Problem 1

Suppose the United States in 2019 has the following annual data in billions of USD:

GNE	EX	IM	NFIA	NUT	KA	I
22,150	2,500	3,125	300	-250	0	600

(a) Was GDP higher or lower than GNE? Interpret.

Solution. Start with GNE, which is *gross national expenditure*: total expenditure on final goods and services by home country's consumers, businesses, and government in any given period. In maths,

$$\text{GNE} = C + I + G. \tag{1}$$

GDP is *gross domestic product*, which accounts for final goods and services produced by home country (hence the word *product*). Let's relate this to GNE. Some GNE expenditure is on imports, which are not produced by home country, and therefore shouldn't be part of GDP; and some home country production is in the form of exports, which are not part of home country expenditure, and therefore aren't counted in GNE. Point is, if we subtract imports and add exports to GNE, we arrive at

$$\text{GDP} = C + I + G + \text{EX} - \text{IM}. \tag{2}$$

Using the numbers given, we can solve for GDP $= 22,150 + 2,500 - 3,125 = 21,525$.

GDP is less than GNE, which means the US is spending more on stuff than it is producing stuff. Makes sense, since imports are larger than exports. Note that we define the *trade balance* to be
$$\text{TB} = \text{EX} - \text{IM}, \tag{3}$$
and the numbers in this problem give TB $= 2,500 - 3,125 = -625$. It's negative, so the US spends more on foreign goods and services than the rest of the world spends on US goods and services.

(b) Was GNI higher or lower than GDP? Interpret.

Solution. GDP – that is, producing stuff – is one potential source of home country's income. But home country can earn income in other ways. GNI is *gross national income*, which accounts for factor income earned by home country land/labor/capital in other countries (e.g. a citizen of home country earning income in a foreign country counts as home country GNI); in other words, home country is exporting some of its factor services, EX_{FS}, and earning income from abroad because of it.

By the same logic, stuff produced in the US by foreign land/labor/capital (e.g. a foreign citizen earning income in home country does not count as home country GNI) ends up as foreign income; home country has imported a foreign country's

factor services, IM_{FS}. Together, the flow of cross-country factor services is called *net factor income earned from abroad*, given by

$$\text{NFIA} = \text{EX}_{\text{FS}} - \text{IM}_{\text{FS}}. \tag{4}$$

Note that factor income includes (among other things) wages, rent, and – perhaps confusingly, but importantly – even interest payments financial assets like bonds (because those interest payments are someone's income).

We can therefore write

$$\text{GNI} = \text{GDP} + \text{NFIA}. \tag{5}$$

NFIA is positive in this question, which means US land/labor/capital abroad earn more factor income than foreign land/labor/income in the US, ergo GNI is higher than GDP. Specifically, $\text{GNI} = 21,525 + 300 = 21,825$.

(c) Was the US a net giver or receiver of unilateral transfers?

Solution. GNDI is *gross national disposable income*, which takes GNI and accounts for more potential sources of income: it adds transfers received from other countries, UT_{IN} (e.g. foreign aid received); and subtracts transfers given to other countries, UT_{OUT} (e.g. foreign aid given); which together are called *net unilateral transfers*, given by

$$\text{NUT} = \text{UT}_{\text{IN}} - \text{UT}_{\text{OUT}}. \tag{6}$$

GNDI therefore reflects all available *income resources* generated for that country, which in maths is

$$\text{GNDI} = \text{GNI} + \text{NUT}. \tag{7}$$

US has negative NUT in this question, which means the US gives more transfers than it receives. GNDI is therefore $\text{GNDI} = 21,825 - 250 = 21,575$.

(d) Find the current account, CA.

Solution. Putting this all together, we can write

$$\text{GNDI} = \text{GNE} + \text{TB} + \text{NFIA} + \text{NUT}.$$

The *current account*, CA, is all of the stuff in GNDI other than GNE, that is,

$$\text{CA} = \text{TB} + \text{NFIA} + \text{NUT}, \tag{8}$$

which measures all net payments to home country arising from the full range of international transactions in goods, services, and income. It is one-half of the *balance of payments* (BOP) accounts, which deals with external transactions in goods, services, factor services, and unilateral transfers. Using the numbers for this question, we have $\text{CA} = -625 + 300 - 250 = -575$.

Notice that we can write $\text{CA} = \text{GNDI} - \text{GNE}$, which implies that CA is negative when home expenditure exceeds home available income... and that can only happen

if home is borrowing from another country.

(e) Find the financial account, FA.

Solution. The other half of the BOP accounts is the sum of the *financial account*, FA, which is essentially the "trade balance" for assets,

$$FA = EX_A - IM_A, \tag{9}$$

and the *capital account*, KA, which is for transfers of assets,

$$KA = KA_{IN} - KA_{OUT}. \tag{10}$$

Aside from statistical discrepancy, the two balance each other via the *balance of payments identity* so that

$$CA + (FA + KA) = 0. \tag{11}$$

Given our numbers, the BOP identity $-575 + (FA + 0) = 0$ implies that $FA = 575$. Negative CA implies a *current account deficit*, and therefore a *financial account surplus*.

Indeed, the US is a *net borrower*: overall it is selling (exporting) a surplus of assets like US Treasury bonds to foreigners (the FA surplus) in order to finance expenditure on goods and services beyond its current income resources (the CA deficit).[1]

(f) Find national saving.

Solution. National saving is given by $S = Y - C - G$. We aren't told C or G, however, so we need a different approach.

We can substitute the GNDI equation $Y = C + I + G + CA$ into the national saving equation's Y term and simplify to get

$$S - I = CA, \tag{12}$$

which is called the *current account identity*. We know $CA = -575$ and we are given $I = 600$, so it follows that $S = -575 + 600 = 25$.

I've already established that negative CA means home expenditure exceeds home available income, and the CA identity is another way of establishing the same conclusion by comparing national saving relative to investment. In this case, investment spending is quite large relative to national saving, and that large investment must be paid for by borrowing from a foreign country (the FA surplus).

To summarize,

- GDP measures production of income resources within home country borders.
- GNI measures production of income resources by land/labor/capital of the country, regardless of location.

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[1]The capital account is typically pretty small in practice, at least in developed countries, so we'll often just pretend it's zero. You should still know that it's part of the balance of payments identity, however.

- GNDI measures production of income resources by land/labor/capital of the country, regardless of location, in addition to gifts of income resources. That is, it measures total income resources available to the home country: this is our Y.
- GNE measures home country expenditure on final goods and services.
- CA is the difference between income *available* to be spent, and income *actually* spent, on final goods and services.
- If income exceeds expenditure (equivalently if national saving exceeds investment), then CA > 0. This means FA < 0 because the country is using its unspent income to acquire foreign assets (lending).
- If expenditure exceeds income (equivalently if investment exceeds national saving), then CA < 0. This means FA > 0 because the country is exporting assets to finance the extra expenditure (borrowing).

Problem 2

Determine how the following scenarios would affect the US balance of payments.

(a) A US Apple salesman in Japan sells an iPad to a local resident for yen worth \$500.

Solution. Because $\text{CA} + (\text{FA} + \text{KA}) = 0$, we must have

$$\Delta\text{CA} + (\Delta\text{FA} + \Delta\text{KA}) = 0.$$

Thus a change in CA must be matched with some other offsetting change: this is called the *double-entry principle of bookkeeping*.

The iPad is exported to Japan, which is a CA credit of \$500 through the trade balance $\text{TB} = \textbf{EX} - \text{IM}$. The US imports yen – the US now owns more of a foreign asset – which is an FA debit of \$500 through $\text{FA} = \text{EX}_A - \textbf{IM}_A$.

(b) The central bank of China purchases \$1 million dollars of export earnings from a firm that has sold \$1 million of toys to the United States, and the Chinese central bank holds these dollars as reserves.

Solution. The US is importing \$1 million worth of toys, so that is a CA deficit through $\text{TB} = \text{EX} - \textbf{IM}$. China is acquiring \$1 million dollars, i.e. China now owns more (exported) US assets, so there is a FA credit through $\text{FA} = \textbf{EX}_A - \text{IM}_A$.

(c) The US trades \$200 worth of almond butter to Australia for \$200 worth of Vegemite.

Solution. No exchange of assets, so the financial and capital accounts don't factor in at all. There is an export worth \$200, and an import of \$200, and therefore there is no overall change in the capital account because there is no change in TB overall.

(d) The US central bank sells \$500 million worth of US Treasury bonds to a British financial firm in exchange for pound sterling foreign reserves.

Solution. Only assets are exchanged, so the current account does not factor in at all. The US is exporting its own assets, but it's also importing foreign assets, and therefore there is no overall change in the financial account.

(e) George, a US citizen, makes a \$5000 donation to a charity that will send medical relief to a country suffering a natural disaster.

Solution. No assets are exchanged, so think CA. There is an export, namely the medical relief going to the foreign country, which increases CA through the trade balance, $\text{TB} = \mathbf{EX} - \text{IM}$. It's a charitable gift of goods and services, so it decreases CA through net unilateral transfers, $\text{NUT} = \text{UT}_{\text{IN}} - \mathbf{UT_{OUT}}$.