

Globalization and Income Inequality

Roy J. Ruffin^{1,2}

International trade theory offers hypotheses about how globalization affects income inequality both between countries and within countries. Technology flows from rich to poor countries; differences between rich and poor are greater than differences among rich countries; and since poor countries are likely to gain more from the trade gains due to lower living costs, globalization is likely to improve global inequality. Inequality within nations has been studied by the Stolper-Samuelson theorem and it is here argued that the theorem gives an oversimplified picture.

JEL Classification: F11

Keywords: Global Inequality, Country Inequality, Trade

1. Introduction

This paper deals with the stories international trade theory tells about how globalization affects income inequality both between countries and within countries. Indeed, ever since David Ricardo discovered comparative advantage, trade theorists have been concerned about the income inequality brought about by trade or technology flows. John Stuart Mill, who invented the paradigm used by trade theorists, discussed the division of the gains from trade as well as the theorem that in free trade small countries gain more from trade than large countries (Mill, 1848). After the Heckscher-Ohlin model was formalized, Stolper and Samuelson (1941) extracted the result that trade would lower real wages in the labor-scarce country and raise real wages in the labor-abundant country.

Does trade increase income inequality (i.e., average per capita income) between countries? Does trade increase income inequality within countries? I'll call the first *global inequality* and the second *country inequality*. Clearly, it is possible for country inequality to rise while global

¹ University of Houston, Houston, TX 77204. Email: ruffin@uh.edu

²This paper was prepared for the international seminar on "Globalization, Agglomeration, and Inclusive Growth," May 21-22, 2009 at Jadavpur University, Kolkata, India. I wish to thank all of the participants of that conference without implicating them in the results.

inequality falls. There is a third category, *world citizen inequality*, say a Gini coefficient for world individual incomes ignoring countries, which, except for some brief comments, I will not discuss (see Bourguignon and Morrisson, 2002).

Global inequality in the world has diminished since about 1990 due to above-average growth rates in per capita incomes in China, India and Russia. How much of this is due to expanded trade and how much to an increase in internal efficiency is an interesting question. As a theorist I will just address the theory of when we can expect globalization to reduce or increase global inequality. Here I will simply look at the simple economics of global inequality from the standpoint of the off-the-shelf Ricardian model with and without technological diffusion. When trade results in technological diffusion from rich to poor countries, it may seem that global inequality is reduced unless one adopts a Marxian-type exploitation of the poor countries by foreign direct investment. Jones and Ruffin (2008a) show that even without exploitation global inequality may not be reduced by technology transfer, as will be explained later. Moreover, I will present a simple argument based on standard monopoly theory to show that the monopolistic extraction of profits from a poor country has ambiguous effects.

When we are speaking purely of trade liberalization, it is possible for anything to happen. But there are four stylized empirical facts (which I cannot document here, but leave to others more qualified) that indicate global inequality should be reduced: technology flows from rich to poor countries, differences between poor countries and rich countries are more pronounced than differences between the rich countries; poor countries as a whole probably export goods that are less important in their budgets relative to their imports and so conducive to greater cost of living gains (Ruffin and Dogan, 2009); and, finally, trade allows more exploitation of economies of scale and more variety.

Country inequality is a much more delicate question. Here we have the famous Stolper-Samuelson (SS) theorem that trade benefits the abundant factors and hurts the scarce factors. So if the poor countries have a relative abundance of unskilled labor, the expansion of trade should reduce country inequality for poor countries but raise such inequality for rich countries. It doesn't seem to have happened this way. So I am going to suggest some modifications that have not received sufficient investigation in the literature. The first modification is what I call the aggregation problem. We live in a multi-commodity universe. Thus, in such a setting, SS just deals with the question of what happens when *all* export prices rise by the same percentage, holding import prices constant. This is an artificial problem and seldom occurs in the real world. The second problem SS ignores is changes in the degree of competition brought about by globalization. The third problem is that SS ignores the role of intra-industry trade (Krugman, 1981). Finally, and perhaps more fundamental, is the SS theorem is based on the assumption

that all firms are identical in an industry when it is now well-known that firms which export are more productive than domestic firms (Melitz, 2003). This is where more theoretical work is required and which I have not supplied.

2. Global Inequality

The Ricardian model of international trade is a nice vehicle for studying global inequality because it simply has one factor of production that earns all of the income. The Dixit/Stiglitz/Krugman model of intra-industry trade falls into this category as well, but I will not address this question (Ruffin, 2009; Cox and Ruffin, 2010). There are two questions: What happens when technology improves in one country in a trading world? What happens when trade is liberalized?

Technology Diffusion

In a recent paper, Jones and Ruffin (2008a) exhibited the “technology transfer paradox” in which the country losing a technology to a poorer country can actually gain through trade creation. Thus, all can gain. The Jones-Ruffin theorem is based on a multi-commodity Ricardian framework of constant returns, a single productive factor (labor), free trade, and perfect competition. When an advanced country loses a technology to another country with lower wages, it gains from a lower price of the goods produced by that technology but must shift the released resources into the next best *available* activity or activities. The well-known Figure 1 tells the story before the technology is transferred but also indicates the economics of what happens after the transfer. With a finite number of goods produced under Ricardian assumptions and complete free trade there is complete specialization in all goods except perhaps a common good. Assume the home country is more efficient in all goods so the foreign/home wage ratio is $w^*/w < 1$, as shown by the horizontal dotted line. The first and highest step in Figure 1 refers to the productivity ratio of foreign to home for the foreign country’s best good; and the last step is that ratio for home’s best good. As L^*/L increases, the foreign country generally produces a larger number of goods or more of some common good and the relative wage w^*/w falls except along the flats where a good is produced in common the relative wage is constant. At point *F*, the foreign country just started to produce the common good belonging to that flat and the home country is the world supplier; as L^*/L increases some more, the foreign country moves into that good and the home country moves out; at point *H* the home country is only an incipient producer of that good. Now suppose that one of the home country’s best technologies is transferred to the foreign country when the world economy is in the vicinity of point *H*. The home country can seamlessly move resources out of its transferred technology into the common good indicated by point *H* as long as the demands are roughly the same. There is no necessity for w^*/w to change

significantly because foreign simply moves out of the production of the common good into the new good. We call a situation such as “ H ” a “turning point” and there are many of them in a multi-commodity framework. Both countries gain without any compensation paid from the foreign country to the home country because the price of the transferred good falls (in wage units) and all other prices remain the same. Surprisingly, perhaps, there is no change in global inequality because both countries gain equally since they face the same commodity prices so that w^*/w measures the ratio of real incomes as well.

Of course, it is possible for the advanced country to lose from this uncompensated transfer of technology if the advanced country has no room to expand its production of the common good and must move to an industry with a smaller productivity advantage, and so allow w^*/w to rise (increasing the cost of imports). But then global inequality must fall if we don’t take account of payments for the technology.

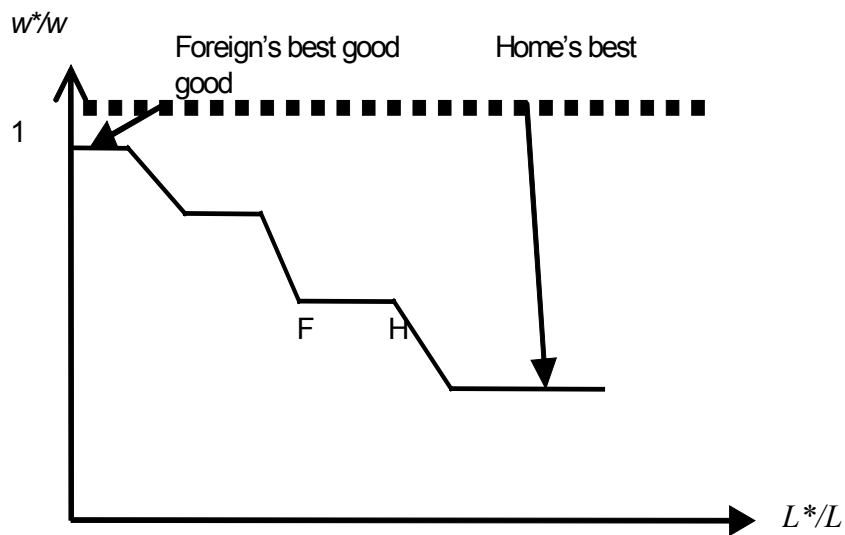


Figure 1: The Ricardian Multi-Good Model

A redistribution toward the poor country occurs only if w^*/w rises with a technology transfer. A simple two-good Ricardian example that allows a numerical calculation is useful for pointing out the importance of the advanced country’s productivity advantages (Ruffin and Jones, 2007). Suppose it costs the home country *one* unit of labor to produce *one* unit of either good 1 or good 2. It costs the foreign country $a_i^* > 1$ units of labor to produce a unit of good i , with $a_1^* > a_2^*$.

These are the direct measures of the home country's productivity advantage. Thus, the home country has an absolute advantage in both goods, but a comparative advantage in good 1. Making the simple Mill-Graham assumption that the utility function (direct and indirect) for each country is $u = (c_1c_2)^{1/2} = w/2(p_1p_2)^{1/2}$, it is easy to calculate the distribution of world income before and after the transfer of technology. Before the transfer of good 1's technology to the foreign country, let's assume both countries are specialized so that:

$$L^*/a_2^* > L > L^*/a_1^* \quad (1)$$

This assures that under the Mill-Graham assumption that

$$p_1/p_2 = L^*/La_2^* \quad (2)$$

If we now select the wage in home to be $w = 1$ and the wage in foreign to be w^* , then it must be that $p_2 = w^*a_2^* = La_2^*/L^*$ or $w^* = L/L^*$. This is obvious because with equal demands for each good in the world, both countries must have the same nominal GDP. But let us now calculate real income for home as $u = 1/2(La_2^*/L^*)^{1/2}$ while $u^* = (L/L^*)/2(La_2^*/L^*)^{1/2}$. Thus u/u^* the ratio of real income in home to foreign is simply $L^*/L > 1$.

Now suppose good 1 is produced by some blueprint that the foreign country can somehow manage to learn. For simplicity assume the foreign country, with its large labor supply, must now produce both goods 1 and good 2, and home will have to be specialized in good 2. Thus, $p_2 = 1$ because we assume $w = 1$. What about p_1 ? We need the new w^* . This is easy because foreign must produce good 2 as well so $w^*a_2^* = 1$, the cost of production in the home country; therefore, $w^* = 1/a_2^*$. Accordingly, $p_1 = w^*$ as it only takes one unit of labor to produce a unit of good 1 now. So $u^{new} = 1/2(1/a_2^*)^{1/2}$ and $u^{*new} = (1/a_2^*)/2(1/a_2^*)^{1/2}$ so that $(u/u^*)^{new}$ has dropped to $a_2^* < L^*/L = (u/u^*)^{old}$. This shows that the uncompensated technological spread of best technology unsurprisingly improves the world distribution of global real income when poor country relative wages rise and improves it more the weaker the advanced country's productivity advantage in the new goods it exports.

What the above analysis ignores of course is the real-world complexities of monopsony, oligopoly, and payments for the use of the technology. The big question then is whether the technology transfer backfires and cause the country receiving the technology to lose; no doubt there are many who think that is the case. It would be interesting to consider a situation in which the home country transfers a monopoly or oligopoly to a foreign country, pays the lower foreign wage, and repatriates the profits. With lower marginal costs one would think that the price of the product will still fall; but it may no longer be true that the foreign country gains more than the advanced country. I did not discuss this in my oligopoly paper (Ruffin, 2003), but a

straightforward combination of that work with Jones and Ruffin (2008a) is very feasible. Again, a simple example indicates that the results can be surprising. To simplify, suppose a monopolist in the home country sells only in a foreign country. If a rich-country monopolist transfers its production to a poor foreign country with lower marginal costs, profit-maximization requires price to fall for the same foreign demand and monopoly profits rise. If demand is linear and marginal costs constant, the ratio of foreign consumer surplus to monopoly profits equals one-half. If home per capita income is more than double foreign per capita income, however, the relative real income of the foreign country will increase. In general, anything can happen.

The role of the chain of comparative advantage among countries

Instead of technology transfer, now just consider the globalization of resource and technology constrained economies via the expansion of international trade through lower tariffs, quotas, and transport costs. To simplify, I'll just consider the move from autarky to free trade. It is a well-known theorem that small countries gain more for trade than large countries due to economies of scale and more expanded variety in the Dixit/Stiglitz/Krugman model of intra-industry international trade (Ruffin, 2009; Cox and Ruffin, 2010). It will also happen in a Ricardian model if poor countries have atypical comparative advantages, so that trade expansion will be associated with greater gains. This can be demonstrated with the standard world PPF curve in the Ricardian trade model with three countries. In the highly stylized Figure 2 below, AB is the PPF of the smaller rich countries (Japan, Australia), BC is the PPF of the larger rich countries (Europe, U.S.), and CD is the PPF of the poor countries. Everybody gains because the free trade

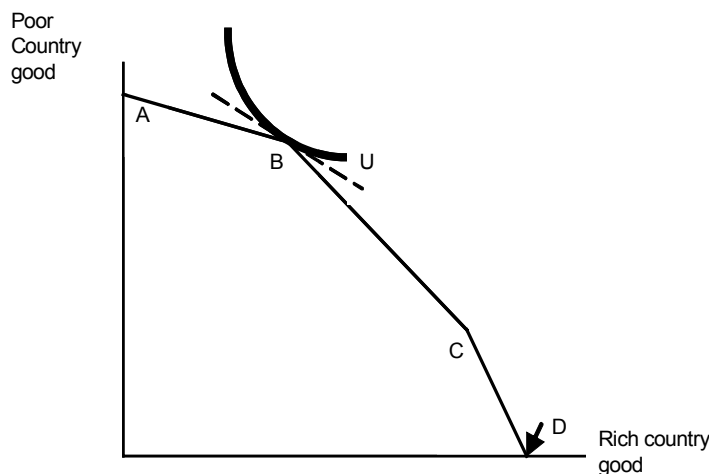


Figure 2: Three Country Trade

price ratio given by the dashed line diverges from the autarky price ratios, but the largest gains accrue to the poor countries that have an “extreme” comparative advantage compared to the homothetic world preferences indicated by indifference curve U.

The Role of Demand

A final point I want to make about international trade and the distribution of world income has to do with preferences. I now want to abstract from three countries and go back to two countries, one poor and one rich. Ruffin and Dogan (2009) recently investigated the role of demand in the gains from trade. Ruffin and Dogan established the “demand paradox” that the role of demand in determining a country’s relative income is quite different from the role of demand in determining the gains from trade. The former depends on relative demands for exports; the latter depends on the cost savings from imports and how important are the imports. The higher world demand for a country’s exports, the higher its relative income; but the gains from trade come from imports and from cost-of-living considerations it is better for imports to be more important. Here I will illustrate the related proposition that if poor countries export goods that are less important on the world stage than the goods of the rich countries, they will be more likely to gain more from trade. Notice I did not say that they would gain more but that they are more likely to gain. In other words, if you looked at a sample of liberalizing poor countries versus the rest of the world to each country, one should expect from the Ricardian perspective that some would not gain relative to the rest of the world but that there would be a larger fraction of countries that gain relatively when they export unimportant goods! This neglected point is due to the fact that the gain from trade consists of the decrease in the real cost of living that occurs with trade. If a country exports goods that are less important on the world stage, the rise in those prices relative to the prices of imported goods means that the decrease in the cost of living from international trade will be larger and, so, the gains from trade will be larger (Ruffin and Dogan, 2009).

I now want to show that as the goods exported by a country become less important, the probability that trade will improve its relative standing increases. Suppose the utility function for every country is $u = (c_1^b c_2^{1-b})$. Then if w is the wage of each unit of labor, the indirect utility function is:

$$u = b^b (1-b)^{(1-b)} w / (p_1)^b (p_2)^{1-b} \quad (3)$$

Thus, b is the fraction of country or world income devoted to good 1, which we will say is the rich country's good. Let the home or rich country have a comparative advantage in good 1 so that $a_1^*/a_1 > a_2^*/a_2$. With free trade both countries will be specialized and gain from trade if:

$$a_1^*/a_1 > w/w^* > a_2^*/a_2 \quad (4)$$

Equilibrium will prevail when $(1-b)wL = bw^*L^*$, so inserting this into (4) we get the condition for complete specialization by both countries:

$$a_1^*(1-b)/a_1b > L^*/L > a_2^*(1-b)/a_2b \quad (5)$$

Notice that preferences are just as important as relative productivity advantages in determining the gains from trade. Inequalities (4) or (5) define the set of mutual gain endowments as $M = \{L^*/L: a_1^*/a_1 > w/w^* > a_2^*/a_2\}$. Using (3) it is easy to show in autarky relative income is:

$$u_A/u_A^* = (a_1^*/a_1)^b (a_2^*/a_2)^{1-b} \quad (6)$$

With free trade, using (1) and the free trade relationship that $w^*/w = (1-b)L/bL^*$, the ratio of home real income to foreign is (since they face the same prices):

$$u_{FT}/u_{FT}^* = bL^*/(1-b)L \quad (7)$$

Now define the set $G = \{L^*/L: u_{FT}/u_{FT}^* < u_A/u_A^*\}$, i.e., the set of endowments for which liberalization improves the global distribution of income. It is a theorem that as b rises, and the demand for the poor country's good is smaller, the intersection of sets M and G gets larger. This is illustrated in Table 1 for just three values of b , 0.6, 0.5, and 0.4 with $a_1^*/a_1 = 4$ and $a_2^*/a_2 = 2$. This means paradoxically that the lower the demand for the poor country's good, given that both countries gain from trade, the greater the probability that the move from autarky to free trade will increase its real income relative to the rich country. It is not a sure fire bet because relative endowments also play a role, so that if L^*/L is too large the poor country, while it will still gain from trade, its relative income will fall. Thus, when 60% of world income is devoted to the rich country's good, and both countries gain from trade, we can expect that slightly a slightly greater than 50% chance that the poor country will gain more; but when 40% of world income is devoted to the rich country's good, there is slightly less than a 33% chance that the poor country will gain more. Note that in the model it is somewhat unfair to the poor country because if half of world income is devoted to each good, yet the poor country will only gain on the rich only 41.5% of the time. I have no intuitive explanation of this curious theoretical fact. But it is certainly true that selling goods that fewer people want is not the worst fate because the gains from trade consist of what happens to the cost of living; and if you sell something important,

your cost of living does not go down as much. The importance of being unimportant has advantages!

Table 1: When Trade raises the relative income of the poor country

$$M = \{L^*/L: a_1^*/a_1 > w/w^* > a_2^*/a_2\}; G = \{L^*/L: u_{FT}/u_{FT}^* < u_A/u_A^*\}$$

$$a_1^*/a_1=4; a_2^*/a_2=2$$

<i>b = rich country's share</i>	<i>M: L*/L range Both gain</i>	<i>G: L*/L range Foreign gains more</i>
0.6	$8/3 > L^*/L > 4/3$	$2.02 > L^*/L > 4/3$
0.5	$4 > L^*/L > 2$	$2.83 > L^*/L > 2$
0.4	$6 > L^*/L > 3$	$3.96 > L^*/L > 3$

3. Country Inequality and Trade

Now I turn to the impact of trade on internal income distribution and exclude from my analysis the role of international factor mobility.³ The primary theorem dealing with the impact of trade on the internal distribution of income has of course to do with the issues raised by the Stolper-Samuelson theorem that abundant factors gain from trade, and scarce factors lose. Commonsense would tell us that since the poor countries are abundant in unskilled labor compared to the rich countries, trade should improve the internal distribution of income in the poor countries and worsen it in the rich countries. However, there are several points that I want to make about Stolper-Samuelson that are commonly not made.

The first and most basic problem with Stolper-Samuelson is that it deals with 2 goods and 2 factors. What if you had many more goods than factors? In this situation it is no longer obvious that trade will have such a clear-cut impact on the internal distribution of income for the simple reason that as trade is liberalized, all export prices will not rise proportionately and all import prices will not fall at the same time. Dogan (2008) estimates a specific factors model with two mobile factors—skilled and unskilled labor--and 40-some sectors of the U.S. economy. Here is

³ The impact of factor mobility is best studied in a specific factors model or any model with more factors than goods. Ruffin (1981) shows that any Heckscher-Ohlin style model with 3 factors and 2 goods is similar to the specific factors model in the analysis of factor mobility.

the theoretical model expressed along the lines of Ron Jones' version of the specific factors model (Jones, 1971):⁴

$$\begin{bmatrix}
 -\sigma_{sk} & 0 & \sigma_{sk}^1 \lambda_{s1} & \sigma_{sk}^2 \lambda_{s2} & \dots & \sigma_{sk}^N \lambda_{sN} \\
 0 & -\sigma_{uk} & \sigma_{uk}^1 \lambda_{u1} & \sigma_{uk}^2 \lambda_{u2} & \dots & \sigma_{uk}^N \lambda_{uN} \\
 \theta_{s1} & \theta_{u1} & \theta_{k1} & 0 & \dots & 0 \\
 \theta_{s2} & \theta_{u2} & 0 & \theta_{k2} & \dots & 0 \\
 \vdots & \vdots & \vdots & \vdots & \dots & \vdots \\
 \theta_{sN} & \theta_{uN} & 0 & 0 & \dots & \theta_{kN}
 \end{bmatrix}
 \begin{bmatrix}
 \hat{w}_s \\
 \hat{w}_u \\
 \hat{r}_1 \\
 \hat{r}_2 \\
 \vdots \\
 \hat{r}_N
 \end{bmatrix}
 =
 \begin{bmatrix}
 \hat{S} \\
 \hat{U} \\
 \hat{P}_1 \\
 \hat{P}_2 \\
 \vdots \\
 \hat{P}_N
 \end{bmatrix}$$

The first two are the equations of motion of the full employment conditions for skilled (S) and unskilled labor (U), where the ^'s signify proportionate changes; the last N equations represent the competitive pricing motion equations (r_i of course is the return to the specific factor in the i th sector). The parameters are elasticities of substitution (the σ 's), cost shares (the θ 's), and factor shares (the λ 's). For example, σ_{sk} is industry-weighted the elasticity of substitution between capital and skilled labor across all industries. By estimating the production functions for each industry, one can then solve for all the elasticities. Dogan finds that if the prices of each the skill-intensive good rises by 1 %, the return to skilled labor rises by more than 1%, just as in S-S. But this is just the point: in practice all prices don't rise by the same percentage when trade is opened, and some prices undoubtedly fall. I believe there is a serious aggregation problem that has not been sufficiently investigated. Table 2 is a partial copy of some of the results: the first column shows the percentage impact of a 1% change in the price of the products of the industry on skilled wages, the second on unskilled wages; and the last column shows whether the industry is skill-intensive or unskilled-intensive. Generally, as expected, the individual effects are very small and sometimes the reverse of expectations (as in the Electrical equipment industry).

⁴ See Ruffin and Jones (1977) and Jones and Ruffin (2008b) for an extensive analysis of the impact of trade on the real income of a single mobile factor. Ruffin (2001) examines a model with Heckscher-Ohlin and specific factors properties and includes skilled and unskilled labor as well as capital

Table 2: The Impact of Prices on Skilled and Unskilled Wages

<i>INDUSTRY</i>	\hat{w}_s/\hat{P}_i	\hat{w}_u/\hat{P}_i	$\frac{(\hat{w}_s - \hat{w}_u)}{\hat{P}_i}$	λ_s/λ_u
Plastics and rubber products	-0.171	0.045	-0.216	0.48
Wood products	-0.039	0.019	-0.058	0.29
Furniture and related products	-0.059	0.026	-0.085	0.32
Primary metals	-0.122	0.056	-0.177	0.48
Fabricated metal products	-0.298	0.068	-0.366	0.46
Machinery	0.097	0.072	0.025	0.97
Electrical equipment, appliances and components	-0.273	0.033	-0.306	1.10
Motor vehicles, bodies and trailers	0.014	0.047	-0.033	0.79
Miscellaneous manufacturing	-0.046	0.012	-0.057	0.60
Railroad transportation	-0.005	0.013	-0.018	0.42
Transit and ground passenger transportation	-0.030	0.010	-0.040	0.47
Warehousing and storage	-0.263	0.087	-0.350	0.38
Water transportation	-0.034	0.010	-0.044	0.80
Air transportation	0.007	0.030	-0.023	1.29
Other transportation and support activities	0.016	0.006	0.009	1.43
Broadcasting and telecommunications	0.005	-0.002	0.006	2.64
Wholesale trade*	0.496	0.073	0.424	1.07
Retail trade*	0.009	0.393	-0.384	0.47
Federal Reserve banks	0.083	0.027	0.056	1.38
Securities, commodity contracts, investments	0.129	-0.015	0.144	5.05
Real estate	0.010	0.007	0.003	1.42
Accommodation and food services*	-0.116	0.025	-0.141	0.50
Management of companies and enterprises*	0.027	-0.055	0.081	1.53
Motion picture, sound recording industries	-0.011	0.004	-0.015	1.52
Arts, entertainment, and recreation*	-0.005	0.021	-0.026	0.70
Health care and social assistance*	1.034	-0.137	1.171	1.64
Legal services	0.085	-0.024	0.109	5.18

Source: Dogan (2008)

The second problem with Stolper-Samuelson is that it assumes prices equal average costs. If there is a price markup, as there would be with market imperfections of some sort, then when trade is opened the markups themselves should fall as there is added competition. This tends to

raise the returns to all factors as there is a smaller amount going to profits or quasi-rents. If liberalization results in greater payments to all factors of production other than profits, then it is theoretically possible for trade to have beneficial effects on labor. In a recent paper (Ruffin, 2003), I argued that in an oligopoly situation with a single factor of production as in Ricardo, the existence of oligopoly profits means that it is always the case that trade benefits that single factor of production in both countries, so the Stolper-Samuelson theorem that trade benefits labor in one country and hurts labor in the other country no longer holds. The reason for this is that under oligopoly, the gains from trade come from both lower import prices and lower export prices due to the added competition (all prices of course measured in units of labor).

The third problem is that of intra-industry trade combined with the Heckscher-Ohlin model also attenuates the Stolper-Samuelson theorem. Paul Krugman's paper on intra-industry trade had two types of labor that were immobile between two monopolistically competitive industries (Krugman, 1981). It does not seem to be well known but he showed that it was possible for the both factors to gain as international trade expands variety in each sector, one of which is a net exporter and the other of which is a net importer. Therefore, the Stolper-Samuelson theorem again need not hold.

The above problems with Stolper-Samuelson suggest that trade may not cause much change in income inequality. Lest I be accused of being a Pollyanna, the fourth and final possibility is that perhaps more international trade always causes the internal distribution of income to deteriorate in most countries. Why? Today, we know a lot more about the microeconomics of trade. And what has been discovered recently is that the firms that export are more productive than the firms that don't export (e. g., Melitz, 2003). So when trade is liberalized, the returns to the firms and factors that work in the more productive sectors will increase relative to other returns. It would be interesting to flesh out the income distribution issue in such models by dropping the Melitz assumption of a Ricardian-type production structure with a single factor of production.

In conclusion, I am optimistic that trade liberalization will promote less global inequality, because the stars seemed to be aligned for trade to benefit poor countries more than rich countries. Country inequality should rise in rich countries and fall in poor countries on Stolper-Samuelson grounds, but this is suspect because of aggregation problems and the rise of intra-industry trade. Moreover, the inequalities of individual incomes may rise because the global scope of exporting and importing may be relatively intensive in more skilled managers and employees than purely domestic activities.

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