

# **Trade and Distribution: A Multisector Stolper-Samuelson Finger Exercise**

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## **Trade and Distribution**

One of the basic building blocks of the political economy of international trade is the Stolper-Samuelson result: the shift from no trade to free trade is good for the owners of the abundant factor of production, but bad for the owners of the scarce factor of production. This accounts for why support for free trade tends to be stronger in democratic than in authoritarian regimes. The scarce factor of production tends to be, well, scarce. Hence not many potential voters own a lot of it. Hence the political support for trade protection in any system of government that gives weight to broad as opposed to strong preferences will tend to produce trade liberalization.

In the United States, and to some degree in western Europe, things are widely thought to be different—or so the argument goes, The abundant factors of production are things like capital, organization, and technology, which have concentrated ownership. The scarce factor of production is labor. Hence free trade tends to be politically unpopular because it is not in the interest of the majority of potential voters.

This argument of an inconsistency between free trade and the well-being of the majority of potential voters rests substantially on the two-factor

example of the Stolper-Samuelson result. It does not fare too well when we generalize to a situation in which there are a number of different factors—even if the ownership of the abundant factors of production is very concentrated indeed.

## The Basic Framework

Let the price of final output  $Y$  be fixed at one, and let the quantity of final output  $Y_j$  in country  $j$  be produced from  $N$  intermediate goods  $X_{ij}$ , for  $i$  running from 1 to  $N$ , according to the production function:

$$Y = N \left( \prod_{i=1}^N X_i^{1/N} \right)$$

Let the production of intermediate good  $i$  in country  $j$  depend on that country's endowment of type- $i$  factors of production  $F$  according to:

$$X_{ij} = F_{ij}$$

And let us stack the deck as much as possible against free trade by concentrating the ownership of the abundant factor as much as possible. Let only one factor be abundant, and let  $N-1$  factors be scarce by setting the supply of each type of factors of production in each of  $N$  countries be equal to one, save for type  $j$  in each country  $j$ , for which:

$$F_{jj} = \lambda$$

## From No-Trade to Free Trade

If there is no international trade then the level of output in country  $j$  will be:

$$Y_j = N\lambda^{1/N}$$

And the returns  $r$  to each of the factor of production types will be:

$$r_{ij} = (1/N)Y_j = \lambda^{(1/N)} \text{ for } i \neq j$$

$$r_{jj} = (1/N)Y_j/\lambda = \lambda^{((1-N)/N)}$$

with the owners of each factor of production—scarce or abundant alike—earning a fraction  $1/N$  of total output.

If there is free trade, then the return  $r$  to each factor of production type will be:

$$r_{ij}^f = 1$$

And the level of total output will be:

$$Y_j^f = N - 1 + \lambda$$

with each of the scarce factors receiving a fraction  $1/(N-1+\lambda)$  of total output, and the abundant factor receiving a fraction  $\lambda/(N-1+\lambda)$  of total output. Thus in this framework only the returns to the one single abundant factor, factor  $j$  in country  $j$ , rise with free trade.

As  $N$  grows large, the returns to almost every factor of production fall: the decrease in their share of output more than offsets the increase in total output. For each of the scarce factors the fall in its fraction of income by a proportional amount  $(\lambda-1)/(N-1+\lambda)$  more than outweighs the growth of the pie by the proportional factor  $(N-1+\lambda)/(N\lambda^{(1/N)})$ .

But a household's income is unlikely to depend on returns to a "scarce" factor alone. There will be some cross-ownership. Suppose a household's endowment  $W$  is composed of some proportion of one of the scarce factors  $F_i$  and some proportion of the abundant factor  $F_j$ :

$$F_i = (1 - \phi/N)W$$

$$F_j = (\phi/N)\lambda W$$

Think of  $\phi$  as the fraction of proportionate ownership that a household holds in the initially abundant factor. Now we can ask the interesting question: How large does  $\phi$  have to be before free trade is good for that household? What fraction of proportionate ownership in the abundant factor must a household have before free trade becomes, for it, a win?

Household income under no trade is:

$$\begin{aligned}
&= r_{ij}(1 - \phi/N) + r_{ij}\lambda\phi/N \\
&= (1 - \phi/N)\lambda^{1/N} + \lambda^{1/N}\phi/N \\
&= \lambda^{1/N}
\end{aligned}$$

Household income under free trade is:

$$\begin{aligned}
&= r_{ij}^f(1 - \phi/N) + r_{ij}^f\lambda\phi/N \\
&= (1 - \phi/N) + \phi\lambda/N
\end{aligned}$$

While the net gains from trade to the economy are:

$$(\lambda - 1)/N + 1 - \lambda^{(1/N)}$$

The net gains from trade to the household are:

$$\phi(\lambda - 1)/N + 1 - \lambda^{(1/N)}$$

These gains will be positive as long as the fraction of proportionate ownership share  $\phi$  is above its critical value:

$$\phi^* > \frac{N(\lambda^{(1/N)} - 1)}{\lambda - 1}$$

If  $\lambda$  is infinitesimally close to 1, the society-wide net gains from trade are doubly infinitesimal, equal to:

$$\frac{(N-1)(\lambda-1)^2}{2N^2} - \frac{(N-1)(2N-1)(\lambda-1)^3}{6N^3} + \dots$$

and an order of magnitude smaller than the change in the returns to the scarce factors, which are equal to:

$$-\frac{(\lambda-1)}{N} + \frac{(N-1)(\lambda-1)^2}{2N^2} - \dots$$

Thus if  $\lambda$  is close to one, the critical condition on  $\phi$  is approximately:

$$\phi^* > 1 - \frac{(N-1)(\lambda-1)}{2N} + \frac{(N-1)(2N-1)(\lambda-1)^2}{6N^2} - \frac{(N-1)(2N-1)(3N-1)(\lambda-1)^3}{24N^3} + \dots$$

For  $\lambda$  very close to one, the critical  $\phi^*$  is also close to one. Trade among countries with small differences in relative proportions of the trade-relevant factors of production is good only for households that hold a greater than proportionate share of the initially abundant factor of production  $j$ —households for which  $\phi > 1$ .

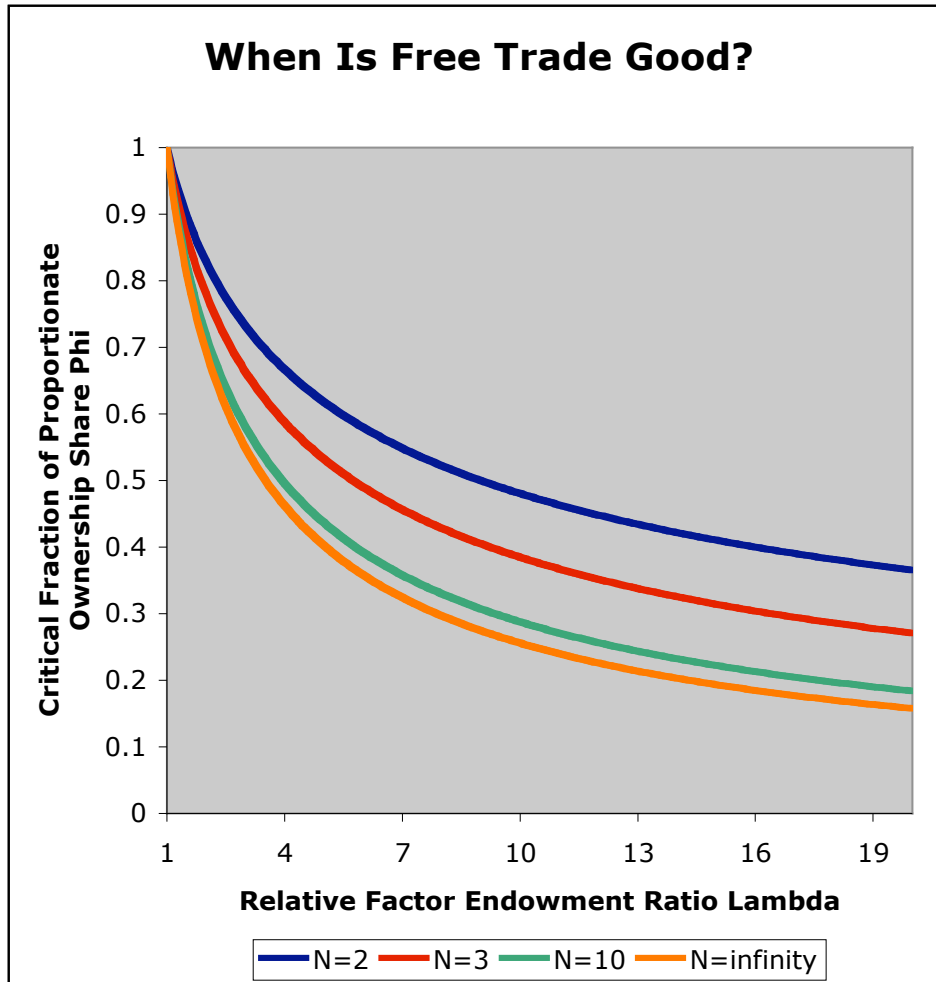
But as  $\lambda$  moves away from 1 things change. Efficiency and productivity gains grow faster than do the income redistributions from changing factor prices. Even households where the share of ownership of the initially-abundant factor is significantly less than proportionate can benefit. In the limit as  $N$  becomes large, the condition on  $\phi$  for free trade to benefit the household becomes:

$$\phi^* > \frac{\ln(\lambda)}{\lambda - 1}$$

## Discussion

The figure shows the fraction of proportionate ownership of the initially-abundant factor needed in order to make free trade win-win, as a function of the disparate relative endowment of the trade-relevant factors of production and of the number of sectors in the economy. The greater the number of sectors, the lower is the critical fraction ownership share.

If we think about trade with countries for which relative factor abundances in narrow sectors vary by perhaps 20-to-1—think of Jamaica’s bauxite or Saudi Arabia’s oil or China’s unskilled manufacturing labor productivity/real wage ratio—the large- $N$  case suggests that trade is good even for households that have as little as one-fifth a proportionate ownership share of the initially-abundant factor of production. For smaller differences in relative factor endowment intensities and for smaller numbers of sectors, the hill that free trade must climb is steeper. With three sectors and a relative factor intensity of three the household requires a two-thirds proportionate ownership share. With two sectors and a relative factor intensity of two the household requires a proportionate ownership share greater than 0.828.



These finger exercises do show that we have little reason to trust the intuition derived from the two-sector Stolper-Samuelson model. We have a world with multiple sectors and with substantial differences in factor endowment intensities. We have a world economy a fair degree of formal and informal cross-ownership—formal cross-ownership via property rights, formal cross-ownership through the financing of the government by taxes on the “scarce” factors of production, plus the informal and institutional features of the economy that create labor rent sharing, efficiency wages, monopoly power based on location, monopolistic competition, and all the other deviations from perfect competition that can give those stakeholders other than the formal equity owners an effective claim on the cash flows attributable to technology, capital, and

organization. Thus it seems a slam-dunk to presume that in the real world free trade is very likely to benefit the overwhelming majority of people in nearly every country, in spite of the intuitions generated by the two-good two-factor two-country version of Stolper-Samuelson.