

ECON 1550

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Instructor: Fernando Duarte

Head TA: Leo Zucker

Undergraduate TAs: Eric Kim, Raisa Axenie, Nathalie Peña

Submission: Canvas or Gradescope

Problem Set 2 Answer Key

Chapter 2: National Income Accounting and the Balance of Payments

1. Import Restrictions Effects on the Current Account

Please answer Question 2 from Chapter 2 of the textbook, reproduced here for convenience:

“Equation (2-2) tells us¹ that to reduce a current account deficit, a country must increase its private saving, reduce domestic investment, or cut its government budget deficit. Nowadays, some people recommend restrictions on imports from China (and other countries) to reduce the American current account deficit. How would higher U.S. barriers to imports affect its private saving, domestic investment, and government deficit? Do you agree that import restrictions would necessarily reduce a U.S. current account deficit?”

Solution: It is possible to tell stories in which the effect on the current account goes either way. There are many valid answers. Here, we focus on investment (as discussed in class), which empirically is often the key factor in determining whether the current account improves. Public and private saving can, of course, also change.

One direct channel through which investment can increase is through an increase in demand. When imported goods become more expensive or less available, consumers may switch to domestic substitutes. Another channel is through profits. If domestic producers' monopoly power increases because of the reduced competition from abroad, profits can increase. If profitability is expected to be persistent, it can induce domestic firms to invest to increase future production.

¹Equation (2-2) is

$$S^p = I + CA - S^g = I + CA - (T - G) = I + CA + (G - T),$$

where S^p is private savings, I is investment, CA is the current account, S^g is government savings, T are taxes and G is government spending.

On the other hand, investment might fall in industries that face higher costs of imported intermediate goods, or higher costs of domestic substitutes.

Equation (2-2) is a powerful accounting identity: it must hold at all times and is therefore sufficient to rule out many common claims about the current account. In particular, it makes clear that tariffs affect the current account insofar as they also change private saving, domestic investment, or the government budget balance.

At the same time, the accounting identity alone cannot generate predictions about the direction or magnitude of specific variables, as evidenced by the examples above. Making such predictions requires additional assumptions—an explicit model with behavioral equations.

We will introduce and study those models later in the course.

2. New Dynamics for American Primary Income

Question 10 from Chapter 2 of the textbook states:

“If you go to the BEA website for “U.S. International Transactions”, table 1.1, you will find that in 2015, U.S. income receipts on its foreign assets were \$ 775.85 billion (line 6), while the country’s payments on liabilities to foreigners were \$ 582.47 billion (line 14). Yet we saw in this chapter that the United States is a substantial net debtor to foreigners. How, then, is it possible that the United States received more foreign asset income than it paid out?”

In this question, we work through an updated version. There have been some interesting developments since 2015!

Go to FRED (Federal Reserve Economic Data) at <https://fred.stlouisfed.org> and plot the series “Balance on primary income” with series ID IEABCPI. Then answer the following:

- (a) Give one concrete example that would contribute to the time series positively (make the balance on primary income larger) and one that would contribute negatively (make it smaller).

Solution: Here are a few examples (you only need one that contributes positively and one negatively for full credit).

Contribute positively:

- Wages paid to Prof. Duarte for teaching in France.

- Profits earned by Nike’s subsidiary in Vietnam.
- Dividends received by a U.S. resident on shares of the Japanese firm Toyota.
- Interest received by U.S. residents on bonds they own that were issued by the Government of Mexico.
- Interest received by the Federal Reserve from the Banco Central do Brasil on dollars provided through a currency swap line during the Covid pandemic.

Contribute negatively:

- Dividends paid to a U.K. resident on shares of the U.S. company NVIDIA.
- Interest paid by Bank of America to an Australian resident on U.S. dollar deposits.
- Interest paid by the U.S. Treasury to the People’s Bank of China on its holdings of U.S. Treasury securities.

(b) List all quarters in which the balance on primary income is negative.

Solution: There are only seven negative quarters in the entire dataset:

- Q3 2001: -\$620 million
- Q4 2023: -\$297 million
- Q1 2024: -\$10,219 million
- Q2 2024: -\$11,210 million
- Q3 2024: -\$21,225 million
- Q1 2025: -\$2,596 million
- Q2 2025: -\$5,772 million

Additional information (not needed for full credit):

Here is the plot for the entire series, obtained from <https://fred.stlouisfed.org/series/IEABCPI>. The balance on primary income for each quarter is shown in the figure below. Quarters with negative values are marked with red dots.



(c) The United States is a substantial net debtor to foreigners. How, then, is it possible that the United States received more foreign asset income than it paid out?

Solution: Assets is a stock variable, while income is a flow variable². That the value of foreign assets owned by the U.S. is less than the value of American assets owned by foreign countries (the U.S. is a net debtor) is a comparison between two stock variables. On any given quarter, the income flow generated by the smaller stock of foreign assets owned by the U.S. can be larger than the income flow generated by the larger stock of American assets owned by foreign countries. If bucket A has less water than bucket B, you can still pour more water out of bucket A than out of bucket B.

Income over one quarter equals assets at the beginning of the quarter multiplied by the return on those assets. Historically, the U.S. received a substantially higher rate of return on its foreign assets than other countries did on their U.S. assets. Key reasons include:

- U.S. foreign direct investment tends to earn higher returns than portfolio investment
- A substantial amount of foreign-held U.S. assets are Treasury securities, which have relatively low returns
- U.S. multinational corporations book profits in low-tax jurisdictions, inflating measured returns on foreign assets

The 2024 reversal suggests these advantages are no longer sufficient to offset the

growing interest payments on the U.S.'s large net debtor position at the current relatively high level of interest rates.

²Stock: a variable that can be expressed as a quantity at a point in time (such as physical capital). Flow: a variable that can be expressed as a quantity per unit of time (such as investment).

- (d) Go to the BEA website at <https://www.bea.gov/itable/> and find Table 1.1 U.S. International Transactions. For the year 2024, report the values of primary income receipts (line 6) and primary income payments (line 14). Compute the annual balance on primary income by subtracting payments from receipts. Compare this annual balance to the sum of the four quarterly values from the FRED series for 2024. Do they match? Are they expected to match?

Hint: Finding the numbers should take, at most, 5 minutes. The need to poke around a bit (rather than giving you the exact link) is built into this problem intentionally so that you gain some familiarity with international account statistics.

Solution: From BEA Table 1.1 for the year 2024:

- Line 6 (Primary income receipts): \$1,451,065 million
- Line 14 (Primary income payments): \$1,492,104 million
- Balance (Line 6 – Line 14): $\$1,451,065 - \$1,492,104 = -\$41,039$ million

Sum of quarterly IEABCPI values for 2024:

$$\begin{aligned} \text{Q1 2024} + \text{Q2 2024} + \text{Q3 2024} + \text{Q4 2024} \\ = (-10,219) + (-11,210) + (-21,225) + 1,615 \\ = -41,039 \text{ million.} \end{aligned}$$

The two values match exactly. The quarterly series comes from BEA Table 1.2 (Expanded Detail), while Table 1.1 is the summary table—but both contain the same primary income balance data.

- (e) If you had taken this course in 2023, the textbook's 2015 framing would still have applied, with over two decades of positive values for the time series. The magnitude of the 2024-Q3 value (a deficit of \$21 billion) is particularly noteworthy. Do some research and try to pinpoint the causes behind this large deficit. Keep it short and concrete. This question will be graded on effort rather than correctness.

Solution: The textbook’s assumption that the U.S. receives more on its foreign assets than it pays on its liabilities held true for over two decades but reversed starting in Q4 2023. Q4 2023 marked the first quarterly deficit since Q3 2001, and Q1–Q3 2024 plus Q1–Q2 2025 all had deficits (Q4 2024 was positive), with Q3 2024 being the largest at $-\$21.2$ billion.

In Q3 2024 specifically, primary income receipts (earnings from overseas investments) fell by $\$15.5$ billion, or 4.3%, primarily driven by declining direct investment earnings, while primary income payments decreased only slightly (BEA Survey of Current Business, January 2025). The deterioration was broad-based, with declining balances across all three major categories: direct investment, portfolio investment, and other investment earnings.

This structural shift reflects several factors:

- Rising interest rates increased payments on U.S. debt held by foreigners (much of it in Treasury securities). Net external interest payments now reach 1.3% of GDP.
- The “low-for-long” era of near-zero interest rates ended, so the U.S. can no longer borrow as cheaply while earning high returns abroad. When this profit-shifting is excluded, the income advantage largely disappears.
- Returns on American assets, dominated by AI-related industries, became relatively more profitable than U.S. investments overseas, further eroding the traditional return differential.

Review of Intermediate Macro

3. The Labor Market and Phillips Curve

Consider the following model of the labor market:

Labor force	L
Employment	N
Wage setting	$W = P^e(1 - u)$
Price setting	$P = (1 + \mu)W(1 + \tau)$
Production function	$Y = N$

In the equations above, W is the nominal wage, P^e is the expected price level, u is the unemployment rate, P is the price level, μ is the markup, τ is a labor tax, and Y is output. The labor tax τ is paid by firms that hire workers. If firms hire workers for a nominal wage W , they must pay τW to the government.

In the short run, the exogenous variables are L , μ , τ , P^e , and Y , while the endogenous variables are N , W , u , P .

In the medium run, the exogenous variables are L , P , μ , and τ , while the endogenous variables are N , W , u , P^e , and Y . In the medium run, the expected price level P^e is determined by $P^e = P$.

- (a) Write an equation for the unemployment rate, u , in terms of the labor force L and employment N . Is this equation an identity, a behavioral equation, or an equilibrium condition?

Solution: The unemployment rate is

$$u \equiv \frac{L - N}{L}.$$

This is an identity so we use \equiv instead of $=$.

- (b) Solve the model in the short run.

Hint: Recall that “solving the model” means to write all endogenous variables in terms of exogenous variables only.

Solution: The short-run solution is:

$$N = Y$$

$$W = P^e \frac{Y}{L}$$

$$u = 1 - \frac{Y}{L}$$

$$P = P^e (1 + \mu) \frac{Y}{L} (1 + \tau).$$

We now show how to derive this answer. The production function gives the solution for N :

$$N = Y.$$

Using the answer from a) and $N = Y$, we get the solution for u :

$$u = \frac{L - N}{L} = \frac{L - Y}{L} = 1 - \frac{Y}{L}.$$

Combine the wage and price setting relationships:

$$P = P^e(1 + \mu)(1 - u)(1 + \tau).$$

Using the solution for u gives the solution for P :

$$\begin{aligned} P &= P^e(1 + \mu)(1 - u)(1 + \tau) \\ &= P^e(1 + \mu) \left(1 - \left(1 - \frac{Y}{L} \right) \right) (1 + \tau) \\ &= P^e(1 + \mu) \frac{Y}{L} (1 + \tau). \end{aligned}$$

Plugging the solution for P into the price setting relationship:

$$P^e(1 + \mu) \frac{Y}{L} (1 + \tau) = (1 + \mu)W(1 + \tau).$$

Simplifying and solving for W gives:

$$W = P^e \frac{Y}{L}.$$

(c) Solve the model in the medium run.

Solution: The medium-run solution is:

$$\begin{aligned} N &= \frac{L}{(1 + \mu)(1 + \tau)} \\ W &= \frac{P}{(1 + \mu)(1 + \tau)} \\ u &= 1 - \frac{1}{(1 + \mu)(1 + \tau)} \\ P^e &= P \\ Y &= \frac{L}{(1 + \mu)(1 + \tau)}. \end{aligned}$$

We now show how to derive this answer. First, we note that the equations that give the short-run solution obtained in part b) are valid equations in the medium run with $P = P^e$ (can you see why?). The short-run solution for P with $P = P^e$ gives:

$$1 = (1 + \mu) \frac{Y}{L} (1 + \tau).$$

Solving for Y gives:

$$Y = \frac{L}{(1 + \mu)(1 + \tau)}.$$

Plugging the last equation into the solutions for u and W from part b), and using $P = P^e$, we get:

$$u = 1 - \frac{Y}{L} = 1 - \frac{1}{(1 + \mu)(1 + \tau)},$$

$$W = \frac{P}{(1 + \mu)(1 + \tau)}.$$

- (d) How do u , P , P^e , and Y respond to an increase in the labor tax τ in the short run? Give economic intuition for your answer.

Solution: Short run

Using the answers from part b), we can see that an increase in the labor tax τ leads to an increase in the price level P and no change in any of the other variables.

The intuition is as follows. Since output Y , the labor force L , and the expected price level P^e are exogenous, they are unchanged. To produce the same output as before the increase in tax, the production function implies that firms need to hire the same number of workers, so N remains unchanged. With N and L unchanged, the unemployment rate u also remains unchanged. The wage setting relation implies that the nominal wage W also stays the same: since the unemployment rate is unchanged, the bargaining power of workers and firms does not change, and since the expected price level is unchanged, the real standard of living that workers expect and the real wage bill that firms expect to pay both remain unchanged. By the price setting relation, higher labor taxes increase firms' marginal cost $W(1 + \tau)$ even if wages have not changed. To keep earning the same markup μ as before the tax increase, firms increase the price

P at which they sell their goods.

- (e) How do u , P , P^e , and Y respond to an increase in the labor tax τ in the medium run? Give economic intuition for your answer.

Solution: Medium run

Using the answers from part c), we can see that an increase in the labor tax τ leads to lower N , W and Y ; higher u ; and unchanged P^e .

The intuition is as follows. Since P did not change, the price that firms charge for the goods they sell is unchanged. By the price setting relation, to earn the same profit margin μ at the given price level P , firms keep the marginal cost $W(1 + \tau)$ unchanged. For a given nominal wage W , the increase in tax τ makes marginal cost go up. To offset the increase in marginal cost caused by the higher tax rate, firms pay a lower nominal wage. In turn, a lower nominal wage W and an unchanged expected price level P^e leads to a lower expected real wage W/P^e . By the wage setting relation, the lower expected real wage leads to an increase in the unemployment rate u or, equivalently, a reduction in employment N , as workers' willingness to work declines. The production function then implies that the lower number of workers produce less output Y .

- (f) We now introduce subscripts to keep track of the value of variables at different points in time. For a variable x , we denote its value at time t by x_t . For example, P_t is the price level at time t . We assume all variables can change over time (so we add time subscripts to all variables).

Inflation and expected inflation are defined by:

$$\pi_t \equiv \frac{P_t - P_{t-1}}{P_{t-1}},$$

$$\pi_t^e \equiv \frac{P_t^e - P_{t-1}}{P_{t-1}}.$$

The non-linear Phillips Curve. Using your answers from parts (a) and (b), give an expression for inflation π_t only as a function of π_t^e , μ_t , u_t , and τ_t .

Solution: In part b), we found that

$$P = P^e(1 + \mu)\frac{Y}{L}(1 + \tau).$$

Using the answer from part a), we can re-write the last equation as:

$$P = P^e(1 + \mu)(1 - u)(1 + \tau).$$

Introducing time subscripts for all variables gives:

$$P_t = P_t^e(1 + \mu_t)(1 - u_t)(1 + \tau_t).$$

Dividing both sides by P_{t-1} , we get:

$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}^e}(1 + \mu_t)(1 - u_t)(1 + \tau_t).$$

Using the definitions for inflation and expected inflation, we get:

$$1 + \pi_t = (1 + \pi_t^e)(1 + \mu_t)(1 - u_t)(1 + \tau_t).$$

This is the *non-linear* Phillips curve (because inflation is not a linear function of π_t^e and u_t).

(g) Show that the expression you found in part (f) can be written as:

$$\frac{1 + \pi_t}{1 + \pi_t^e} = \frac{1 - u_t}{1 - u_t^n},$$

where u_t^n is the medium-run unemployment rate that you found in part (c), also called the natural rate of unemployment.

Solution: From c), we have that

$$u = 1 - \frac{1}{(1 + \mu)(1 + \tau)},$$
$$u_t^n = 1 - \frac{1}{(1 + \mu_t)(1 + \tau_t)}.$$

Substituting the last equation into the non-linear Phillips Curve from part f) and re-arranging, we find that

$$\frac{1 + \pi_t}{1 + \pi_t^e} = \frac{1 - u_t}{1 - u_t^n}.$$

- (h) The Phillips Curve. Show that when π_t , π_t^e , u_t , and u_t^n are small enough, a good approximation to the expression given in part (g) is:

$$\pi_t = \pi_t^e - (u_t - u_t^n).$$

Hint: Use that when x and y are small enough,

$$\frac{1 + x}{1 + y} \approx 1 + x - y$$

is a good approximation.

Solution: Using the hint with $x = \pi_t$ and $y = \pi_t^e$ gives the approximation

$$\frac{1 + \pi_t}{1 + \pi_t^e} \approx 1 + \pi_t - \pi_t^e.$$

Using the hint with $x = -u_t$ and $y = -u_t^n$ gives the approximation

$$\frac{1 - u_t}{1 - u_t^n} \approx 1 - u_t + u_t^n.$$

Plugging the two approximations into the expression

$$\frac{1 + \pi_t}{1 + \pi_t^e} = \frac{1 - u_t}{1 - u_t^n}$$

found in part g) gives

$$1 + \pi_t - \pi_t^e = 1 - u_t + u_t^n.$$

Re-arranging, we get

$$\pi_t = \pi_t^e - (u_t - u_t^n).$$

This is the Phillips curve, which is a linear equation (inflation is a linear function of π_t^e and u_t).

(i) From now on, assume that the labor force is always $L = 1$.

Show that the Phillips Curve from part (h) can also be written as:

$$\pi_t = \pi_t^e + (Y_t - Y_t^n),$$

where Y_t^n is the medium-run level of output that you found in part (c), also called the natural level of output or potential output.

Solution: The answer from part a), the production function $Y = N$, and $L = 1$, imply

$$u = 1 - Y.$$

After adding time subscripts and the superscript n for the medium run, plugging the last equation into the Phillips Curve from part h) gives

$$\pi_t = \pi_t^e - ((1 - Y_t) - (1 - Y_t^n)).$$

Simplifying,

$$\pi_t = \pi_t^e + (Y_t - Y_t^n).$$

(j) Assume the economy is initially at its medium-run equilibrium with $P = 1$. Then, the government increases labor taxes from τ to τ^{new} (with $\tau < \tau^{new}$). Immediately after the increase in τ , the economy jumps to its short-run equilibrium. Keep assuming that $L = 1$ at all times. The variables μ , P^e , and Y that are exogenous in the short inherit their value from the initial medium-run equilibrium.

Is inflation π_t in the short-run equilibrium positive, negative, or zero? Give intuition for why.

Hint: Use your previous answers.

Solution: From part c), the initial medium-run equilibrium with $L = P = 1$ has

$$Y = Y^n = \frac{1}{(1 + \mu)(1 + \tau)},$$

$$P^e = P = 1.$$

The short-run solution from part b) with

$$\begin{aligned} L &= 1, \\ Y &= Y^n = \frac{1}{(1 + \mu)(1 + \tau)}, \\ P^e &= 1, \end{aligned}$$

is

$$\begin{aligned} N &= Y^n, \\ W &= Y^n, \\ u &= 1 - Y^n, \\ P &= (1 + \mu)(1 + \tau^{new})Y^n = \frac{1 + \tau^{new}}{1 + \tau} > 1. \end{aligned}$$

Inflation in the short-run equilibrium is positive

$$\pi_t = \frac{\frac{1 + \tau^{new}}{1 + \tau} - 1}{1} = \frac{\tau^{new} - \tau}{1 + \tau} > 0.$$

- (k) Find expected inflation π_t^e in the short-run equilibrium. Is expected inflation positive, negative, or zero? Give intuition for why.

Hint: Use the Phillips Curve.

Solution: The new medium-run natural level of output after taxes increase from τ to τ^{new} is

$$Y^{n,new} = \frac{1}{(1 + \mu)(1 + \tau^{new})}.$$

Plugging this $Y^{n,new}$ and the expressions for Y^n and π_t from part j) into the Phillips Curve

$$\pi_t = \pi_t^e + (Y^n - Y^{n,new})$$

gives

$$\frac{\tau^{new} - \tau}{1 + \tau} = \pi_t^e + \left(\frac{1}{(1 + \mu)(1 + \tau)} - \frac{1}{(1 + \mu)(1 + \tau^{new})} \right).$$

Solving for π_t^e and simplifying,

$$\begin{aligned}\pi_t^e &= \frac{\tau^{new} - \tau}{1 + \tau} - \left(\frac{1}{(1 + \mu)(1 + \tau)} - \frac{1}{(1 + \mu)(1 + \tau^{new})} \right) \\ &= \frac{1}{(1 + \mu)(1 + \tau)} \left((\tau^{new} - \tau)(1 + \mu) + \frac{1 + \tau}{1 + \tau^{new}} - 1 \right).\end{aligned}$$

Expected inflation is positive:

$$\begin{aligned}\Rightarrow \pi_t^e &> 0 \\ \Rightarrow \frac{1}{(1 + \mu)(1 + \tau)} \left((\tau^{new} - \tau)(1 + \mu) + \frac{1 + \tau}{1 + \tau^{new}} - 1 \right) &> 0 \\ \Rightarrow (\tau^{new} - \tau)(1 + \mu) + \frac{1 + \tau}{1 + \tau^{new}} - 1 &> 0 \\ \Rightarrow (1 + \mu)(1 + \tau^{new}) &> 1.\end{aligned}$$

Where I have used that μ , τ , and τ^{new} are positive and that $\tau^{new} > \tau$.