

Economics 39F: Final Exam

Please be concise and to the point. Print your name on your exam and turn it in with your blue books. You have 3 hours (but I doubt you will need it). The exam has 100 points. Answer all 3 questions. You should spend the first 10 minutes reading the exam. Good luck!

1. (50 points) The just-concluded 26th United Nations Climate Change Conference in Glasgow (known as COP26) has raised many issues for the global economy that will have to be addressed as countries race to prevent global carbon emissions from leading to atmospheric carbon levels that would be catastrophic for the future of life on the planet. An issue that has come to the forefront in drafting an agreement at the COP26 conference is whether industrialized countries (the “global north”) will agree to pay what amounts to reparations – or in the language of the COP26 conference, payments for “losses and damages” – to developing countries for the harm that these countries will suffer from climate change. As one *New York Times* article noted in its summary of the COP26 conference:

“One of the most divisive questions involves countries of the global north — which have prospered for over a century by burning coal, oil and gas and spewed greenhouse gases into the atmosphere — and whether they should compensate developing countries for the irreparable harms they have caused. The draft proposes a new “technical assistance facility” to help countries with losses and damages...”

The proposed international transfers from industrialized countries to developing countries would likely be massive, and the Biden Administration is interested in assessing their economic implications for the United States. You have been hired as a winter intern by the US Special Presidential Envoy for Climate John Kerry to help in this assessment. Kerry has done a back-of-the-envelope calculation and has concluded that (i) the face value of the transfer that the US will make to developing countries is a good approximation of the true economic cost to the US economy in terms of foregone consumption, and (ii) if every citizen in the US is asked to contribute equally to the fiscal cost of the transfer (i.e., if, in order to fund the transfer, each US citizen receives a tax bill from the government for the same amount), then all US citizens will share the overall economic burden of the transfer equally. Knowing that you are an expert in international trade, Kerry wants you to use your knowledge of trade models to check his calculations.

In particular, please answer the following questions that Envoy Kerry has raised. Throughout, you may assume that there are two countries, the US (representing the global north) and Bangladesh (representing the developing world) and two goods, clothing and appliances, with the US exporting appliances in exchange for imports of clothing from Bangladesh under conditions of global free trade. Moreover, Kerry’s staff has discovered that the clothing exported by Bangladesh to the US can be best thought of as “fast fashion” (i.e., cheap and disposable production of clothing based on trends and rapid consumption) which is an item that makes up a large share of every additional dollar spent by US consumers but only a small share of every additional dollar spent by consumers in Bangladesh, so please make use of this fact in your analysis.

- a) First, using the Basic Trade Model and assuming that both the US and Bangladesh are large countries, assess whether or not the face value of the transfer from the US to Bangladesh will accurately reflect the cost to the US of the transfer in terms of forgone consumption.

- b) Second, using the assumptions of the Specific Factors Model to represent the US economy in the short run, with appliance-specific capital stuck in the appliance sector, clothing-specific capital stuck in the clothing sector, and labor mobile between the appliance and the clothing sectors, build on your answer from part (a) to assess whether or not all US citizens (i.e., all US factor owners) will share the burden of the transfer equally in the short run as long as they are all asked to contribute equally to the fiscal cost of the transfer.

- c) Third, using the assumptions of the Heckscher-Ohlin Model to represent the US economy in the long run, with capital and labor both mobile between the appliance and the clothing sectors and with appliances the capital-intensive good and clothing the labor-intensive good, build on your answer from part (a) to assess whether or not all US citizens (i.e., all US factor owners) will share the burden of the transfer equally in the long run as long as they are all asked to contribute equally to the fiscal cost of the transfer.
- d) Finally, Envoy Kerry is also concerned about the economic impacts of the possibility of climate refugees from Bangladesh arriving in the United States in future years, and he asks that you provide him with an analysis of this issue. In particular, he asks that you consider the short run and long run impact on the US distribution of income of an increase in the US labor supply (generated by a rise in “climate refugees”), using the Specific Factors Model described in part (b) above to perform the short run analysis and the Heckscher-Ohlin Model described in part (c) above to perform the long run analysis. For this analysis (and in contrast to your analysis above), he tells you that you can assume that the US is a small open economy and therefore takes the world prices of appliances and clothing as given and fixed (and you may also assume that the influx of climate refugees is small enough that the US continues to produce both goods).

2. (30 points) Using the Continuum-of-Goods Ricardian Trade Model, suppose that the home-country unit labor requirement for good $z \in [0,1]$ is given by $\ell(z) = 1 + \theta \times z$ while the foreign-country unit labor requirement for good $z \in [0,1]$ is given by $\ell^*(z) = 1 + \theta^* \times z$, with $\theta \geq 0$ and $\theta^* \geq 0$. Let us interpret $\theta \times z$ as the amount of labor required to comply with the pollution standard of the home country when producing one unit of good z in the home country given the home-country standard θ . Likewise, $\theta^* \times z$ is the amount of labor required to comply with the pollution standard of the foreign country when producing one unit of good z in the foreign country given the foreign-country standard θ^* . So we can think of low- z goods as “naturally clean” goods, because for a given pollution standard it doesn’t take much labor to clean up the production process and meet the standard for low- z goods (e.g., for a given standard $\theta > 0$, $\theta \times z$ will be small for a low- z good), while we can think of high- z goods as “naturally dirty” goods.

- a) Show that, if the home country has a strict environmental standard while the foreign country has none (i.e., if $\theta > 0$ and $\theta^* = 0$), then the home country will specialize in a range of naturally clean (low z) goods.
- b) Then show that if the world’s preferences shift away from consumption of dirty goods and toward consumption of clean goods (so that the budget shares $b(z)$ for the low- z goods originally produced in the home country rise and the budget shares for high- z goods originally produced in the foreign country fall), then the foreign country, with its lax/nonexistent pollution standards, will ironically *gain* competitiveness and begin exporting a range of goods that, prior to the world’s preference shift toward cleaner goods, it would have imported from the home country. Explain intuitively why this is so.

3. (20 points) Using the 2-good, 2-country Ricardian trade model, with countries trading freely and with the foreign country initially specialized in production according to its comparative advantage and with the home country initially producing positive amounts of both goods, show that if “climate refugees” were to begin leaving the foreign country and coming to the home country (thereby reducing the foreign labor endowment L^* and increasing the home labor endowment L by the same amount), the arrival of climate refugees in the home country would not alter the real per-capita income (and hence the real wage of labor) in the home country.

Extra Credit (5 points) Pose a question on a trade policy topic that your uncle might ask you at the Thanksgiving dinner table this Thursday, and provide an answer that, while supported by the models we have covered in Econ 39 this Fall, you have translated into words and intuitive explanations that your uncle could appreciate without having taken Econ 39 himself.

①

Economics 39F
Sketch of Answers to Final Exam
Fall 2021/2022

1. In this problem we are told to consider a 2-country world, with the US (representing the "global north") exporting appliances to Bangladesh (representing the developing world) in exchange for imports of clothing under conditions of ~~free~~ global free trade. Moreover, we are told that both countries are large, and that clothing can be thought of as "Fast Fashion" which is an item that makes up a relatively large share of every additional dollar spent in the US but only a small share of every additional dollar spent in Bangladesh. We are asked to use this setup to answer Climate Envoy Kerry's ~~the~~ questions about the economic implications of reparations payments from the global north to the developing world that have been discussed in COP26.

a) Kerry first wants to know if the face-value of the transfer from the US to Bangladesh will accurately reflect the cost to the US in terms of forgone consumption. We are told to make use of

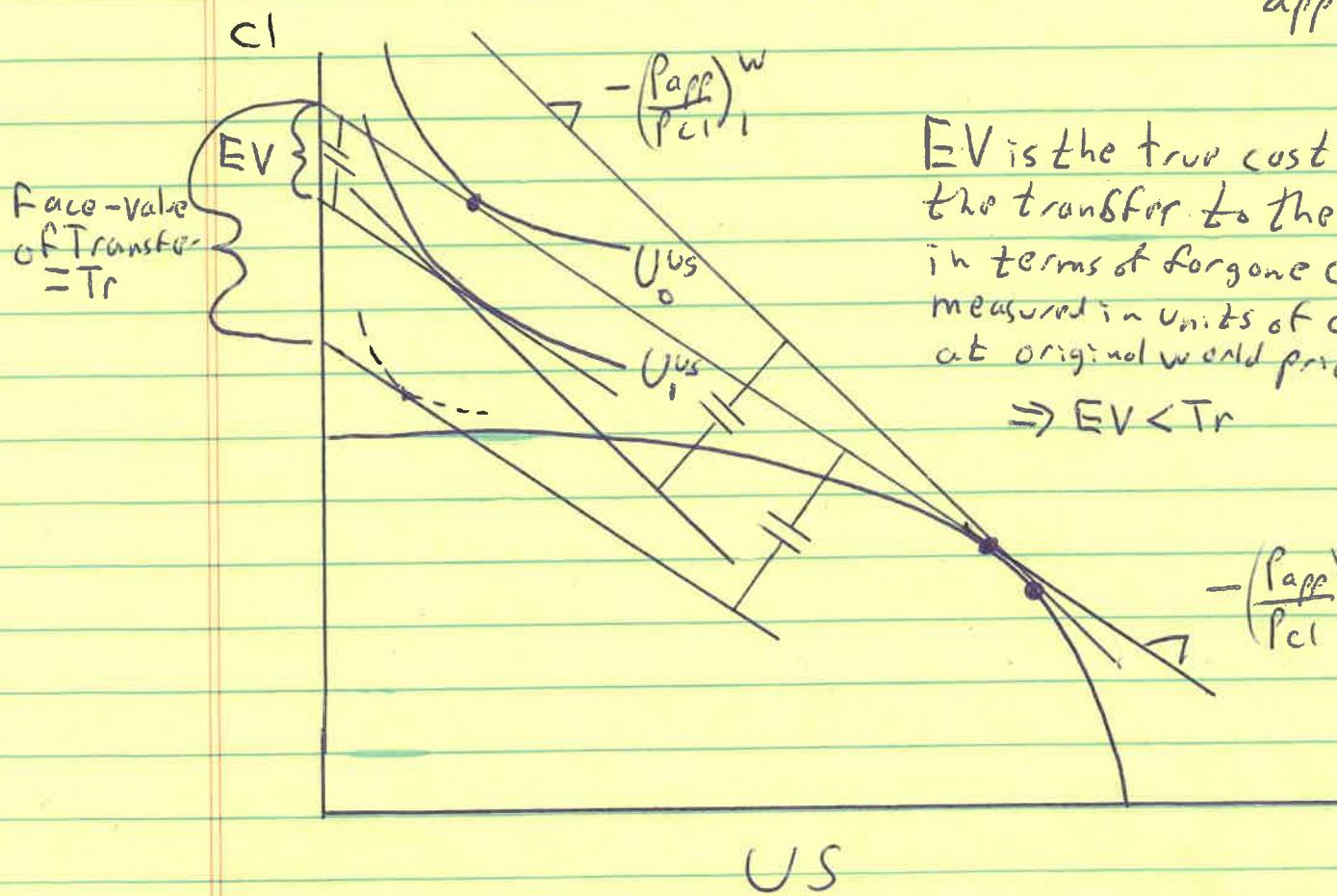
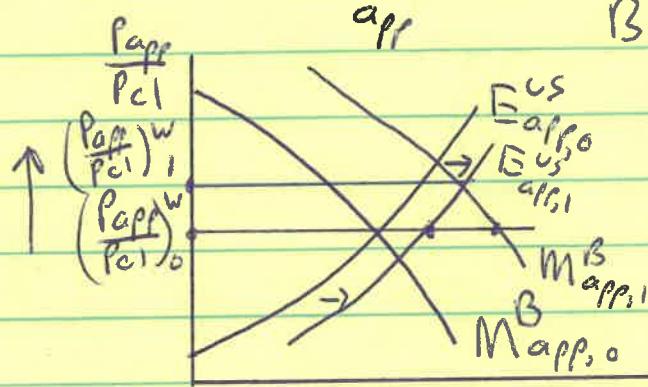
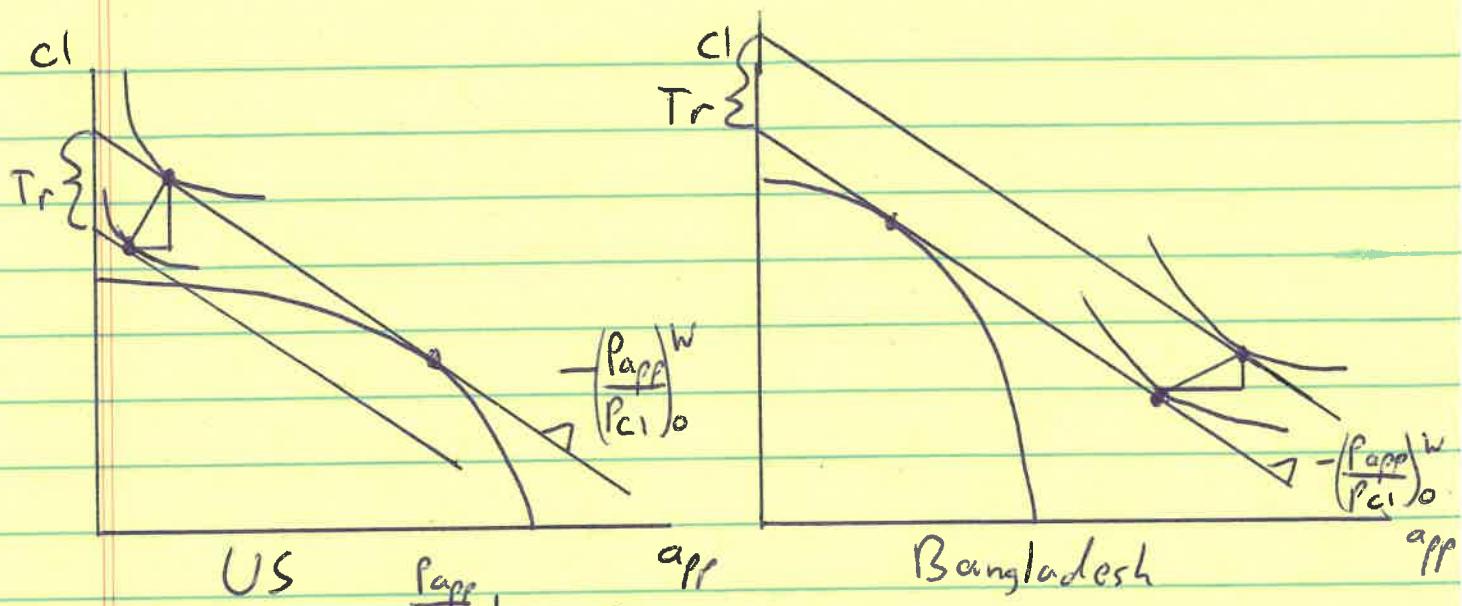
(2)

the Basic Trade Model to answer this question. Here, the assumed structure of preferences is crucial, since it describes the "anti-Kegnes" case of the Transfer Problem, in which the marginal propensity of each country to consume its import good is large (not small, as Kegnes assumed), leading to a terms-of-trade improvement (a rise in $\frac{P_w}{P_{C1}}$) for the US as a result of the transfer it makes to Bangladesh. This implies that the face-value of the transfer will ~~overstate~~ overstate the true cost of the transfer to the US in terms of forgone consumption. The figures on the next page confirm this point.

The top two figures depict the implications of the transfer from the US to Bangladesh at fixed world prices. The middle figure confirms that at fixed world prices the US export supply curve of appliances shifts out by less than the Bangladesh import demand curve, leading to a rise in $\frac{P_w}{P_{C1}}$. The bottom

figure then confirms that the true cost of the transfer to the US is smaller than the face value.

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EV is the true cost of the transfer to the US in terms of forgone consumption measured in units of clothing at original world prices.
 $\Rightarrow EV < Tr$

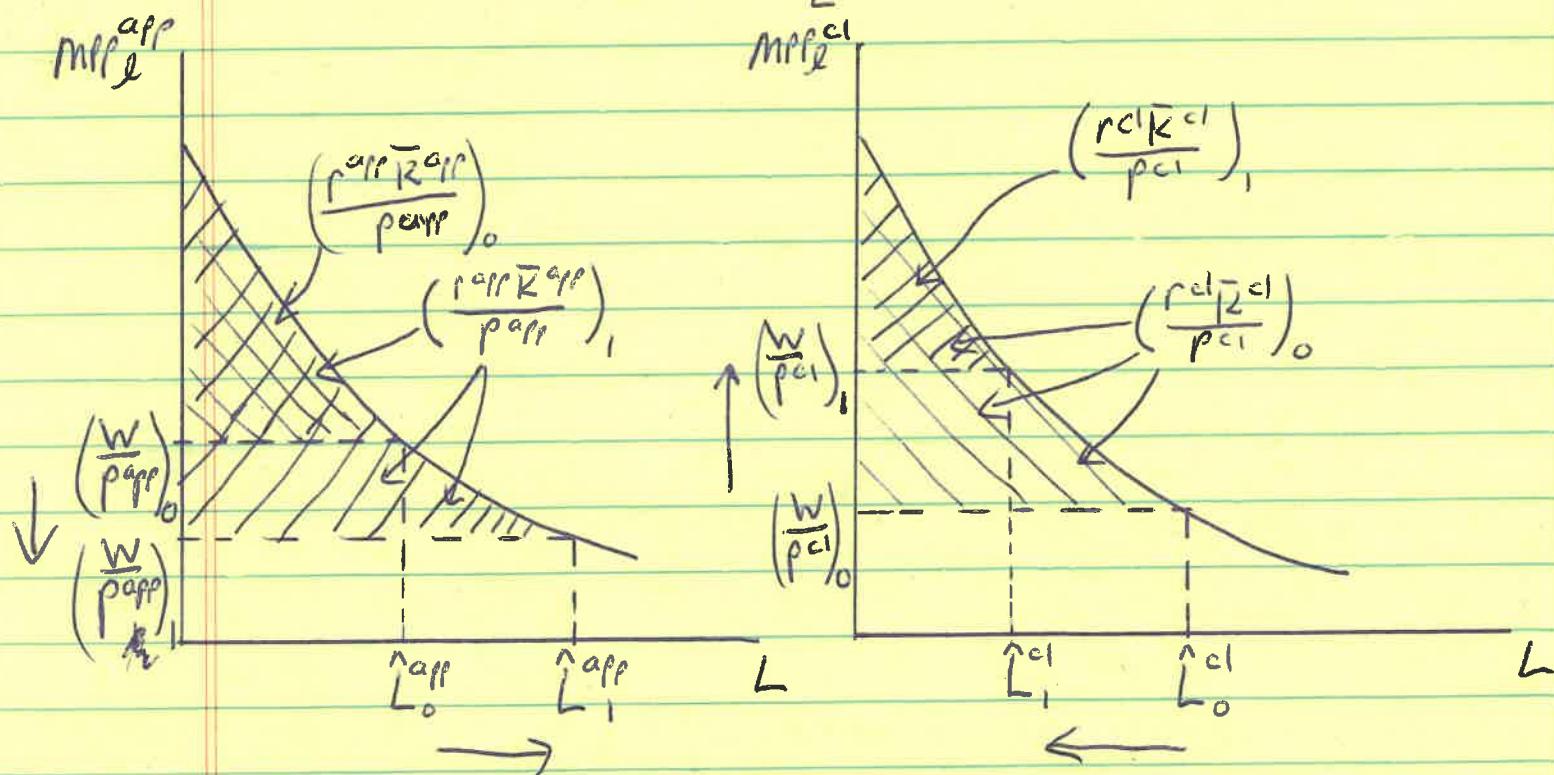
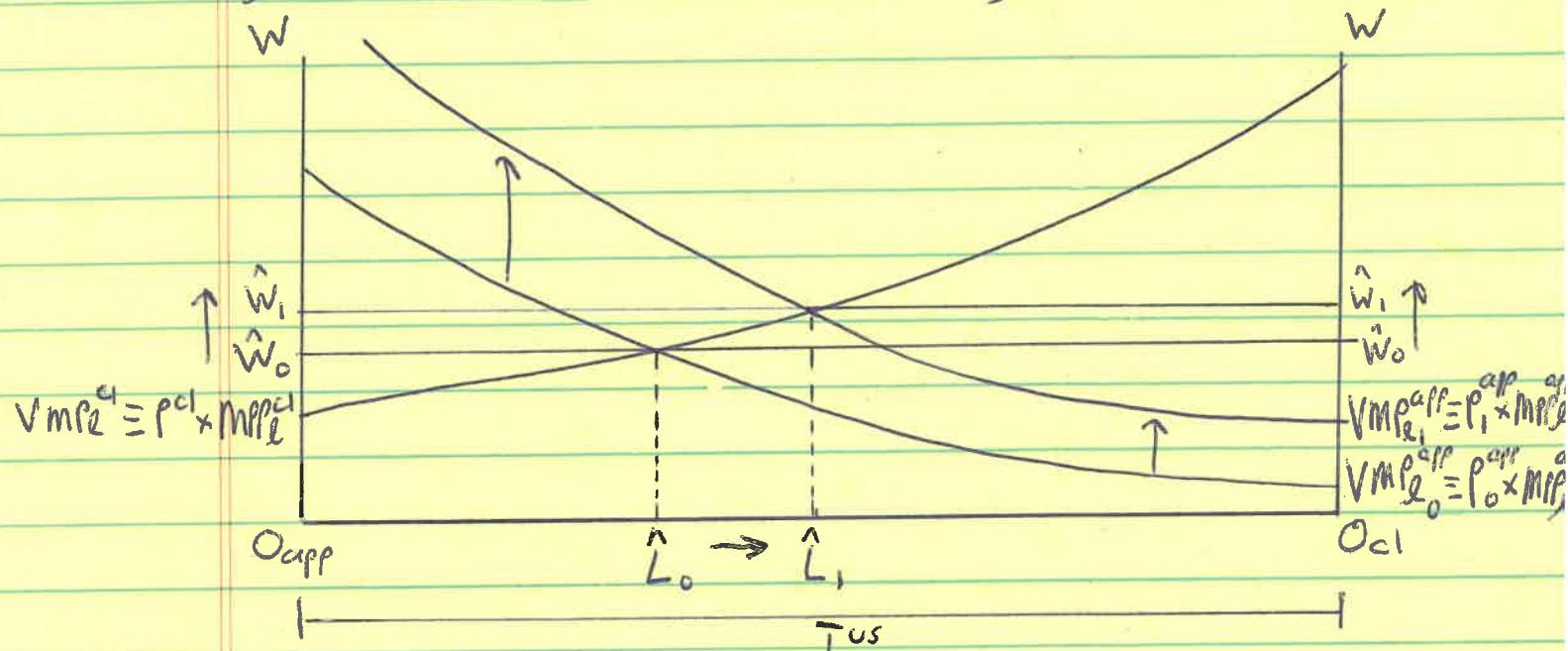
(4)

b) Next we are asked to consider whether, if all US citizens are asked to contribute equally to the fiscal cost of the transfer, they will share equally in the overall burden of the transfer payments to Bangladesh. ~~This~~ ~~will~~ in the short run. We are told to use the assumptions of the Specific Factors Model to represent the US economy in the short run, with appliance-specific capital stuck in the appliance sector and clothing-specific capital stuck in the clothing sector and with labour mobile between the sectors. We know from part (a) that the transfer will result in an increase in $\left(\frac{P_{ap}}{P_{cl}}\right)^W$, which with global free

trade means an increase in $\frac{P_{ap}}{P_{cl}}$ in the US. If this relative price change creates winners and losers in the US in terms of pre-tax real income, then citizens of the US will not share equally in the overall burden of the transfer if they are asked to contribute equally to the fiscal cost of the transfer. The figures on the next page confirm that this is indeed the case, by showing that in terms of pre-tax real income clothing-specific capital owners lose, appliance-specific

(5)

Capital owners gain, and labor is likely to gain given that we are told US citizens spend a large share of their income on clothing.



As these figures depict, with P^{cl} normalized not to change so that $\frac{P^{\text{app}}}{P^{\text{cl}}}$ rising implies P^{app} rising,

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The top figure depicts $VMP_L^{APP} = P^{APP} \times MPP_L^{APP}$ shifting upward and leading to a rise in the nominal wage \hat{W} and an increase in labor employed in the appliance sector L^{APP} and a decrease in labor employed in the clothing sector in the US. The bottom two figures depict the impact of the rise in P^{APP} on the (pre-tax) real incomes of factor owners in the US. The left bottom figure shows that the real (pre-tax) income of US appliance-specific capital owners measured in units of appliances rises from $(\frac{r^{APP}K^{APP}}{P^{APP}})$ to $(\frac{r^{APP}K^{APP}}{P^{APP}})$, as depicted.

And since P^{APP} rises relative to P^{CL} , the real income of appliance-specific capital owners is higher in terms of their purchasing power for clothing as well. The bottom right figure shows that the real (pre-tax) income of US clothing-specific capital owners measured in units of clothing falls from $(\frac{r^{CL}K^{CL}}{P^{CL}})$ to $(\frac{r^{CL}K^{CL}}{P^{APP}})$, as depicted.

And since P^{CL} falls relative to P^{APP} , the real income of clothing-specific capital owners is lower in terms of their purchasing power for appliances as well.

$$\left(\frac{r^{CL}K^{CL}}{P^{CL}} \right)_0 \text{ to } \left(\frac{r^{CL}K^{CL}}{P^{APP}} \right)_1 \text{ as depicted.}$$

And since P^{CL} falls relative to P^{APP} , the real income of clothing-specific capital owners is lower in terms of their purchasing power for appliances as well.

(7)

real income of clothing-specific capital owners is lower in terms of their purchasing power for appliances as well. Finally, the two bottom figures confirm that

$\left(\frac{w}{p_{all}}\right)$ falls while $\left(\frac{w}{p_{cl}}\right)$ rises,

which implies that the real wage of US workers will rise if and only if they spend a sufficiently large share of their income on clothing. But since the problem tells us to assume that clothing is like "fast fashion" and that US consumers spend a large share of every dollar on this, we can conclude that it is "likely" that US real wages will rise.

In any case, the figures confirm that the impact of the US transfer to Bangladesh ~~won't~~ on pre-tax real incomes in the US in the short run will not be uniform, and so we can conclude that if all US citizens are asked to contribute equally to the fiscal cost of the transfer, the overall burden of the transfer will not be shared equally by all US citizens ~~in the~~ in the short run.

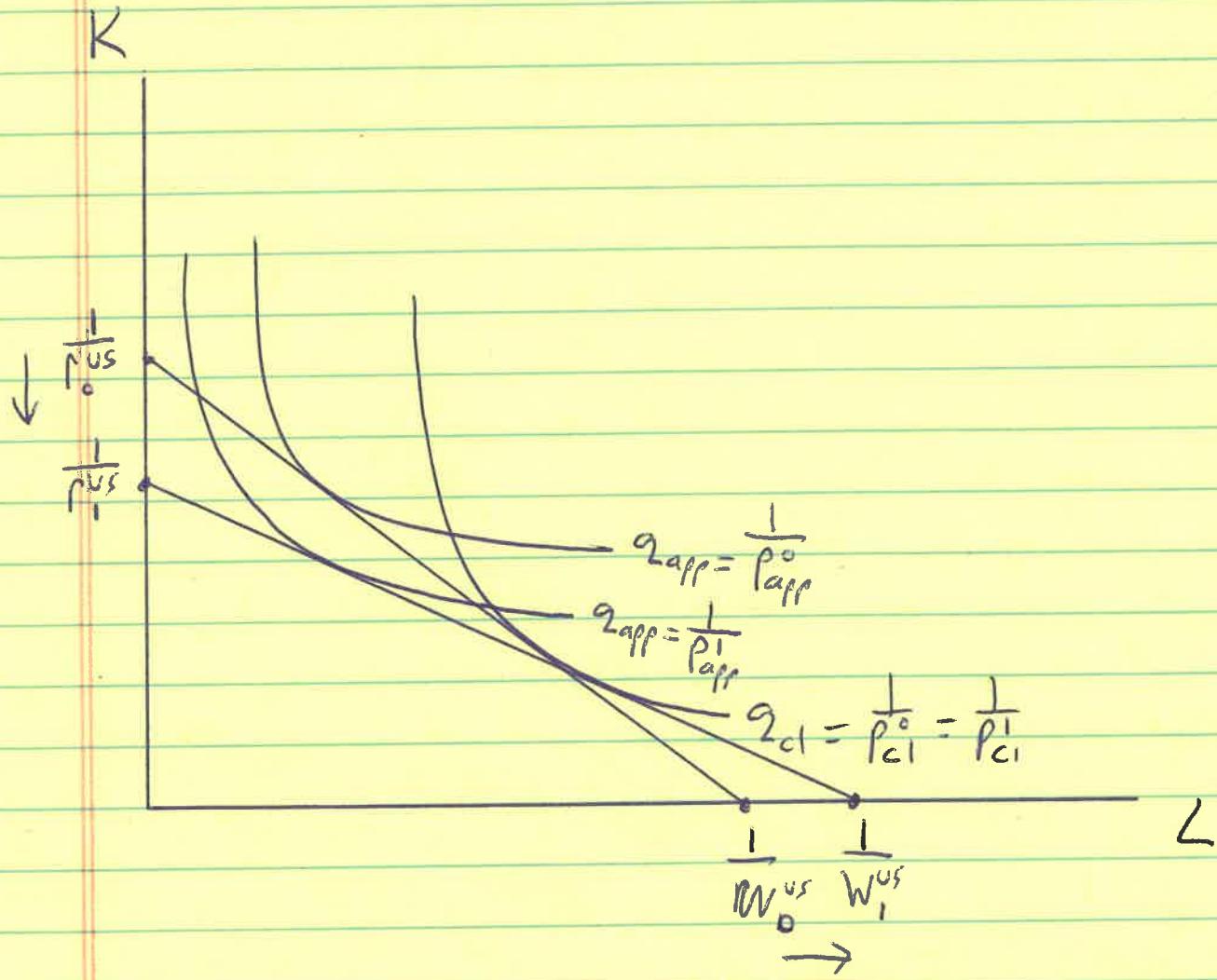
c) Next we are asked to consider whether, if all US citizens are asked to contribute equally

(8)

both the fiscal cost of the transfer, they will share equally in the overall burden of the transfer payments to Bangladesh in the long run. We are told to use the assumptions of the Heckscher-Ohlin model to represent the US economy in the long run, with capital and labor both mobile between the appliance and the clothing sector and with appliances the capital-intensive and clothing the labor-intensive sector (and since we are only asked to apply these assumptions to the US economy, we can ignore the fact that the Heckscher-Ohlin model assumes that preferences are identical across countries while we have assumed for this problem that preferences are different across countries). Again using part (a), we know that $\left(\frac{P_{app}}{P_{cl}}\right)^W$ and hence the US $\left(\frac{P_{app}}{P_{cl}}\right)$ will rise as a result of the transfer from the US to Bangladesh. Normalizing P_{cl} not to change, we then have that P_{app} rises as a result of the transfer. Focusing again on pre-tax real incomes, we know from the Stolper-Samuelson Theorem that this will lead to a real income rise for capital in the US and a real income fall for US labor. The following figure

(9)

and accompanying calculations confirm that this is the case.



As depicted, the rise in p_{app} shifts the unit value isoquant for appliances radially inward, and this leads to the flatter unit iso-cost line with y -axis intercept $\frac{1}{W_0^o}$ and x -axis intercept $\frac{1}{W_1^{us}}$. With a " n " over a variable denoting the percentage change in the variable, we then have from the figure that $\frac{n}{W_0^{us}} < 0 = \hat{p}^{cl} < \hat{p}_{app}$. Hence, the

(10)

real (pre-tax) wage falls in the US as a result of the relative price change induced by the ~~the~~ US transfer to Bangladesh. Turning to the impact on US capital owners, we have from the figure that

$$\hat{r}^{us} > 0 = \hat{p}^{cl} > \hat{w}^{us} \text{ and } \hat{p}^{app} > 0.$$

This implies that either

$$(i) \hat{p}^{app} > \hat{r}^{us} > 0 = \hat{p}^{cl} > \hat{w}^{us}$$

or

$$(ii) \hat{r}^{us} > \hat{p}^{app} > 0 = \hat{p}^{cl} > \hat{w}^{us}.$$

But we can rule out (i) by supposing (i) holds and ~~the~~ showing that this would be inconsistent with zero profits in the appliance sector before and after the price change.

To show this, suppose that (i) holds and that we have $\Pi_{app}^0 = 0$, so that at original prices we have zero profits in the appliance sector.

But then if (ii) holds, and $\hat{p}^{app} > \hat{r}^{us} > 0 > \hat{w}^{us}$, we could make no changes to

production q_{app} or factor hiring K_{app} and L_{app} and make positive profits after the price change,

(11)

because revenue $P_{app} \times Q_{app}$ would then rise by more than cost $[rK_{app} + WL_{app}]$ and of profits

$$\Pi_{app} \equiv \text{Revenue} - \text{Cost}$$
$$= P_{app} \times Q_{app} - [rK_{app} + WL_{app}]$$

Started at zero they would then rise above zero, which is inconsistent with a perfectly competitive equilibrium.
So ruling out (i) with this argument, we then have

$$(ii) \hat{P}_{us} > \hat{P}_{app} > 0 = \hat{P}_C$$

and we can conclude that US Capital owners gain in real pre-tax terms from the relative price changes induced by the transfer.

So the figure and accompanying calculations confirm that the impact of the US transfer to Bangladesh on pre-tax incomes in the US in the long run will not be uniform, and so we can conclude that if all US citizens are asked to contribute equally to the fiscal cost of the transfer, the overall burden of the transfer will not be shared equally by all US citizens in the long run.

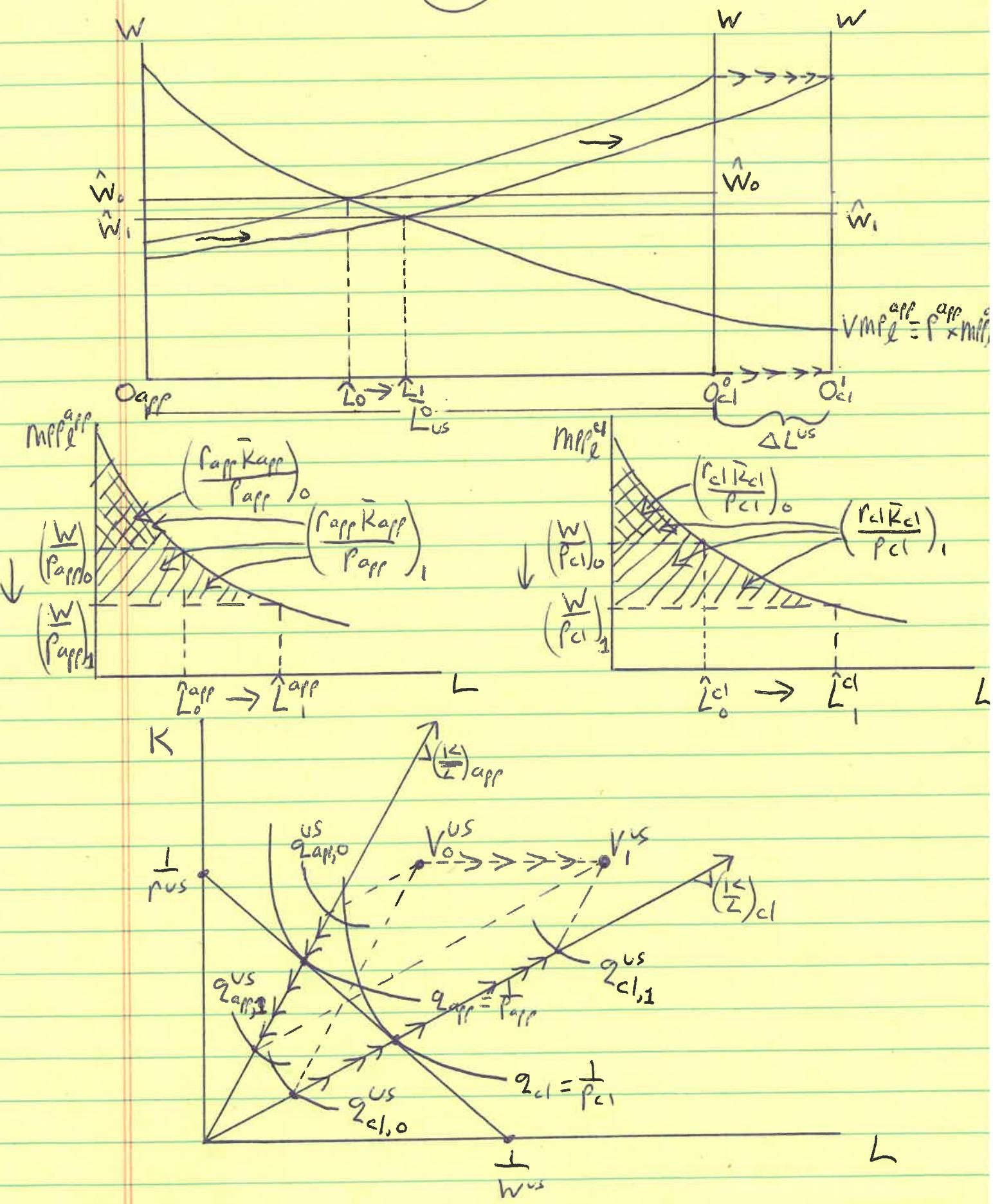
(12)

d) Finally, we are asked to consider the economic impacts of possible "climate refugees" arriving in the US. Specifically, we are told to assume that the US (for this part of the problem) is a small open economy that can be thought of as a specific factors economy (as in part b) in the short run and a Heckscher-Ohlin economy (as in part c) in the long run, and we are asked to assess the short run and long run impacts of a rise in US labor supply (augmented by "climate refugees") on the distribution of income in the US. We are also told to assume that the increased US labor supply still leaves the US producing both goods.

The figures on the next page depict the impact ~~of~~ of an increase in the US labor supply on the US income distribution in the short run (the top three figures) and in the long run (the bottom figure).

In the short run, as the top three figures show, the real wage of labor in

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(14)

the US falls, while the real incomes of appliance-specific capital and clothing-specific capital both rise. Recalling that prices don't change due to the small-open-economy assumption, these real income effects can be seen directly from the ~~Figure~~ ~~bottom~~ ~~bottom~~ Figures, which depict $\frac{w}{P_{app}}$ and $\frac{w}{P_{cl}}$ falling and $\left(\frac{r_{app}k_{app}}{P_{app}}\right)$ and $\left(\frac{r_{cl}k_{cl}}{P_{cl}}\right)$ rising.

In the long run, as the bottom figure on the previous page shows, there is no change in the US distribution of income, as the US wage w^* and US capital rental rate r^* remain unaffected by the increase in US labor supply. Instead, as the bottom figure depicts, the US economy adjusts to the inflow of labor by altering its industrial mix away from capital-intensive appliances and toward the production of labor-intensive clothing.

(15)

2. We are asked to consider a special case of the continuum-of-goods Ricardian trade model where $l(z) = 1 + \theta x z$ and $l^*(z) = 1 + \theta^* x z$ with $\theta \geq 0$ and $\theta^* \geq 0$. We are told to interpret $\theta x z$ as the amount of labour needed to comply with the pollution standard θ , with higher z goods then corresponding to "dirtier" goods because they take more labour to "clean up production" and comply with a given standard θ .

Hence, we have for any standards $\theta \geq 0$ and $\theta^* \geq 0$,

$$A(z) \equiv \frac{l^*(z)}{l(z)} = \frac{1 + \theta^* x z}{1 + \theta x z}$$

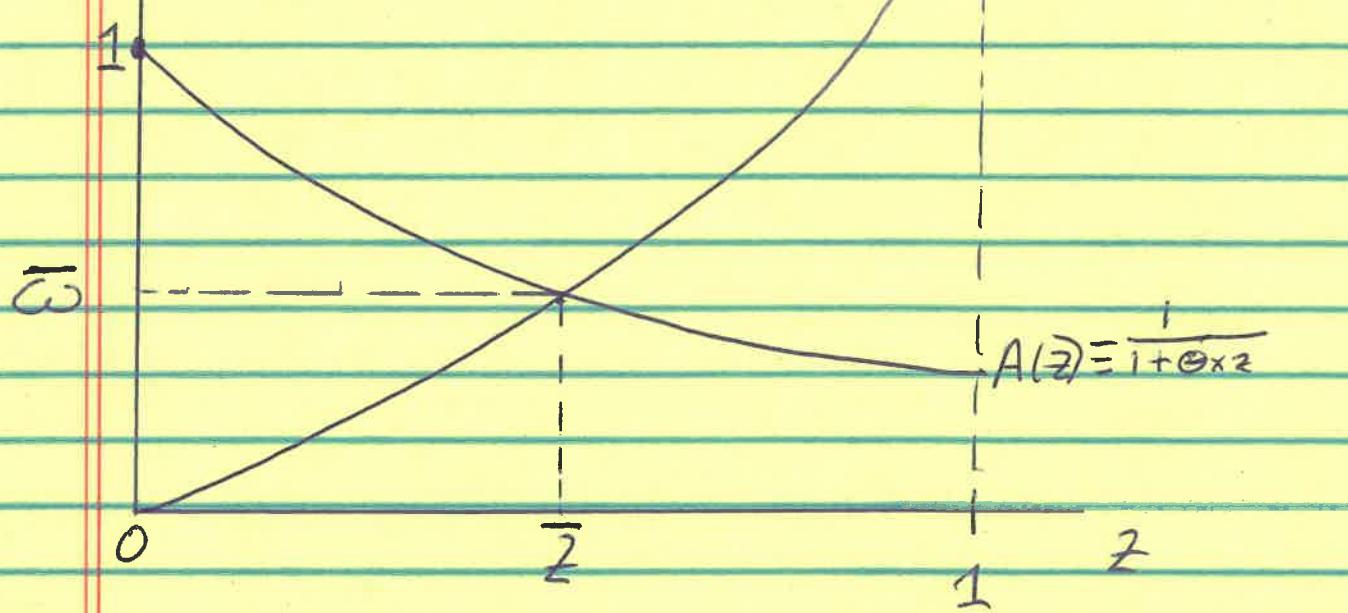
$$B(\tilde{z}) \equiv \frac{\gamma(\tilde{z})}{1 - \gamma(\tilde{z})} \frac{L^*}{L}, \text{ where } \gamma(\tilde{z}) \equiv \int_0^{\tilde{z}} b(z) dz.$$

- a) We are first asked to show that, if the home country adopts a standard $\theta > 0$ and the foreign country has no standard and hence $\theta^* = 0$, then the home country will specialize in a range of naturally clean (low z) goods.

With $\theta \geq 0 = \theta^*$, we have $A(z) \equiv \frac{l^*(z)}{l(z)} = \frac{1}{1 + \theta x z}$. The figure on the next page depicts the trading equilibrium.

(16)

$$\omega = \frac{w}{w^*}$$



As depicted, the home country specializes in goods $z \in [0, \bar{z}]$, and these are indeed the "naturally clean" goods as compared to goods $z \in [\bar{z}, 1]$.

b) We are next asked to show that if the world's preferences shift away from consumption of dirty goods and toward consumption of clean goods, so that the budget shares $b(z)$ for low- z goods increase and the budget shares for high- z goods fall, then \bar{z} will move to the left and, ironically, the foreign country -- who by assumption has no pollution standard in place ($\theta^* = 0$) -- will gain competitiveness.

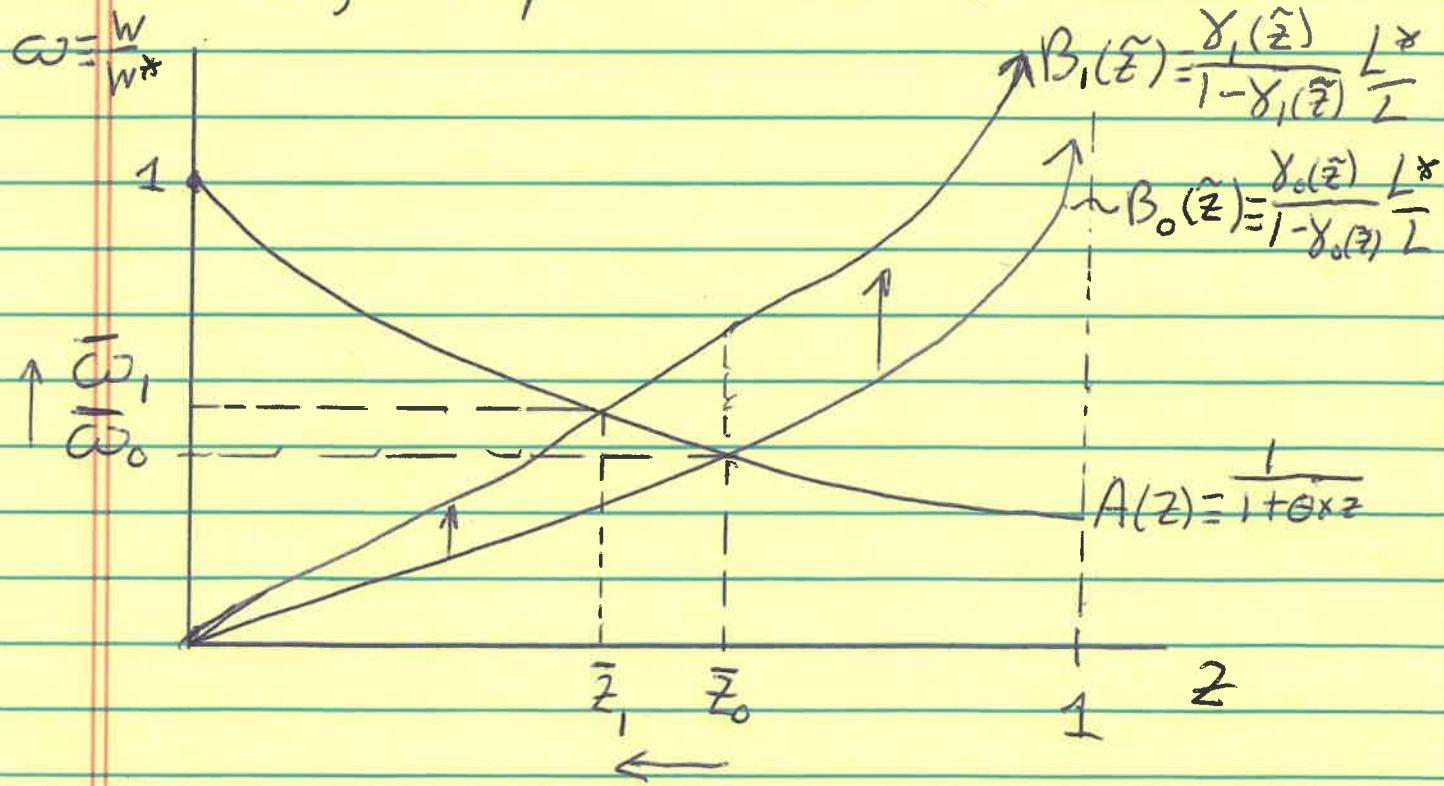
(17)

and began exporting a range of goods that, prior to the preference shift toward clean goods, it would have imported from the low country.

To show this, recall that $\gamma(\tilde{z}) = \int_0^{\tilde{z}} b(z) dz$. We are told that $b_1(z) > b_0(z)$ for $z \in [0, \bar{z}_0]$, that is, preferences shift toward the range of goods originally produced in the low country. Therefore, we have

$$\gamma_1(\bar{z}_0) = \int_0^{\bar{z}_0} b_1(z) dz > \int_0^{\bar{z}_0} b_0(z) dz = \gamma_0(\bar{z}_0).$$

This means that the $B(z)$ curve shifts up at \bar{z}_0 , as depicted in the figure below:



(18)

As depicted, with the $B(\bar{z})$ curve shifting up, we have \bar{w} rising and \bar{z} falling, hence the relative wage in the foreign country falls ($\bar{w} = \frac{w}{w^*}$ rises) and foreign competitiveness ~~increases~~ increases (\bar{z} falls).

Intuitively, this is because the preference shift toward the closer goods produced in the home country shifts the world's underlying demand for labor toward demand for home labor and away from demand for foreign labor at the original scope of production for each country as determined by \bar{z}_0 . This in turn increases the relative wage of home labor ($\bar{w} = \frac{w}{w^*}$) and leads to the loss of home-country competitiveness and gain in foreign-country competitiveness indicated by the fall in \bar{z} .

3. We are asked to use the 2-good 2-country Ricardian trade model to examine the impact of "climate refugees" on the real wage of labor in the home country. In particular, we are told that these countries are trading freely and that initially the foreign ~~country~~ country is specialized in production of its comparative advantage good while the

(19)

home country is producing positive amounts of both goods. Note that this implies that initially the foreign country is a small country. Hence, with L increasing and L^* falling as "climate refugees" flow from the foreign country to the home country, the foreign country must also remain a small country after the flow of climate refugees. We will use this fact to confirm that the arrival of climate refugees in the home country will not alter the real per-capita income (and hence the real wage of labor) in the home country.

The three figures on the next page depict the answer. The top left figure depicts the home country, the top right figure depicts the foreign country, and the bottom figure depicts the determination of the equilibrium world relative price (P_x/P_0). Since the foreign country is initially a small country, the home country and the foreign country initially trade at the home country's autarky prices. And since, with the increase in L and equivalent decrease in L^* induced by climate refugee flows, the foreign country remains a small country, the two countries continue to trade at the home country's autarky prices after the refugee flow has occurred.

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This means that home-country GNP measured in units of X at the home-country's autarky prices (which are also the world prices) increases by the percentage increase in the home labor supply, as depicted in the top left figure. This in turn implies that the real per-capita income (and hence the real wage of labor, since $\frac{GNP}{L} = \frac{WL}{L} = W$) in the home country is not altered.

