that all products increased by the same price as milk, this is not likely. Therefore, it may be the case that the price of tickets increased by more than the CPI or less than the CPI.

5. **Suppose an economy is represented by the following Cobb-Douglas production function:**

$$Y = \bar{A}K^{1/4}L^{3/4}$$

a. **Calculate the marginal product of labor. (5 points)**

The marginal product of labor (MPL) is equal to the partial derivative of the production function with respect to labor:

$$\frac{\partial Y}{\partial L} = \bar{A}\frac{3}{4}K^{1/4}L^{-1/4} = \frac{3}{4}\bar{A}\left(\frac{K}{L}\right)^{1/4}$$

b. **What is the intuition (non-technical reason) behind the positive correlation or comovement between the amount of capital in the economy and the marginal product of labor? (8 points)**

The idea is that the more capital is available in the economy, the more capital there is for an additional unit of labor to work with. For instance, adding a 6th worker when there are 2 units of capital available will add less to overall output than when adding a 6th worker when there are 20 units of labor. Basically, this implies there are more "machines per worker."

c. **Does your answer to part 'b' contradict the idea that we expect diminishing marginal product of labor? Briefly explain. (8 points)**

No, the answer to part 'b' does not contradict diminishing marginal product of labor because part 'b' still displays diminishing marginal product of labor. Part 'b' asked about changing the amount of capital, and not labor. The amount of labor (L) is in the denominator, which means that if L increases, the MPL decreases.

d. **What would happen to the real wage (w) in the economy described in this question if the amount of capital decreased? Briefly explain. (7 points)**

We saw that in equilibrium, firms increase hiring until the MPL matches the cost of a worker. That's how we can surmise that the real wage is equal to MPL and therefore conclude that a decrease in the amount of capital leads to a decrease the real wage at equilibrium.