ECON 35101 International Macroeconomics and Trade: Assignment 3

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1 Factor Prices

1.1 The Heckscher-Ohlin Model

Let's start with the assumptions with the Heckscher-Ohlin theorem: two countries share the same technologies and homothetic preferences. Suppose that the world's total endowments for labor and capital are L and K. Denote a_{if} the requirement for factor f to produce one unit of good i. Since technologies are identical in two countries, a_{if} are equalized.

We can draw this in an Edgeworth box. Each point in the box indicate one possible allocation of factor endowments between two countries. We could also draw the cone, or parallelogram, of diversification, with slopes determined by a_{if}'s. The parallelogram is the factor price equalization (FPE) set, as shown in Figure 1.

In an integrated equilibrium, meaning two countries can be treated as one, both goods are produced in both countries. When the point of endowment allocation lies within the FPE set, this necessarily implies that factor prices are equalized since

$$p_1 = wa_{1L} + ra_{1K}, \quad p_2 = wa_{2L} + ra_{2K}$$

which yields unique solutions for w, r. Intuitively, in the integrated equilibrium with no trade cost, prices of goods are the same, and each factor is paid at its marginal product, which is the same when technologies are identical. Two countries could freely adjust the output mix to achieve full employment of both factors as long as endowments lie within the FPE set.

However, if endowments are dissimilar such that the point of endowment allocation lies outside the FPE set, there is no way for both countries to produce both goods as before, so

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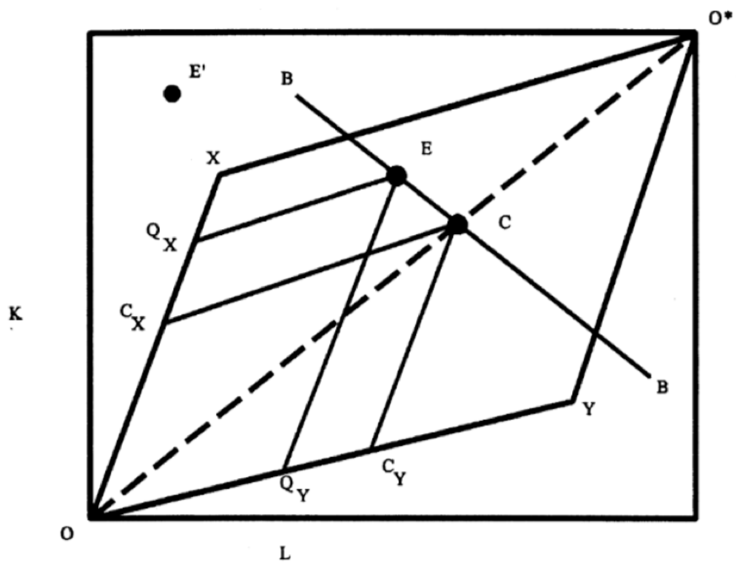

Figure 1: The FPE set

each country must specialize in producing the good in which it has an comparative advantage. Now relative factor prices depend on relative endowments, which are different for two countries.

1.2 Applying The HO Model to Rossi (2019)

The HO model could help understand the pattern in Rossi (2019). The paper documents several facts: (1) relative labor supply of high- and low-skill individuals is higher in rich countries, (2) the skill premium is lower in rich countries. We could try to understand these using our HO framework. There are two factors for each country, and for country c we denote L_c to be the supply of low-skill labor and K_c to be the supply of high-skill labor. Returns to low- and high-skill labor are w_c and r_c, respectively, and r_c/w_c is the skill premium.

We argue that the HO model could explain these facts. Suppose we are back to the case with two countries (country c and the ROW), two goods (a generic low-skill labor-intensive good and a generic high-skill labor-intensive good), and two factors (low- and high-skill labor). Under the assumptions described above, we know that as long as the relative supply of high- and low-skill labor are not too dissimilar, factor prices are equalized, implying that the skill premium is the same in country c and in the ROW. Of course, the assumptions with the HO model are quite strong. Nonetheless, it is possible that the model could partly rationalize the facts we see as long as the real-world case does not deviate too much from the assumptions. That being said, it could be that trade absorbs part of the variations in relative factor supply and explains the cross-country differences in skill premium.

The explanatory power would depend on how we define goods and/or factors. As discussed in the lecture, the implications of the model depend on the number of factors F and the number of goods G. When $F = G$, similar arguments apply here. When $F > G$, the FPE set has measure zero, and these arguments are unlikely to come through. When $F < G$, we could back out the factor content of trade using Heckscher-Ohlin-Vanek Theorem. Still, trade absorbs some variations in factor supply as in the extreme case ($F = 1$, $G = \infty$) of Dornbusch et al. (1977).

2 Identifying The Commuting Elasticity

2.1 How are the gravity- and GMM-based estimates obtained?

The gravity-based estimates are obtained from estimating equation (4) of Ahlfeldt et al. (2015):

$$\pi_{ij} = \frac{T_i E_j (d_{ij} Q_i^{1-\beta})^{-\varepsilon} (B_i w_j)^{\varepsilon}}{\sum_{r=1}^{S} \sum_{s=1}^{S} T_r E_s (d_{rs} Q_r^{1-\beta})^{-\varepsilon} (B_r w_s)^{\varepsilon}}$$

Take log and aggregate at the district level, and we obtain an equation that can be estimated with data (equation (25)).

$$\log \pi_{IJ} = -\nu \tau_{IJ} + \vartheta_I + \varsigma_J + e_{IJ}$$

The authors use both OLS and PML to estimate the commuting elasticity ν. The identification assumption is that residence and workplace residual fundamentals included in e_{IJ} are not correlated with commuting time τ_{ij}.

The GMM-based estimates are obtained based on equation (34).[1]

$$\mathbb{E}\left[\psi H_{Mj} - \sum_{i \in \chi_j} \frac{\omega_j / e^{\nu \tau_{ij}}}{\sum_{s=1}^{S} \omega_s / e^{\nu \tau_{is}}} H_{Ri} \right] = 0$$

where all except ω_j and ν are observed in the data. The authors adopt a nested optimization approach in which ω and $\Lambda = \{\nu, \varepsilon, \lambda, \delta, \eta, \rho\}$ are solved iteratively. Hence, given ω, we can solve for ν directly from the equation above. The identification assumption is that the total number of workers commuting for less than 30 minutes in the model is equal to the corresponding number in the data.

[1] By the way, I might be too picky, but I guess in the paper the S in the superscript of the summation over i is redundant.

2.2 Under what conditions do they differ and under what conditions do they coincide?

First, note that equation (4) implies equation (7):

$$H_{Mj} = \sum_{i=1}^{S} \frac{\omega_j / e^{\nu \tau_{ij}}}{\sum_{s=1}^{S} \omega_s / e^{\nu \tau_{is}}} H_{Ri}$$

Comparing equation (7) with equation (34), we can spot several differences: (a) the share of workers commuting for less than 30 minutes ψ and (b) the set of residence locations χ_i within 30 minutes travel time of workplace location j. (a) and (b) rely on whether we assume the 30-minute cutoff. All else equal (meaning no production or amenity externalities in either case), equation (7) and (34) are the same when we do not impose this 30-minute cutoff, which implies $\psi = 1$ and $\chi = \{1, ..., S\}$. Given that commuting cost explodes as commuting time increases, imposing the 30-minute cutoff may not severely affect the estimates for ν.

If (a) and (b) do not make any difference, then (7) and (34) are essentially the same and should yield the same estimate for ν. Then, any difference between the two methods should originate from the difference in their underlying identification assumptions. Recall that the GMM-based approach assumes that equation (34) holds in expectation. It allows for aggregate measurement error with zero mean. On the other hand, the gravity-based approach allows for measurement error in pair-specific commuting cost d_{ij} but assumes the measurement error is not correlated with observed commuting time. Hence, the gravity-based estimates would be different from the GMM-based estimates if there is measurement error in d_{ij} because in this case $d_{ij} \neq e^{\nu \tau_{ij}}$, and equation (34) does not hold in general. However, it does not mean that the gravity-based estimates are better since the former could be biased if the measurement error is correlated with τ_{ij}.

2.3 Which estimate should be preferred by the reader/researcher?

The answer to this question depends on the assumptions the readers/researchers impose, which may vary across research settings, available data, and models. Here, if we believe there is measurement error using τ_{ij} to approximate d_{ij} and the measurement error is not constant across residence-workplace pairs (otherwise the measurement error cancels out in equation (34)), then the gravity-based estimates might be preferred. However, we should be cautious when accepting the gravity-based estimates because they can be biased if the measurement error is correlated with commuting time. This is likely when people choose to live closer to a location because of some features that are pair-specific.[2] If that is the case, one may prefer the GMM-based estimates because correctly specified structural equations could capture the real commuting cost that is not fully reflected in commuting time.

3 Regional Convergence

Barro and Sala-i Martin (1992) find slow rate of convergence among 48 contiguous U.S. states and rationalize the findings using the neoclassical growth model. They conclude that when diminishing return of capital sets in slowly (say, $y = Ak^{\alpha}$ and α is large), the model generates slow rate of convergence. This explanation is potentially problematic since it treats U.S. states as closed economies, whereas contiguous states are very likely to frequently trade with each other.

The model in Ventura (1997) says that in a world with trading economies, the law of diminishing returns only applies to world averages. If we look at the states in the U.S., the average capital stock might be high enough such that investment has already had a low return. For some states in the U.S., capital stock is lower than average, but the return to investment is not as high as what it would be in a closed economy neoclassical growth model. Low return to investment dampens growth rate and the rate of convergence. This explanation differs from above in that slow convergence is the result of high average capital stock instead of large α.

The model in Acemoglu and Ventura (2002) suggests that diminishing return does not occur in investments but in terms of trade. A poor country accumulates capital faster than average and increases exports as the its relative income grows. But this implies deteriorating terms of trade, which depresses further investment. Coming back to the case of 48 U.S. states, it is very likely that differences in state primitives (μ, ρ, ϕ) are much smaller than the differences across countries. Moreover, the variation in relative income across states should be smaller than the variation across countries. By equations (18) and (19), terms of trade and rates of return across states should be close to each other. Hence, slow rate of convergence might because of U.S. states are “too similar” to generate large variation in terms of trade and high returns.

Another explanation could be drawn from the innovation and growth literature, in which high growth rate for countries far from technological frontier is achieved by learning from countries at closer to the frontier. As in Buera and Oberfield (2020), less productive countries grow faster by drawing insights from more productive countries. In addition, the higher the trade cost, the more productive foreign sellers become (due to selection), the higher the

[2] Dingel and Tintelnot (2020) provide an example that a very large share of Columbia University employees reside in nearby university-owned residence.

growth rate. In light of this, it is possible that U.S. states face slow rate of convergence because they are all close to the frontier and the intranational trade costs are trivial relative to international trade costs.

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