Evaluation guidelines Exam – Econ 4415 International Trade – December 2021

Problem 1: Specific factor (25 %)

Consider a country, Norway, that produces two goods, wheat and fish. Wheat is produced with workers and tractors. Fish is produced with workers and fishing boats. Workers are mobile between the two industries while tractors are specific to the wheat industry and fishing boats are specific to the fish industry.

1.1) Discuss how the relative goods prices determine the allocation of labour between the two industries and the functional distribution of income.

This is the specific factor model that has been covered in class and in lecture notes. A good answer should include both formal derivations and graphical illustrations. The below is taken from lecture notes. The variables k_i and n denote specific capital in industry i and labour, respectively. Profit maximisation gives as first order condition that the value of the marginal product of labour equals the wage rate for each industry i:

$$\pi_i = p_i x_i - w n_i = p_i F^i(k_i, n_i) - w n_i$$
$$\frac{d\pi_i}{dn_i} = p_i F_n^i - w = 0 \quad \rightarrow \quad p_i F_n^i = w$$
$$\pi_i^* = p_i F^i(k_i, n_i) - n_i p_i F_n^i = p_i \left(F^i - n_i F_n^i\right)$$

Above, the maximised profits in each industry is written as π. Note that π* is the residual between sales incomes and wages expenses since there are no other decision variables than n. The above confirms that employment in each industry is set so that the value of the marginal product of labour equals the wage rate.*

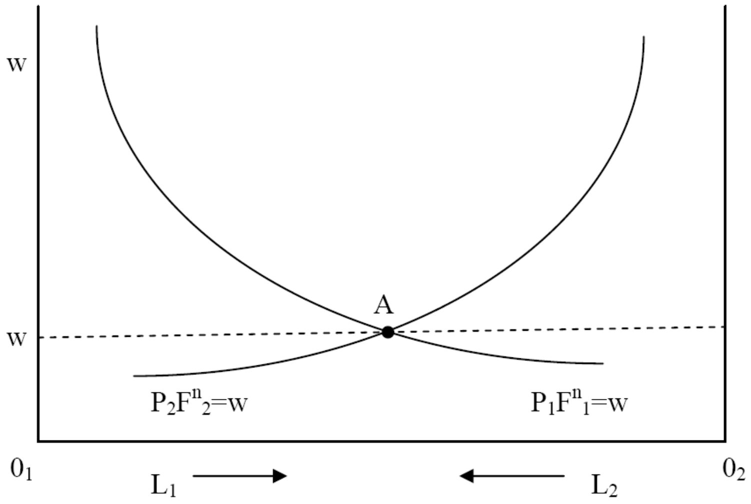
We have two industries (i=1,2) and three factors of production: labour and industry specific capital stocks in the two industries (k_1 and k_2).

The first order conditions for profit maximisation gave as result:

$$\frac{d\pi_i}{dn_i} = p_i F_n^i - w = 0 \quad \rightarrow \quad p_i F_n^i = w$$

Note that the first order conditions implicitly give the demand for labour functions. Since there are diminishing returns to labour these are downward sloping. We can therefore illustrate the labour market equilibrium in this model by using figure 1:

Figure 1



In figure 1 each industry's demand for labour functions are drawn as downward sloping curves from their respective origins (0_1 and 0_2). The equilibrium wage is given where the two curves cross, i.e. at point A. At point A employment of labour in both industries, wage and production in both industries are determined.

Note that the position of both labour demand functions depend on product prices and the given capital stocks in both industries (since $F^i_n = F^i_n(k_i, n_i)$).

Equilibrium in the labour market is determined by relative goods prices and determines wages, rents to each specific factor, the allocation of labour between the two industries and production of the two goods.

1.2) Norway considers starting trading with Sweden. In Sweden the price of wheat is lower than in Norway while the price of fish is higher. How will trade affect incomes for farmers (owners of tractors), fishing boat owners and workers in Norway?

You can presume that rents to capital and wages were equal in the two industries before Norway and Sweden started to trade. Short run effects of trade are described by the specific factor model. In the long run, trade also involves reallocation of capital between the two industries

With trade, the relative price of fish to wheat increases in Norway. This increases incomes for fishing boat owners and reduces the incomes for farmers. The effect on nominal and real wages are ambiguous. Students may well use the following, where good 1 denotes fish and good 2 denotes wheat (taken from the lecture notes). If so, the students must take into account that the price on good 1 increases while the price on good 2 decreases.

Further results are these:

The change in wages can be found from the first order condition from profit maximisation:

$$p_i F_n^i = w$$

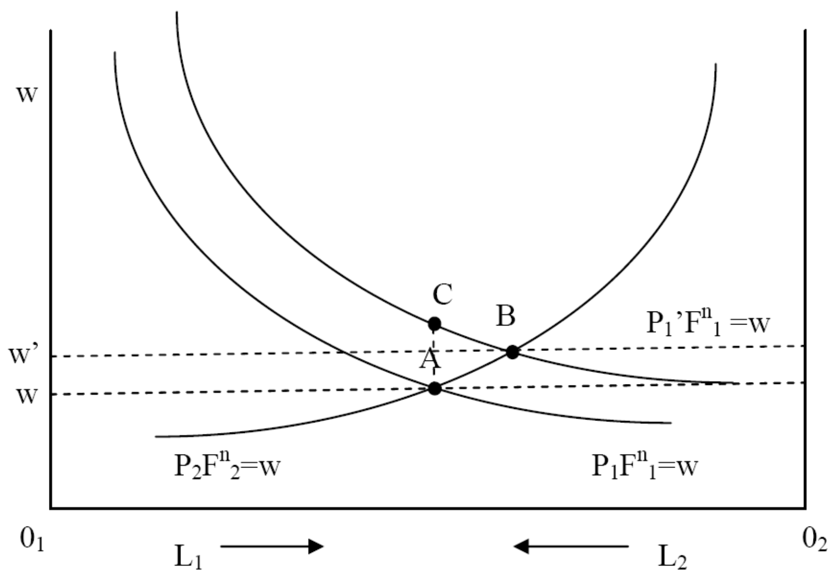
$$\frac{dw}{dp_1} = F_n^1 + p_1 \frac{\partial^2 F^1(k_1, n_1)}{(\partial n_1)^2}\frac{dn_1}{dp_1} = F_n^1 + p_1 F_{nn}^1 \frac{dn_1}{dp_1} < F_n^1 = \frac{w}{p_1}$$

$$\rightarrow \frac{dw}{dp_1} < \frac{w}{p_1} \rightarrow \frac{dw}{w} < \frac{dp_1}{p_1}$$

This holds regardless of factor intensity in industry 1.

What happens with returns to capital in the two industries? From economic intuition it seems reasonable that returns to capital increase in industry 1 and decrease in industry 2. The total value of production is equal to the area below the labour demand curves. The value of production is divided between wage income and residual profits to the owners of capital. Since nothing happens with the price of good 2, one effect of the price increase on good 1 is to reduce the profits in industry 2. There are two reasons for this: Nominal wages increase and employment decreases. For industry 1 profits increases. The reasons are that prices increase more than proportionally than wages and that employment increases.

Figure 2



The results for profits can be demonstrated formally from the maximised profit equation, π, form above:*

$$\pi_i^* = p_i F^i(k_i, n_i) - n_i p_i F_n^i = p_i\left(F^i - n_i F_n^i\right)$$

We can rewrite the above as:

$$\frac{\pi_i^*}{p_i} = \left(F^i - n_i F_n^i\right)$$

This is the ratio between profits and prices. This ratio depends only on factor use. We can take the derivativ of this ratio with respect to n_i:

$$\frac{d\left(\pi_i^* / p_i\right)}{dn_i} = F_n^i - F_n^i - nF_{nn}^i = -nF_{nn}^i > 0$$

This implies that the ratio of profits to prices increases with the use of labour in each industry. Therefore, with increasing n_1, the ratio between profits and prices in industry 1 increase. This means the profits increase more than prices in this industry. Since n_2 decreases, the ratio of profits to prices in industry 2 decreases. Since there is no price change in industry 2, nominal profits decrease.

The results of this exercise show how relative factor rewards changes compare with the relative price changes as:

$$\frac{d\pi_2^*}{\pi_2^*} < 0 < \frac{dw}{w} < \frac{dp_1}{p_1} < \frac{d\pi_1^*}{\pi_1^*}$$

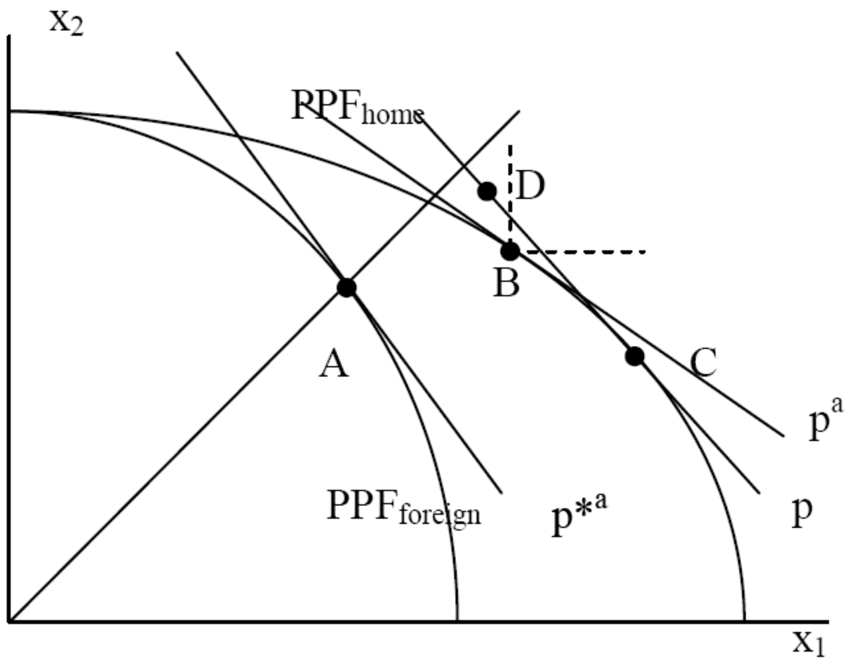
The same result can be arrived at with the help of "Jones algebra" (cfr appendix to lecture note on HOS model). It is left as an exercise also to demonstrate that:

$$\frac{d\pi_2^*}{\pi_2^*} < \frac{dp_2}{p_2} < \frac{dw}{w} < \frac{dp_1}{p_1} < \frac{d\pi_1^*}{\pi_1^*}$$

This equation describes the case when price changes are proportionately larger for industry 1 than for industry 2. This result is also denoted as the "magnifying effect" where changes in rewards to the specific factors are magnified while changes in wages are "caught in the middle".

1.3) Even if some groups will lose from trade, in principle trade may benefit all groups. Explain how.

What are then the gains from trade? Gains from trade cannot generally be demonstrated when some lose from trade while others gain. That would imply weighting groups against each other. Weighting gains and losses for different groups is a political rather than an economical question. We can nevertheless use a weaker criterion to demonstrate gains from trade. There are gains from trade in the sense that potentially the winners from trade can compensate the losers and still be better off. This is seen from considering the below figure. The figure is based on an example where the foreign country has less of the specific factor in industry 1 than the home country, but where the two countries are otherwise identical.



In autarky the two economies are located on points A and B. These points are the two countries' autarky production and consumption points. When there is trade, the home country experiences an increase in the price of good 1. The price line becomes steeper (it is given by –p=-p_1/p_2). Point C denotes the new production point. The new price line has become steeper so consumers demand relatively less of good 1 and more of good 2. The new consumption point is to the right of the 45 degree line (why?), but to the left of C. It could be in point D. The potential gains from trade argument is that also consumption points which contains more of both goods are potentially available. This demonstrates that there are potential Pareto improvements from trade: It is possible to increase consumption of both goods by engaging in trade. Potentially, therefore, winners can compensate losers and still be better off. Whether this compensation is realised depends on income distribution.

Problem 2. The Heckscher-Ohlin model (25 %)

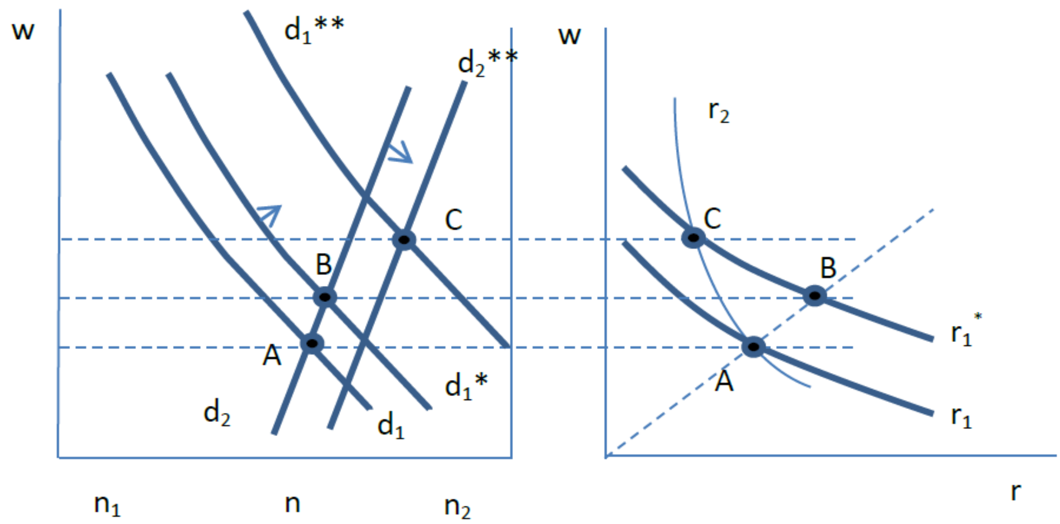
Assume that in the long run, farmers and fishing boat owners can invest in the industries they prefer. Therefore, in the long run, there are only two factors of production. These are labor and capital. Assume that Norway is well endowed with labor relative to Sweden. Also assume that the use of labor to capital is higher in fisheries than in wheat production.

Discuss effects of free trade between Norway and Sweden in the long run.

A point of departure for this discussion could be the below graph. The left hand side represents the labour market (as in exercise 1). The right hand side represents the factor rewards. It is clear that industry 2 is the capital intensive industry.

In the short run a price increase of the labour intensive good gives a new equilibrium in B. In B, however, returns to capital in the labour intensive industry are higher than in the capital intensive industry. Therefore capital flows into the labour intensive industry. Therefore production of the labour intensive good increases more in the long run than in the short run. Wages increase too since labour becomes relative more scarce. Returns to capital fall.

Norway exports fish and imports wheat.



Formal presentations are welcome.

Problem 3. Trade theory (40 %)

Consider the table below. The table is table 1 in Bernard *et al.* (2007). The article is on the reading list. The table indicates which types of trade theories that explain various empirical regularities and predictions. You can focus on the first column ("Old trade theory"), the second column ("New" trade theory) and the fourth column (Heterogenous firms model).

Discuss in detail how these three classes of trade theories explain different facts about trade.

Table 1
Trade Theories and Their Ability to Explain Facts about Trade

Facts	*"Old" trade theory*	*"New" trade theory*	*Integrated model*	*Heterogeneous firms model*	*"Integrated" heterogeneous firms model*
	Ricardo (1817), Heckscher (1919), Ohlin (1933)	*Krugman (1980)*	*Helpman and Krugman (1985)*	*Melitz (2003), Bernard et al. (2003)*	*Bernard, Redding, and Schott (2007)*
Trade					
Interindustry trade	Yes	No	Yes	No	Yes
Intra-industry trade	No	Yes	Yes	Yes	Yes
Exporters and nonexporters within industries	No	No	No	Yes	Yes
Trade and productivity					
Exporters are more productive than nonexporters within industries	No	No	No	Yes	Yes
Trade liberalization raises industry productivity through reallocation	No	No	No	Yes	Yes
Trade and labor markets					
Net changes in employment across industries following trade liberalization	Yes	No	Yes	No	Yes
Simultaneous gross job creation and destruction within industries following trade liberalization	No	No	No	Yes	Yes
Trade liberalization affects relative factor rewards (income distribution)	Yes	No	Yes	No	Yes

Notes: Interindustry trade occurs when a country exports in one set of industries and imports in another set of industries; intra-industry trade occurs when there is two-way exporting and importing within the same industry.

This question invites the students to discuss and compare the three classes of trade theory. The problem is wide and good answers may be diverse. The question is weighted with 40 %. Therefore students should put much effort in this question.

Problem 4. CES utility function (10 %)

Presume that consumers have the following utility function:

$$U = \left(\sum_{i=1}^{n} c_i^{\theta} \right)^{\frac{1}{\theta}}$$

$$0 < \theta < 1$$

Here, c_i denotes consumption of good i. Consumers want to maximize their utility subject to the budget constraint:

$$Y = \sum_{i=1}^{n} p_i c_i$$

Derive the demand function. Include each step of the derivation in your answer.

$$L = \left(\sum_{i=1}^{n} c_i^{\theta} \right)^{\frac{1}{\theta}} - \lambda \left(\sum_{i=1}^{n} p_i c_i - Y \right)$$

$$\frac{dL}{dc_i} = \frac{1}{\theta} \left(\sum_{i=1}^{n} c_i^{\theta} \right)^{\frac{1}{\theta}-1} \theta c_i^{\theta-1} - \lambda p_i = 0$$

$$\frac{dL}{dc_j} = \frac{1}{\theta} \left(\sum_{i=1}^{n} c_i^{\theta} \right)^{\frac{1}{\theta}-1} \theta c_j^{\theta-1} - \lambda p_j = 0$$

$$\frac{c_i}{c_j} = \left(\frac{p_i}{p_j} \right)^{\frac{1}{\theta-1}}$$

$$c_i = c_j \left(\frac{p_i}{p_j} \right)^{\frac{1}{\theta-1}}$$

$$p_i c_i = c_j p_i^{\frac{\theta}{\theta-1}} p_j^{\frac{1}{1-\theta}}$$

$$Y = \sum_{i=1}^{n} p_i c_i = c_j p_j^{\frac{1}{1-\theta}} \sum_{i=1}^{n} p_i^{\frac{\theta}{\theta-1}}$$

$$c_j = \frac{p_j^{\frac{1}{1-\theta}} Y}{\sum_{i=1}^{n} p_i^{\frac{\theta}{\theta-1}}}$$