Tariffs: macro, micro

Problem

1. Tariff man: will a tariff ceterus paribus affect trade deficit?

2. The appeal: if you make something more expensive, you tend to buy less of it.

3. The tricky part: general equilibrium effects.

Strategy:

1. Establish "follow the money" idea (aka "hot potato").

2. Go through various scenarios with specific examples:

a. A tariff (quota): a tax on imports

b. Investment (additions to the capital stock)

c. Saving (income that is not consumed)

3. In the country of FM ("Family"), a small number of citizens: Alex, Bobby, Danny, Mom. Why so small a number?

Terminology

1. Tariff: a tax imposed on an imported good

2. Exports: the value (price times quantity) of goods/and or services sold by domestic entities to foreign entities, per unit of time (a *flow*).

3. Imports: the value (price times quantity) of goods/and or services bought by domestic entities from foreign entities per unit of time (a *flow*).

4. Bilateral trade balance deficit: the value (price times quantity) of goods/and or services bought by domestic entities from entities located in a particular foreign country **minus** the value (price times quantity) of goods/and or services sold by domestic entities to foreign entities located in the same particular foreign country, per unit of time.

5. Aggregate trade deficit: the value (price times quantity) of goods/and or services bought by domestic entities from entities located in all foreign countries **minus** the value (price times quantity) of goods/and or services sold by all foreign entities to domestic residents, per unit of time.

6. Saving(s): a **flow** concept: income minus expenditure (all per unit of time, e.g., per quarter-year, per year, per month, etc.)

7. Investment: a **flow** concept: additions to the capital stock. Note we talk of the *stock* of capital.

8. NFA (Net Foreign Assets): a **stock** concept; holdings by citizens/residents/entities of one country of foreign assets, e.g., bonds, physical capital, minus the holdings by foreigners of domestic assets.

Baseline scenario: the nation of FM, WL, and CC

The countries

There are three countries: FM, WL (West End Liquors, who sell **C**raft beer) and CC (Cheech and Chong Whole Foods, a famous provider of "produce," sometimes known as "**T**ea"):

https://thefreshtoast.com/cannabis/where-all-those-marijuana-slang-terms-came-from

We sometimes combine, or equivalently aggregate, the two countries of WL and CC and name it RW (**R**est of **W**orld).

The residents/citizens

For WL and CC, we just imagine they have some citizens. It's not important for us to think more carefully about who they are and what they do.

For FM:

Alex and Bobby are Uber/Lyft drivers. They drive, i.e., provide **R**ides for people who are not residents/citizens of FM, i.e., residents/citizens of WL and CC. When Alex and Bobby provide rides to these non-residents (non-citizens) of FM, the revenue they earn from this counts as the value of exports for FM. For simplicity, we make the additional assumption that Alex and Bobby only sell Uber/Lyft rides to citizens of CC, not to any citizens of WL. This makes it easy to distinguish issues about trade balances into those concerning bilateral balances, e.g., the balance between FM and WL, and overall balances, namely the balance beween FM and RW (WL and CCWH combined).

Danny is a tree farmer (producer of Wood), who sells her goods to Alex or Bobby, **but not to foreigners**. Danny might buy T from CC.

Mom is the "government" of FM. As such she might undertake policies that affect the behavior of her fellow citizens, perhaps in service of what she thinks is something that is "good for the country." For simplicity, we assume Mom doesn't purchase or sell anything.

Also for simplicity, we assume only Alex buys C : Bobby and Danny don't buy C. (Of course, this doesn't mean Alex *only* buys C: she could also buy T). Again for simplicity, we assume Bobby only buys T from CC and any of the things produced by Danny.

We summarize all this in a chart:

Indiv.	buys from	sells to
A	WL(C_A),CC (T_A)	CC (R_A)
B	CC(T_B),D(W_B^D)	CC(R_B)
D	CC(T_D)	B (W_D)

A specific example: imposition of a tariff

No change in saving, investment

Let's put some numbers in that reflect prices and quantities in the pre-tariff state. First, to be concrete, lets assume the folowing prices:

$$P_T = P_T^* = \$1.00,\ P_C^* = \$2.00; P_R = \$1.00;$$
$$P_W = \$1.00;$$

To display the pattern of expenditure among all the people in this model world, we construct a matrix in which in each cell of the matrix we put an ordered pair that describes the dollar values of the bilateral transactions that occur: (Row's sales to Column, Row's purchases from Column).For example, the ordered pair in the entry where Row is "B" and Column is "CC" tells us that Bobby sells \$24 worth of stuff (*U*ber rides, in our example) to citizens/residents of CC, and buys \$12 worth of stuff (*T*ea, in our example) from citizens/residents of CC. In this matrix, we also display each individual's income (Y_i) and each entity's bilateral **T**rade **B**alance **D**eficit.

	Alex	Bobby	Danny	WL	CC	Y_i	TBD_i^{WE}	TBD_i^{CC}	TBD_i^{FAM}	TBD_i^{RW}
A		$(0,0)$	$(0,0)$	$(0,18)$	$(24,6)$	24	18	-18		0
B	$(0,0)$		$(0,12)$	$(0,0)$	$(24,12)$	24	0	-12		-12
D	$(0,0)$	$(12,0)$		$(0,0)$	$(0,12)$	12	0	12		12
FM				$(0,18)$	$(48,30)$	60	18	-18		0
WL	$(18,0)$	$(0,0)$	$(0,0)$		$(0,18)$	18		18	-18	0
CC	$(6,24)$	$(12,24)$	$(12,0)$	$(18,0)$		48	-18		18	0

Alex's behavior pre-tariff

To start, we focus on Alex.

From giving Uber/Lyft rides to foreigners, Alex earns an income/week symbolized by Y_A. To fix ideas, assume Alex earns \$24/week, i.e., $Y_A = \$24/week$. We assume Alex spends all her income per week, and only consumes two goods: C_A (*C*raft beer) bought from WL, and T_A ("*T*ea") bought from CC. The subscripts tells us that we are talking about things bought by Alex. To be concrete, assume each week Alex buys 9 bottles of Beer ($C_A = 9$) at \$2/bottle ($P_C = \$2$), i.e., spends \$18/week on beer, and six

(6) units, e.g., six (6) "bricks", of tea ($T_A = 6$) at \$1/unit ($P_T = \$1$), i.e., spends \$6/week on Tea.

We can depict Alex's budget, and her trade balances, for a week as:

	numbers	symbols
Expenditure on Craft Beer:	$\$2 \times 9 = \$18$	$P_C C_A$
Expenditure on Tea:	$\$1 \times 6 = \$6$	$P_T T_A$
Total expenditure:	\$24	$P_C C_A + P_T T_A$
Total income:	\$24	Y_A
Bilat. TBD_A^{WL}	$\$18 - \$0 = \$18$	$P_C C_A - P_R \overbrace{R_A^{WL}}^{0}$
Bilat. TBD_A^{CC}	$\$6 - \$24 = -\$18$	$P_T T_A - P_R R_A^{CC}$
Aggreg. TBD_A^{ROW}	$\$24 - \$24 = 0$	$P_C C_A + P_T T_A - P_R R_A^{CC}$

Alex's *budget constraint* reflects her decision to spend all of her income per week:

$$Y_A = P_C C_A + P_T T_A; \qquad \text{Exp=Inc}$$

$$T_A = \frac{Y_A}{P_T} - \frac{P_C}{P_T} C_A; \qquad \text{Rearrg}$$

$$T_A = 24 - 2C_A. \qquad \text{\#'s}$$

That is, Alex does not *save*.

Bilateral trade balance

Mom worries that FM is a "loser" because FM has a bilateral trade deficit with WL:

$$TBD_{FM}^{WL} = value\ imports - val\ \exp orts\ ;$$
$$= \$18.00 - \$0.$$

Imposition of a tariff

To rectify this, Mom imposes a tariff on purchases of C, raising the price paid by Alex to $\$3/bottle$:

$$\overbrace{P_C}^{\$3.00} = \overbrace{P_C^*}^{\$2.00} + \overbrace{t}^{\$1.00}$$

How is this paid? It could be paid just like sales tax, gas tax, and so forth: collected by the seller (importer) but sent to Mom. In practice, collected by an importing firm, e.g., "Driskill Importers and Exporters," or Walmart.

Alex's behavior post-tariff

At this price of $\$3.00/bottle$, we assume Alex buys 4 bottles/week, paying $\$12$/week (this is consistent with "acceptable" preferences, for those who have had Inter. Micro. Note that as the price to Alex went up, she substituted the now relatively cheaper Tea

for coffee).

Alex's budget (and trade balances) now looks like this:

	numbers	symbols
Expenditure on Craft Beer:	$\$3 \times 4 = \$12$	$(P_C^* + t)C_A$
Expenditure on Tea:	$\$1 \times 12 = \$12$	$P_T T_A$
Total expenditure:	$\$24$	$(P_C^* + t)C_A + P_T T_A$
Total income:	$\$24$	Y_A

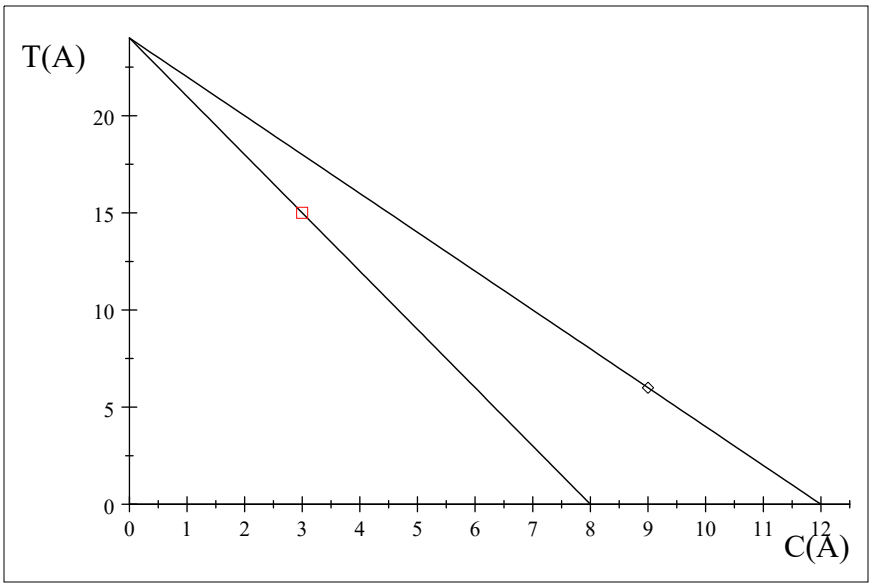
Bilat. TBD_A^{WL}	$\$8 - \$0 = \$8$	$\overbrace{P_C^*}^{\$2}\ \overbrace{C_A}^{4} - P_R R_A^{WL}$
Bilat. TBD_A^{CC}	$\$12 - \$24 = -\$12$	$P_T T_A - P_R R_A^{CC}$
Aggreg. TBD_A^{ROW}	$\$8 - \$12 = -4$	$P_C^* C_A + P_T T_A - P_R \overbrace{R_A^{WL}}^{0} - P_R R_A^{CC}$

In equational form:

$$
\begin{aligned}
Y_A &= (P_C^* + t)C_A + P_T T_A; \\
T_A &= \frac{Y_A}{P_T} - \frac{(P_C^* + t)}{P_T} C_A; \\
T_A &= 24 - 3C_A.
\end{aligned}
$$

Again, Alex does not save.

Depiction:



Of course, we could contemplate other responses by Alex to this increased price of C and her subsequent reduction in spending on said beer. She could sell fewer Uber/Lyft rides, for example. We keep it simple here and just look at the case we've started.

Mom post-tariff

Mom gets $\$4$/week ($\overbrace{\$1}^{t} \times \overbrace{4}^{4/week}$: small country assumption; WL still gets $\$2$/bottle).

Assessment of tariff effects: follow the money

"Initial" impact on Alex (an incomplete thought experiment)

After the tariff is imposed, Alex is now only spending only $\$12$ on craft beer, whereas she had been spending $\$18$. Of this $\$12$, $\$8$ goes to WL $(4 \times \$2)$, and $\$4$ goes to Mom ($\overbrace{4}^{C_A} \times \overbrace{\$1}^{t}$).

Without accounting for what Mom might do with the money, for the country of FM the Bilateral TBD with WL has "gone down" by $\$10$ (remember: FM doesn't export anything to WL, so the TBD_{FM}^{WL} is just the value of imports):

$$\begin{aligned}\Delta TBD_{FM}^{WL} &= P_C^* \times \Delta C_A \\ &= \$2 \times \overbrace{5}^{9-4} = \$10.\end{aligned}$$

Check

Before the tariff:

$$TBD_A^{WL} = TBD_{FM}^{WL} = \$18.$$

After the tariff (without accounting for what Mom does with the $\$4$ she got from the

tariff),

$$TBD_{A}^{WL} = TBD_{FM}^{WL} = \$2 \times 4 = \$8.$$

Hence

$$\Delta TBD_{FM}^{WL} = \$8 - \$18 = -\$10.$$

That is, we would say the bilateral trade deficit has "gone down" by $\$10$.

Reiterate

Because Alex (by assumption) spends her income in its entirety, i.e., does not save, and only on C and T, she spends the money she now no longer spends on craft beer on Tea. This means her spending on Tea $(P_T \times T_A)$ is $\$12$, whereas it used to be $\$6$. **If this were all there was to the story**, the bilateral trade deficit with CC would have "gone up" by $\$6$:

$$\begin{aligned}\Delta TBD_{FM}^{CC} &= P_T \times \Delta T_A \\ &= \$1 \times \overbrace{6}^{12-6} = \$6.\end{aligned}$$

If this were all there was to the story, the overall, that is, aggregate, trade balance deficit would have gone down: the increase in the bilateral deficit between FM and CC is less than the decrease in the bilateral deficit between FM and WL. Thus, **if this were all there was to the story**, one might think the tariff has been successful in reducing not just the bilateral trade deficit with WL but has also the *overall* trade deficit (ROW stands for "Rest of World."):

$$\Delta TBD_{FM}^{ROW} = \overbrace{-\$10}^{\Delta TBD_{FM}^{WL}} + \overbrace{(\$6)}^{\Delta TBD_{FM}^{CC}} = -\$4.$$

But this is not the whole story! **We have to follow the rest of the money**!

Mom

Mom now has an extra $\$4.00$. Let us contemplate what she could do with this extra money (assuming she does not save it). Because she is a Mom, we have assumed she does not consume anything. So one thing she can do is pass it on to other members of the family.

1. Suppose she gives it all to Alex. What might Alex do?

a. Buy extra stuff from CC, or from WL. That is, spend all the $\$4.00$ on tea from CC or craft beer from WL.

	numbers	symbols
Exp. on C:	$\$3 \times 4 + (\theta \times \$4.00) = \$12 + \theta \times \$4.00$	$(P_C^* + t)C_A + \theta S_A^M$
Exp. on T:	$\$1 \times 12 + (1-\theta) \times \$4.00 = \$12 + (1-\theta) \times \$4.00$	$P_T T_A + (1-\theta) S_A^M$
Total exp.:	$\$28$	$(P_C^* + t)C_A + P_T T_A + S_A^M$
Total inc.:	$\$28$	$Y_A + S_A^M$

TBD_A^{WL}	$\$8 + \theta \times \$4 - \$0 = \$8 + \$4 \times \theta$	$\overbrace{P_C^*}^{\$2}\ \overbrace{C_A}^{4} + \theta\ \overbrace{S_A^M}^{\$4} - \overbrace{P_R R_A^{WL}}^{\$0}$
TBD_A^{CC}	$-\overbrace{\$12}^{-24+12} + (1-\theta) \times \$4.00 - \$24$	$\overbrace{P_T T_A}^{\$16} - P_U U_A^{CC}$
TBD_A^{ROW}	$\$8 + \$4 \times \theta - \$12 + (1-\theta) \times \$4.00 = 0$	$P_C^* C_A + P_T T_A + S_M^A - P_U U_{WL} - P_U U_A^{CC}$

b. Buy some wood from Danny. Danny then has choices, but if she is intent on spending, not saving, then she eventually spends it on imports. Why? Suppose Hamilton is another member of FM, and Danny spends it on stuff she buys from Ham. What happens then?

c. Maybe she decides to work less, and keep her expenditures unchanged:

	numbers	symbols
Expenditure on Craft Beer:	$\$3 \times 4 = \$12$	$(P_C^* + t)C_A$
Expenditure on Tea:	$\$1 \times 12 = \$12$	$P_T T_A$
Total expenditure:	$\$24$	$(P_C^* + t)C_A + P_T T_A + S_A^M$
Total income from ride sales:	$\$20$	Y_A

TBD_A^{WL}	$\overbrace{\$8}^{4\times\$2}$	$\overbrace{P_C^*}^{\$2}\ \overbrace{C_A}^{4}$
TBD_A^{CC}	$\$12 - \$20 = -\$8$	$\overbrace{P_T T_A}^{\$12} - \overbrace{P_R R_A^{CC}}^{\$20}$
TBD_A^{ROW}	$\$8 - \$8 = 0$	$P_C^* C_A + P_T T_A + S_M^A - P_R R_A^{WL} - P_R R_A^{CC}$

d. If Alex spends it (this extra $4 Mom gives her) all, is she better off than before the tariff? Is he better off? (ceterus paribus, i.e., he doesn't drive more to make more money, nothing else exogenous changes).

i. Not if P_C^* unchanged.

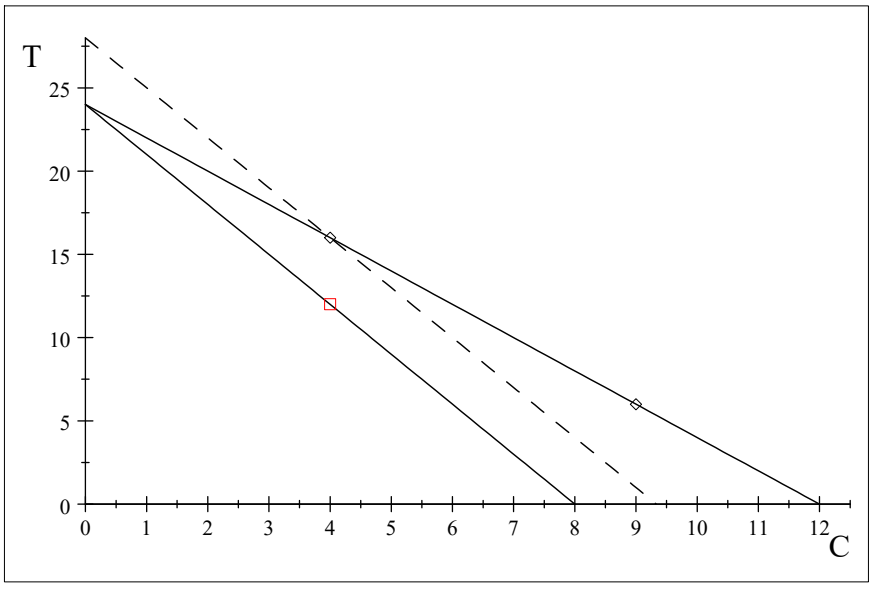
A. A subtle argument: Alex takes what Mom gives him as an exogenous subsidy unaffected by his choice of C_A; the BC that affects his behavior is

$$Y_A = P_C^*(1+t)C_A + P_T^* T_A + S;$$
$$S = tC_A;$$
$$T_A = \frac{Y}{P_T^*} - \frac{P_C^*(1+t)}{P_T^*}C_A - \frac{S}{P_T^*}$$

B. But what must be true in equilibrium:

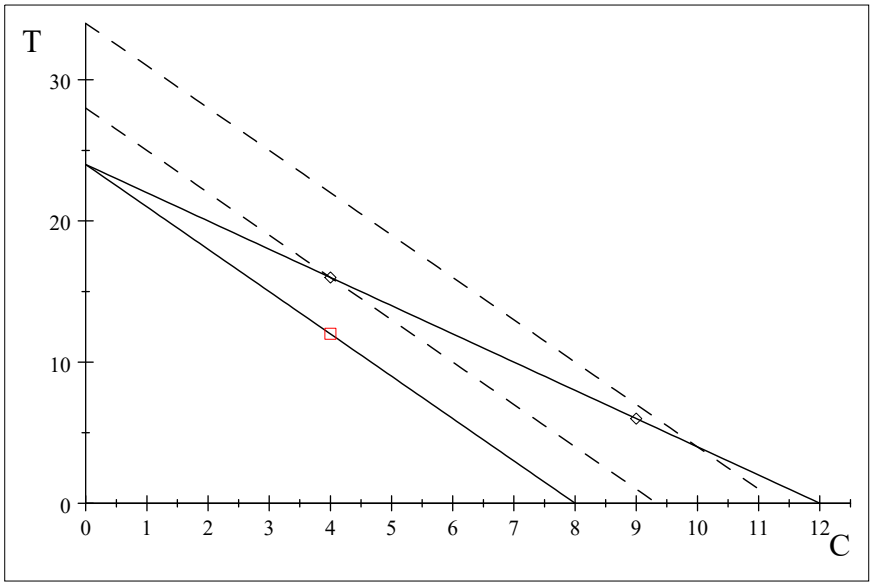
$$Y_A = P_C^*(1+t)C_A + P_T^* T_A + tC_A;$$
$$T_A = \frac{Y}{P_T^*} - \frac{P_C^*(1+t)}{P_T^*}C_A - \frac{t}{P_T^*}C_A$$
$$= \frac{Y}{P_T^*} - \frac{P_C^*}{P_T^*}C_A.$$

C. Let's look at a possibility that will illustrate that Alex could be worse off. The price of C remains unchanged (for Alex) at $\$3/bottle$. Assume this means that Alex doesn't change his demand for C even if his income changes. Hence, she continues to consume four (4) bottles of beer even with the extra $\$4$ he got from Mom. She will thus consume 16 bricks of Tea. This is all depicted below. Why do we know Alex is worse off?



ii. Suppose P_C^* is pushed down. Suppose Mom gets $\$10$, not

$4; Alex now has $16 extra. Here is the picture:



iii. BC pictures helpful here. Remember: we interpret a BC as a "menu."

2. Pushing on a balloon.

Savings and investment

Saving

Recall that before we accounted for the money Mom collected from the tariff, the aggregate trade deficit had changed ("decreased") by $4. That is, the value of imports minus the value of exports was −$4. But when we accounted for Mom giving away the money to people who spent it, the trade balance deficit went back to zero!

Now suppose Mom stuffed the $4 into her mattress.

1. Her savings went up by $4: her income is $4 while her consumption is $0.

2. The value of imports minus the value of exports for FM is −$4.

a. Recall:

i. Alex changed her spending habits

A. by buying only four (4) units of C at $\$3/unit$ instead of nine (9) at $\$2/unit$, thus spending $12 on C instead of $18;

B. by spending the remaining $12 of her income on T, thus increasing her spending on T from $6 to $12.

C. The TBD_A^{WL} thus went from $18 to $8

$(P_C^* = \$2;\ P_C = P_C^* + t = \$3); TBD_A^{WL} = \$8;$

D. The TBD_A^{CC} went from $\$24 - \$6$ to $\$24 - \$12$; $TBD_A^{CC} = -\$12$

ii. No change for Bobby: she earns $\$24$ from ride sales to CC; spends $\$12$ on T from CC and $\$12$ on W from Danny; $TBD_B^{WL} = -\$12$;

iii. No change for Danny: she spends $\$12$ on T from CC; $TBD_D^{CC} = \$12$.

iv. So $TBD_{FM}^{RW} = \$8 - \$12 - \$12 + \$12 = -\$4$.

3. Symbolically:

$$\overbrace{S}^{\$4} = TBS_{FM}^{RW} = \overbrace{-TBD_{FM}^{RW}}^{-(-\$4)}.$$

Investing

Remember Danny produces W (wood). We have assumed so far that any purchases of wood are for consumption, i.e., it is burned in this period of time; it is a *flow* demand.

Suppose Mom decides to take her $\$4$ in tariff revenue and invest it in infrastructure buy buying wood from Danny and using it to build a schoolhouse. This would mean she is *investing*. What happens?

1. Danny now has sold $\$4$ of wood to Mom, which Mom is *investing*;

a. This means Danny only sells $\$8$ of wood to Bobby.

b. Implications:

i. Alex: in presence of tariff, we assume he spends $\$12$ on imports from WL and $\$12$ on imports from CC; his total imports are $\$24$. His exports remain at $\$24$ (remember: he sells rides to CC).

ii. Danny's income hasn't changes (it's still $\$12$) and she continues to import $\$12$ from CC. Her exports are thus zero and her imports are $\$12$.

iii. Bobby used to spend $\$12$ on wood from Danny, but now only spends $\$8$. Bobby thus increases his purchases of T from CC by $\$4$. Bobby's exports remain at $\$24$ (remember: he sells rides to CC). His imports are now $\$16$.

iv. Add things up:

$$EX_{FM} = \overbrace{\$24}^{A} + \overbrace{\$24}^{B} = \$48;$$
$$IM_{FM} = \overbrace{\$24}^{A} + \overbrace{\$16}^{B} + \overbrace{\$12}^{D} = \$52$$

c. Hence

$$TBD_{FM}^{RW} = +\$4.$$

d. Symbolically

$$\overbrace{S}^{\$0} - \overbrace{I}^{\$4} = \overbrace{TBS_{FM}^{RW}}^{-\$4} = -TBD_{FM}^{RW}.$$

Lessons

1. Bilateral vs aggregate

2. The identity must hold:

$$S - I = TBS$$

3. Changing a tariff without changing S or I is **not** going to affect the trade balance.

a. What do we think affects savings, investment?

b. Partial equilibrium thinking here is misleading.

>>>

Getting in the weeds (my scratch work):

1. **a**.

$$U = T + \frac{\gamma}{\phi}C^{\phi}; Y = T + pC;$$

$$T = U - \frac{\gamma}{\phi}C^{\phi};\ \frac{dT}{dC} = -\gamma C^{\phi-1} = -p;$$

$$\gamma C^{\phi-1} = p;\ C^{\phi-1} = \frac{p}{\gamma};\ C = \left(\frac{p}{\gamma}\right)^{\frac{1}{\phi-1}}; C^{\phi} = \left(\frac{p}{\gamma}\right)^{\frac{\phi}{\phi-1}}$$

$$pC = \gamma C^{\phi} = \gamma\left(\frac{p}{\gamma}\right)^{\frac{\phi}{\phi-1}};\ \frac{d(pC)}{dp} = \gamma^{\frac{1-\phi}{1-\phi}}\gamma^{\frac{\phi}{1-\phi}}\left(\frac{\phi}{\phi-1}\right)p^{\frac{\phi-\phi+1}{\phi-1}}$$

$$= \gamma^{\frac{1}{1-\phi}}\left(\frac{\phi}{\phi-1}\right)p^{\frac{1}{\phi-1}}; \frac{d(pC)}{dp} < 0 \text{ iff } 0 < \phi < 1.$$

$$\phi = \frac{1}{2},\ C = \gamma^2 p^{-2}.$$

$$p = 2,\ C = \frac{\gamma^2}{4};\ 4C = \gamma^2,\ \gamma = 2\sqrt{C}\,.$$

$$p = 2,\ C = 9, \gamma = 6.\ C = \frac{36}{p^2}.\ pC = 18$$

$$p = 3,\ C = \frac{36}{9} = \frac{12}{3} = 4;\ pC = 12$$

https://www.royalqueenseeds.com/blog-brick-weed-101-what-it-is-and-how-it-s-made

Could S be sufficiently large that Alex could buy his initial bundle of $(9, 6)$? If he bought this bundle, with the price he pays being $\$3/bottle$, then A's beer expenditure would be $3\$ \times 9 = \$27.$ A's expenditure on T would be $\$6$. Alex's income would be $\$24 + 9 = 33.$

	ΔY_i	$\Delta Y_i - \Delta Exp_i^{CC}$	ΔTBD_i^{CC}
M	4	4 – 4	0
D(i)	4	4	4
D(ii)	8	8	8
B(i)	0	0	0
B(ii)	0		

$\Delta TBD_{FM}^{CC}(i) = 4$