Digressions on Factor Endowment Theory: Empirical Tests of the HO Theorem and Factor Content Approach

Anwesha Aditya
IIT Kharagpur

Testing the Pattern of Trade: Factor Content Approach

- **The HO model was generalized by Jaroslav Vanek (1968) into a theory of factor content of trade known as the HOV model**

- **The HOV model or the theory of *factor content of trade* provides the theoretical basis of empirical tests of the HO theorem by Trefler (1993), Davis and Weinstein (2001) and others**

Factor Content and the Heckscher-Ohlin-Vanek Theorem

- The HO theory was generalized by Jaroslav Vanek (1968) into a theory of *factor content of trade* known as the Heckscher-Ohlin-Vanek (HOV) theory.

- The HOV theory or the theory of *factor content of trade* provides the theoretical basis of the empirical tests of the HO theorem by Leamer (1984), Brown et al (1987), Trefler (1993), Davis and Weinstein (2001) and others.

Higher dimensions in Trade Theory cxnxm

Let there be $c = 1, 2, \ldots..C$ number of countries, and $j = 1, 2, \ldots..J$ number of final traded goods produced with $i = 1, 2, \ldots.I$ number of factors of production.

Assumptions

i. Factors cannot move from one country to the other;

ii. Each good is produced by the same technology in both the countries;

iii. Production technologies for these goods differ from each other in each country;

iv. Identical and homothetic taste

In 2x2 model if $\frac{L}{K} > \frac{L^*}{K^*}$, let $\frac{a_{L1}}{a_{K1}} > \frac{a_{L2}}{a_{K2}}$ implies HC exports good 1 and FC exports good 2.

But if we just move from 2 to 3 goods we cannot do that.

If $\frac{L}{K} > \frac{L^*}{K^*}$, but $\frac{L}{T} < \frac{L^*}{T^*}$

Jaroslav Vanek in late 1960s derive the HOV theory or *factor content of trade.*

Let us define $T^c=X^c-D^c$ as the vector of net exports of good-j.

$$T_j^C = X_j^C - D_j^C > 0 \; if \; country \; c \; exports \; jth \; good$$

$$T_j^C = X_j^C - D_j^C < 0 \; if \; country \; c \; imports \; jth \; good$$

$$T^c = \begin{matrix} T_1^c \\ .. \\ T_J^c \end{matrix}$$

Factor content gives how much labour is there in trade basket.

Step I. Define *factor content of trade which substitutes the factor intensity assumption*

Step II. Define *factor abundance criteria*

Let V_i^c be the endowment of ith factor in country C, X_j^c be the production level of the j-th good in country C.

In 2 factor model, full employment condition is: $L = a_{L1}X_1 + a_{L2}X_2$

In this generalized set up, the full employment conditions of all factors can be written as:

$$\begin{bmatrix} V_1^c \\ V_2^c \\ \\ \\ V_I^c \end{bmatrix} = \begin{bmatrix} a_{11}^c & a_{12}^c \ldots\ldots\ldots a_{1J}^c \\ a_{21}^c & a_{22}^c \ldots\ldots\ldots a_{2J}^c \\ \\ \\ a_{I1}^c & a_{I2}^c \ldots\ldots\ldots a_{IJ}^c \end{bmatrix} \begin{bmatrix} X_1^c \\ X_2^c \\ . \\ . \\ X_J^c \end{bmatrix}$$

$$\Rightarrow \qquad V^c = A^c X^c$$

$$\Rightarrow \quad Xc = \left[A^c\right]^{-1} V^c$$

$[A^c]^{-1}$ will exist if the rows and columns are independent. This will happen if the a_{ij}s are different meaning that production functions and hence isoquants are different for each good. So even if iso-costs are same, the least cost choices will be different.

Demand side

- Let preferences be homothetic and identical across countries

$\Rightarrow D^c = s^c X^W$ **Demand vector is proportional to world output vector**

$$s^c = \frac{Y^c}{Y^W}$$

where s^c is the country-c's share of world income

Now world GDP: $X^w = \sum_{c=1}^{n} x^c$

Since, $X^W = \sum_{c=1}^{C} \left[A^c\right]^{-1} V^c$

So, $D^c = s^c \sum_{c=1}^{C} \left[A^c\right]^{-1} V^c$

Factor Content

Content of each factor-i in the vector of good j is the corresponding element of the vector FC^c

$$FC^c = A^c T^c = A^c X^c - A^c D^c$$

- Factor content of trade is a measure of how much of a factor is embodied in a traded good

$$FC_i^c = \sum_{j=1}^{J} a_{ij}^c T_j^c$$

$$T_j = X_j - D_j$$

The measured content of factor i in trade FC_i^c is > 0 or < 0 if it is more intensively used in exports or in imports since by definition $Tj > 0$ *if j is* exported

Content of each factor-i in the vector of good j is the corresponding element of the vector *FC^c*

$FC^c = A^cT^c = A^cX^c - A^cD^c$

$$FC^c = V^c - A^c s^c \sum_{c=1}^{C} \left[A^c\right]^{-1} V^c$$

HO assumption: all countries share the same technology so we can take $[A^c]^{-1}$ outside the summation sign. Hence the above boils down to

$$FC^c = V^c - A^c s^c \left[A^c\right]^{-1} \sum_{c=1}^{C} V^c$$
$$= V^c - s^c V^W$$

A typical element is,

$$FC_i^c = V_i^c - s^c V_i^W$$

which is a number that measures the “net” content of factor i in all goods traded by country-c.

The factor content equation

$$FC_i^c = V_i^c - s^c V_i^W$$

This number measures the ‘net’ content of factor-i in all goods traded by country-c

If country-c is abundant in factor-i in the sense that it has a larger share of world stock of factor-i than its income share.

$$\frac{V_i^c}{V_i^W} > s^c \equiv \frac{Y^C}{Y^W}$$

Factor-i would tend to be used more intensively in exports than in imports

$\Rightarrow$ A labour abundant country implicitly exports labour

This is the Factor Content Approach or HOV Theorem

Evidence from the Literature using HOV theorem

- Leamer (1984) re-specified Leontief's test and found support for the HOV theorem using the HOV theorem and the factor content approach.

- Brown et al (1987) restimated endowments of 12 factors of production for 27 countries and found that the United States is not very capital abundant.