

## Midterm Solution

### Question 1 — 40 points

- (a) True. The estimated gravity model suggests that trade is roughly proportional to country size. (Lecture 2, Slide 26) [5 points]
- (b) False. Trade over GDP is much lower in the United States than in many other countries. (Lecture 2, Slide 19) [5 points]
- (c) True. Trade expands the consumption possibility frontier (CPF) of a country, just as technological progress does. (Problem Set 2, Q3). [5 points]
- (d) True. The US is more abundant in high-tech workers than in low-tech workers relative to China. Trade will induce a decline in the wage of the US low-tech workers relative to the wage of the US high-tech workers, as low-tech labor becomes less scarce in the US after starting to trade with China. (Lecture 5, Slide 23) Said differently, trade essentially allows a country to convert a good  $x$  into another good  $y$ ; so one can see it as new technology.<sup>1</sup> [5 points]
- (e) False. A country has a comparative advantage in a good if its relative autarky price is lower than the world relative price under free trade. (Lecture 4, Slide 22) Everything else equal, the autarky relative price for high-tech goods will be higher, not lower, in a country with higher demand for high-tech goods.<sup>2</sup> [5 points]
- (f) Uncertain. On the production side, terms-of-trade improvements increase the output of the exported good. But on the demand side, consumption of the exported good may also go up if the income effect is large enough. This may lead, in principle, to a decrease in exports in response to a terms-of-trade improvements, though this is not the typical case. (Lecture 7, Slide 14) [5 points]
- (g) False. Growth biased towards exports may induce a large deterioration in the terms of trade and result in immiserizing growth. (Lecture 7, Slide 35) [5 points]
- (h) False. Real income is determined by the terms of trade and the *absolute* (not relative) productivity advantage between the two countries.<sup>3</sup> (Problem Set 3, Q2; Lecture 8 Slides 21-22). [5 points]

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<sup>1</sup>Some students said Chinese workers would ‘outprice’ or ‘outcompete’ the US workers in low-tech sectors. This is not what happens in the standard trade models. The relative wage of the US low-skill workers will fall because low-skill workers are less scarce after trade due to the high global supply of low-skill workers. But they are still employed; there is no sense in which they are ‘outpriced’ or ‘outcompeted’.

<sup>2</sup>Aside: this conclusion may be overturned in a model with economies of scale (home market effect).

<sup>3</sup>Furthermore, the terms of trade is determined by the intersection of relative demand and supply, which depends not only on the relative productivity across sectors but also on the relative country size.

## Question 2 — 30 points

1. [10 points] (a). In a two country model, a country has a comparative advantage in a good if its relative autarky price is lower than in the other country.
2. [10 points] (a). The increase in German labor force  $L_G$  will increase the relative supply of beer. Given the Cobb-Douglas preferences, the relative demand is downward-sloping. Thus, the relative price of beer will fall, which is a terms of trade improvement for French workers but deterioration for German workers.<sup>4</sup>
3. [10 points] (d). A country is strictly better off with free trade if the relative prices under free trade differ from its relative autarky prices. To determine the relative prices under free trade, we need information on relative demand, which is absent here.

## Question 3 — 30 points

- (a) [5 points] The US holds an absolute advantage in both goods. The US has a comparative advantage in doughnuts and Canada has a comparative advantage in bagels.
- (b) [5 points] The world relative supply of doughnuts (relative to bagels) is zero if  $p < 1$ ; between 0 and  $L/50$  if  $p = 1$ ; equals  $L/50$  if  $p \in (1, 2)$ ; between  $L/50$  and infinity if  $p = 2$ ; and is infinity if  $p > 2$ . Given the Cobb-Douglas demand, the relative demand is strictly positive and finite, so the world relative price  $p = p_D/p_B$  is bounded by  $p \in [1, 2]$ .
- (c) [5 points] Since consumers spend one-half of their income on doughnuts and the other half on bagels,  $p_D D_D^w = p_B D_B^w$ , where  $D_D^w$  and  $D_B^w$  denote the world demands for doughnuts and bagels. It follows that the world relative demand is given by

$$RD^{World}(p) \equiv \frac{D_D^w}{D_B^w} = \frac{1}{p}$$

Inspecting where the world relative demand intersects with the world relative supply, the relative price is  $p = 1$  if  $RD^{World}(1) \leq \frac{L}{50} \iff L \geq 50$ ;  $p = 2$  if  $RD^{World}(2) \geq \frac{L}{50} \iff L \leq 25$ ; and  $p \in (1, 2)$  if  $L \in (25, 50)$ . The US is strictly better off with trade if  $p$  differs from its relative autarky price of 1. Thus, free trade will strictly increase welfare in the US if and only if  $L < 50$ .

- (d) [5 points] Canada is strictly better off with trade if  $p$  differs from its relative autarky price of 2. Thus, free trade will strictly increase welfare in Canada if  $L > 25$ .

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<sup>4</sup>If you prefer math: The world relative supply of wine falls from  $Q_W^w/Q_B^w = 100/400 = 1/4$  to  $Q_W^w/Q_B^w = 100/440 = 1/4.4$ . The Cobb-Douglas preferences imply  $p_W D_W^w = p_B D_B^w \iff D_W^w/D_B^w = 1/p$  where  $p = p_W/p_B$ . Thus, the relative price of wine rises from 4 to 4.4.

- (e) [5 points] In equilibrium, the US always produces some doughnuts and Canada always produces some bagels regardless of the value of  $L$ . Under perfect competition, the price must equal the unit cost in sectors with strictly positive production. Thus, we know  $p_D = w_{US}a_D^{US} = w_{US}$  and  $p_B = w_{Canada}a_B^{Canada} = 2w_{Canada}$ . Taking the ratio and rearranging,  $w_{US}/w_{Canada} = 2p$ . If  $L = 25$ , then  $p = 2$ , so  $w_{US}/w_{Canada} = 4$ .
- (f) [5 points] In this case, we have complete specialization in both countries, so  $\frac{Q_D^w}{Q_B^w} = \frac{L}{50}$ . Setting world relative demand equal to the world relative supply, we have  $\frac{1}{p} = \frac{L}{50}$  or  $p = \frac{50}{L} = \frac{5}{4}$ . Then,  $w_{US}/w_{Canada} = 2p = \frac{5}{2}$ .