Decreasing Costs in International Trade and Frank Graham's Argument for Protection

Wilfred J. Ethier, 1982, *Econometrica*

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Outline

- Introduction and Motivation
- The Model
- Efficient Outcome and Autarky Equilibrium
- Free Trade Equilibrium and Allocation Curves

- Stability Analysis and Some Alternative Possibilities
- Normative Implications and Argument(s) for Protection
- Case for Increasing Costs in Wheat Production and International Differences
- Conclusion

Introduction and Motivation

- Graham(1923, QJE) argued that increasing returns to scale(IRS) could justify protection.

- Even tough central body of trade theory is based on CRS assumption, IRS is important in reality.

- **Objectives of the Paper:**
  - To examine the consequences of increasing returns.
  - How is increasing returns related to specialization?
  - Use of allocation curves instead of offer curves.

The Model

- 2 countries: home country and foreign country(or rest of the world)
- 2 commodities: Wheat and manufacture
- Single factor: Labor
- Wheat is produced under CRS technology:

$$W = L_w$$

- Manufactures are produced under IRS technology:

$$M = (L_m)^{\alpha}, \alpha > 1$$

- And we also have

$$L_m + L_w = L$$

- L denotes the total labor of the domestic country and L* denotes that of the foreign country. L and L* need not be of equal size.

- With these equations given, one can easily draw the PPF.

- **Prices in the Supply Side**
  - Wheat industry is competitive so that supply price equals the wage rate.
  - Average-cost pricing prevails in the manufacturing sector.
  - So the relative supply price of manufactures in terms of wheat is

$$P_s = \frac{P_m}{P_w} = \frac{(wL_m/M)}{w} = L_m/M = M^{1/\alpha - 1}. \quad (1)$$

  - So the supply curve has a negative slope and differentiation of (1) confirms that the curve declines at a decreasing rate.

Efficient Outcome and Autarky Equilibrium

- **Efficient Outcome**

  Proposition 1: If the world output of manufactures is large enough for the pattern of specialization to matter (i.e. larger than the capacity of the smaller country), then the efficient patterns are precisely those dictated by comparative advantage as in the usual Ricardian model.

- **Autarky Equilibrium**
  - Assume in both countries demand function is of the form

$$M : \phi(P, W + PM)$$

  - then the relative demand price P_d solves

$$M = \phi(P_d, L - M^{1/\alpha} + P_d M)$$

  - Then one can draw the demand curve and the intersection of it with supply curve gives us the autarkic equilibrium which doesn't need to be interior.(so specialization is possible)
  - One can show that the demand curve is steeper than the supply curve if and only if

$$\frac{\alpha}{\alpha - 1} > \eta \qquad (2)$$

where $\eta = -(P/M)\phi_1$

Proposition 2: If condition (2) holds, autarkic equilibrium is unique and stable.

– One can also obtain that

$$\frac{dP}{dL} = \frac{\gamma/M}{\eta - \frac{\alpha}{\alpha-1}}$$

where $\gamma = P\phi_2$. So then we get the following proposition:

Proposition 3: If both countries produce both goods in autarky and if (2) holds, the larger country will have the lower autarkic relative price of the good subject to increasing returns.

– **Remark:** From now on, the paper assumes that the aggregate demand is of the Mill-Graham type: A constant fraction γ of income is spent on manufactures.

Free Trade Equilibrium and Allocation Curves

- Suppose a small country, in the sense that it can't affect international prices, enters into free trade.Then we have the following proposition:

  Proposition 4: A small country entering into international trade will be driven to specialize in that commodity with the lower autarkic relative price. Regardless of which commodity that is, the small country will gain from free trade relative to autarky.

- **Allocation Curves**
  - Let's analyze the free trade equilibrium without the small country assumption
  - Supply prices will be determined as described above. The single world demand price P_d solves

    $$M+M^* = \phi(P_d, L-M^{1/\alpha}+P_d M)+\phi^*(P_d, L^*-M^{*1/\alpha}+P_d M^*)$$

    the solution of which yields

    $$P_d = \frac{\gamma}{1-\gamma}\frac{(L+L^*)-(L_m+L_m^*)}{L_m^\alpha + L_m^{*\alpha}}$$

– Setting $P_d = P_s$ gives the formula for the home allocation curve and setting $P_d = P_s^*$ gives the formula for the foreign allocation curve which are

$$L_m^{1-\alpha} = \frac{\gamma}{1-\gamma} \frac{(L + L^*) - (L_m + L_m^*)}{L_m^\alpha + L_m^{*\alpha}}$$

and

$$L_m^{*1-\alpha} = \frac{\gamma}{1-\gamma} \frac{(L + L^*) - (L_m + L_m^*)}{L_m^\alpha + L_m^{*\alpha}}$$

respectively.

– If $P_d > P_s$, then home country specializes to M, if $P_d < P_s$, it specializes to W.

Proposition 5: The international equilibria are given by the intersections of the two allocation curves.

Stability Analysis and Some Alternative Possibilities

- On the allocation curve demand and supply price are equal so there is no tendency for reallocation of resources

- Below the curve, the demand price exceeds the supply price so that by Marshallian adjustment process, the manufacturing sector will be expanding.

- vice-versa above the curve.

- If we write $P_d = H(L_m, L_m^*)$ and assume $H_1, H_2 < 0$ and $P_s = G(L_m)$ and $P_s^* = G^*(L_m^*)$, then the home and foreign allocation curves are solutions to

$$H(L_m, L_m^*) - G(L_m) = 0$$

$$H(L_m, L_m^*) - G^*(L_m^*) = 0$$

respectively.

- Then the Marshallian adjustment process can be represented by:

$$\widehat{L}_m = \frac{H(L_m, L_m^*)}{G(L_m)} - 1$$

$$\widehat{L}_m^* = \frac{H(L_m, L_m^*)}{G^*(L_m^*)} - 1$$

where as a linear approximation about an equilibrium $L_{m_0}, L_{m_0}^*$

$$\widehat{L}_m = \alpha_1[L_m - L_{m_0}] + \alpha_2[L_m^* - L_{m_0}^*] \quad (3)$$

$$\widehat{L}_m^* = \alpha_2^*[L_m - L_{m_0}] + \alpha_1^*[L_m^* - L_{m_0}^*] \quad (4)$$

where $\alpha_1 = (H_1 - G')/G, \quad \alpha_2 = H_2/G, \quad \alpha_2^* = H_1/G^*$,and $\alpha_1^* = (H_2 - G^{*'})/G^*$, all evaluated at equilibrium.

- Now let's define the following elasticities

$$e = -\frac{(L_m^*/L_m)}{L_m}\frac{dL_m}{d(L_m^*/L_m)} = \frac{L_m^*\alpha_2}{L_m^*\alpha_2 + L_m\alpha_1}$$

and analogously

$$e^* = \frac{L_m\alpha_2^*}{L_m\alpha_2^* + L_m^*\alpha_1^*}$$

and also define $e = -\infty$ if $L_m = 0$ and $L_m^* > 0$ AND $e = 0$ if $L_m = L$ and analogously for e^*

Proposition 6: *(Stability Theorem)*

The dynamic system (3) and (4) is unstable if e or e^* is negative for a country that is producing both goods. Otherwise, stability is equivalent to $e + e^* < 1$, the violation of the Marshall-Lerner condition.

- **Alternative Possibilities**
  - From the formulae of allocation curves one can observe that, allocation curves are independent of L and L^* individually, and depend only on $L + L^*$.

$$L_m^{1-\alpha} = \frac{\gamma}{1-\gamma}\frac{(L+L^*) - (L_m + L_m^*)}{L_m^{\alpha} + L_m^{*\alpha}}$$

  - Thus by allowing L^*/L to vary while keeping $L + L^*$ constant, one can depict all possible cases without the need for any cumbersome shifting of curves.

Proposition 7:(*Symmetry Theorem*)

Suppose that the Marshallian adjustment process applies and that condition (2) holds. Then each country has a lower relative autarky price in the good in which it has an advantage; if the two countries commence free trade from autarky they will reach an equilibrium in which each exports the good in which it has a comparative advantage and in which at least one country, and possibly both, specializes completely. The pattern of specialization will be efficient.

Normative Analysis and Argument(s) for Protection

- **The Normative Implications of Free Trade**
  - Autarkic equilibrium is not Pareto optimal in either country and any full-trade equilibrium in which one of the countries produces both goods must be inefficient in the sense that a reallocation of resources, in the diversified country, towards manufacturing could potentially make some better off while harming none.
  - Even if both countries specialize and the world equilibrium is Pareto optimal in a local sense, it need not be so globally,because of the convexity of the PPF.

Proposition 8: Suppose that the Marshallian adjustment process applies,that condition (2) holds, and that $\gamma > 1/\alpha$. Then, there exists a range of values of L^*/L for which trade is Pareto optimal and confers gains on both countries.

- **Graham's Argument for Protection Revisited**

  Propostion 9:
  The large country must be better off, relative to autarky, in the equilibrium that is attained as a result of a movement from autarky to free trade.

  Propostion 10: (*Graham*)
  Suppose $\gamma^{\alpha} > 1 - \gamma$. Then if L is sufficiently close to L^* the small country will lose from a move from autarky to free-trade,and the large country will gain. If this inequality fails, or if L is sufficiently small relative L^*, both countries must gain.

Implications:

- Greater taste for wheat (lower values of γ, render the Graham case less likely.
- The greater degree of increasing returns (α) the less likely Graham case holds.
- The smaller the small country is,relative to the larger country, the greater the likelihood that it will gain

– **Implications to Commercial Policy**

* Small Country will benefit from a tariff on manufactures; the less trade the better.(Not an infant-industry argument!)

* Small country has an incentive whether starting from autarky or free-trade to subsidize the export of manufactures. So then we will converge to an equilibrium in which small country will gain and the large lose. (This is the infant-industry argument but notice that tariff is not enough,manufactured export must be actually subsidized,at least for a while).

Case for Increasing Costs in Wheat Production and International Differences

- **Increasing Costs in Wheat Production**
  - Everything remains the same except we assume $W = L_w^\beta$ where $0 < \beta < 1$
  - Now the PPF is convex near the W-axis,and concave near the M-axis, and has a single inflection point.
  - The relative supply price is

$$P_s = \beta \frac{W}{L_w} \frac{L_m}{M} = \beta (L - L_m)^{\beta - 1} L_m^{1-\alpha} = -\alpha \frac{dW}{dM}$$

– The relative autarkic equilibrium price is

$$P = \frac{\gamma}{1-\gamma} \frac{[\beta(1-\gamma)]^{\beta}}{\gamma^{\alpha}} [\gamma + \beta(1-\gamma)]^{\alpha-\beta} L^{\beta-\alpha}$$

so that $P/P^* = (L^*/L)^{\alpha-\beta}$; the smaller country has the higher relative autarkic price of manufacture in terms of wheat.

– One can write the equations for allocation curves, which have all the earlier properties with one exception: L and L^* now influence the curves individually even tough $L + L^*$ remains unaltered.

Proposition 11: If the endowments in the two countries permit a free-trade equilibrium in which neither country specializes, the smaller country produces more manufactures in that equilibrium than does the larger.

- Stability and symmetry theorems continue to hold.

- The movement from autarky to free trade benefits the large country,which exports manufactures in a stable equilibrium, and harms the small country, which does not specialize in any stabke equilibrium .

- Thus a greater degree of increasing costs in wheat production enlarges the range of parameter values giving Graham's case

- **International Differences**
  - 3 ways in which countries can differ are examined.

1. **Differences in labor efficiency**

   $*$ The domestic wheat production function becomes $W = bL_w$, and WLOG $b < 1$

   $*$ If $L^* < L$ it is efficient to produce any wheat at home if some manufactures are being produced abroad; the two determinants of comparative advantage(L^*/L and b) reinforce each other.If $L^* > L$ they conflict.

   $*$ When L^*/L is small, the size of b is the dominant consideration for the efficient pattern of specialization.

- ∗ As L^*/L increases there will come a point, at which scale economies dominate and the efficient pattern of specialization will reverse itself
- ∗ Such a point is called *advantage reversal*
- ∗ In such a case, a move from autarky to free-trade could result in an inefficient pattern of specialization, so the symmetry theorem requires this slight qualification.

2. **Differences in the degree of increasing returns**

* Let α and α^* differ from each other.

* Assume WLOG $\alpha^* > \alpha$

* If $L^* > L$ it is inefficient for the large country to produce any wheat if the small country produces some manufactures.

* If $L^* < L$ and if the home economy is sufficient large, an *advantage reversal* will take place as in the previous section.

3. **Differences in tastes(γ)**

* Let γ and γ^* differ from each other.

* There might be the case that the larger country will have a comparative advantage in wheat (and export it in free-trade) and the smaller country in manufactures.

* This case is called by Ethier as *demand reversal*, a precise analog to the situation of that name in the Hecksher-Ohlin model

* If a demand reversal is present the pattern of specialization in free-trade could be inefficient, so this slight qualification to the symmetry theorem is again called for.

Conclusion

- 3 theorems give us the main results
- Symmetry Theorem establishes that increasing returns yield a positive analysis almost perfectly symmetric to that of familiar Ricardian Model
- Stability Theorem gives allocation curves a role in Marshallian adjustment that is just opposite to the role of offer curves in Walrasian adjustment
- Proposition 10 elucidates Graham's argument.

THANK YOU...