International Trade and the Rise in Earnings Inequality

By GARY BURTLESS
The Brookings Institution

I gratefully acknowledge the helpful comments of Henry Aaron, Barry Bosworth, William Dickens, Lawrence Katz, Robert Z. Lawrence, and Adrian Wood on an earlier version of this review.

Free trade is one of the most cherished goals of American economists. The theory of comparative advantage, taught in every introductory economics course, is regarded as a triumph of scientific reason and a compelling argument to reduce legal barriers to international trade. When making the case for adopting the Uruguay round of GATT, officials in the Clinton Administration claimed that trade liberalization under the new treaty would add $5 trillion to world output over the course of a decade. According to calculations by Administration economists, the United States is one of the main beneficiaries of the treaty.

Liberalized trade can confer important benefits on a nation's economy but still reduce the incomes of selected producers. As U.S. trade restrictions have been eased over the postwar period, numerous industries have sought tariff and quota protection to keep producer profits and wages higher than they would be under a regime of unrestricted free trade. Although petitions for protection are often successful, most authorities on international trade believe that tariffs, quotas, and other legal impediments to trade have fallen over time, not only in the United States but throughout the world. World Bank tabulations show that tariff barriers on manufactured goods entering developed countries fell from an average of 40 percent in the late 1940s to less than seven percent by the late 1970s (Wood 1994, p. 173). At the same time, falling transportation and communication costs have reduced the natural barriers to trade. Producers of tradable goods and services in most of the world’s economies are now exposed to greater competition from foreign producers than they have been anytime since the Second World War or indeed anytime in their history.

Even if most economists agree that free trade improves efficiency and raises aggregate welfare, they are divided on the level and distribution of losses suffered by producers who are harmed when trade barriers fall. Three books published in 1994 illustrate the range of disagreement among economists studying this issue. Two of the three essays in Bhagwati and Koster’s new book, Trade and Wages: Leveling Wages Down?, conclude that international trade has played at most a
minor role in pushing down the relative wages of less-skilled U.S. workers. The authors of these essays argue that rising earnings inequality in the United States and other industrialized countries is mainly the result of technological change rather than pressure on unskilled workers’ wages from foreign competition. In contrast, two of the empirical papers in Bergstrand et al.’s *The Changing Distribution of Income in an Open U.S. Economy* imply that increased imports of manufacturing durables is one of the main factors explaining the sharp rise in U.S. earnings inequality after 1979. George Borjas and Valerie Ramey state flatly that “foreign competition in highly concentrated industries can account for much of the trend in wage inequality from 1963 to 1988” (Borjas and Ramey 1994, p. 237). Lynn Karoly and Jacob Klerman are more cautious in drawing a conclusion, but their empirical estimates have a similar implication (Karoly and Klerman 1994). Adrian Wood, in his ambitious new book *North-South Trade, Employment, and Inequality*, argues that the growth of manufacturing exports from newly industrializing economies can explain not only the rise in earnings inequality throughout the industrialized world but also the trend toward higher joblessness in Western Europe and North America.

Most economists who have written about the impact of trade on U.S. wages remain skeptical that lower trade barriers or shocks originating from trade can explain a large part of the decline in the relative wages earned by less-skilled workers. Paul Krugman and Lawrence point out, for example, that imports other than oil from low-wage countries were equivalent to just 2.8 percent of U.S. GDP in 1990. Trade with poor countries was only slightly less important 30 years earlier, when nonpetroleum U.S. imports from low-wage countries represented 2.2 percent of GDP (Krugman and Lawrence 1994, p. 49). John Bound and George Johnson (1992), Lawrence and Matthew Slaughter (1993), and Jeffrey Sachs and Howard Shatz (1994) conclude that trade has played a very small role in the trend toward increased earnings inequality. Kevin M. Murphy and Finis Welch (1991) and Borjas, Richard Freeman, and Katz (1992) find evidence that the effect of trade on the earnings distribution was probably somewhat larger, especially between 1981 and 1986. But by the standards of most previous research, the new studies by Borjas and Ramey (1994) and Wood (1994) offer some of the largest estimates so far of the impact of trade on the distribution of earned incomes in wealthy countries.

The remainder of this review is organized around four questions raised by the new literature on trade and the distribution of earnings. First, what is the nature of the wage developments the new books have attempted to explain? Second, is it plausible that developments in international trade can have a major influence on the distribution of earnings in a large, rich economy? What theory of trade or of the determination of wages would suggest this is a realistic possibility? Analysts approach this question from a variety of starting points, so it is hardly surprising if their research yields conflicting results. Third, what kind of evidence would support the hypothesis that wage trends have been strongly influenced by trade? Can available evidence distinguish between the hypothesis of large trade effects and alternative hypotheses that explain the same shift in the earnings distribution? Do the estimation methods produce believable results? Finally, what are the implications of this new literature for public policy? Should policy decisions relating to trade or wage inequality depend on the estimated impact of trade on wages? Only one of the books under review, by Wood, attempts to answer the last question in a systematic way, but its conclusions are relevant for all three books. Many policies aimed at ameliorating the trend toward greater inequality may be effective whether the trend in wages is mainly due to trade developments, as argued by a minority of economists, or to trends in the technology, as most studies seem to suggest.

1. **Trends in Relative Earnings**

For two decades the U.S. labor market has been characterized by anemic productivity growth and rising inequality in the distribution of wages. Productivity growth began to fall in the late 1960s, slowed to a crawl by the
late 1970s, and then recovered modestly in the 1980s and 1990s. The productivity slowdown had a dramatic and immediate effect on the growth in average worker compensation and wages. Between 1947 and 1973 output per hour grew about 2.5 percent a year and average hourly compensation rose 2.7 percent a year. Annual productivity growth plunged 1.6 percentage points after 1973, falling to just 0.9 percent. The rate of improvement in hourly compensation fell even further to just 0.4 percent a year. Trends in earnings inequality are equally depressing. After a period of relative stability in the 1960s, earnings inequality among men increased gradually during the 1970s and surged in the 1980s. Because inequality grew during a period in which median male earnings was stagnant or declining, men with low earnings have suffered sharp declines in compensation and wages. In fact, men in the bottom 20 percent of the weekly wage distribution earned less in 1988 than similar men earned a quarter of century earlier (Kosters 1994, p. 8). Earnings inequality among women did not begin to rise until the 1980s, and it has risen more slowly than it has among men. Women’s earnings have climbed faster—or declined more gradually—than men’s earnings since the late 1970s.

Kosters’ opening essay in *Trade and Wages: Leveling Wages Down?* offers a compact and useful survey of the main developments of the past 30 years.1

The most widely publicized development was, of course, the sharp slowdown in U.S. wage growth after 1973, but the primary focus of Kosters’ essay is the rapid growth in wage disparities, particularly after 1979. In 1963, the weekly wage received by a man in the 90th percentile of the earnings distribution was about 2.91 times the wage of a male at the 10th percentile of the distribution. This ratio rose to 3.00 by 1969, to 3.47 by 1979, and to 4.42 by 1989 (Kosters 1994, p. 12). Kosters distinguishes three main components of the growth in weekly earnings inequality: (1) rising wage premiums for workers with more advanced schooling; (2) faster growth in earnings as workers age; and (3) increased inequality among workers who have similar or identical levels of measured skill. The dominant factors that pushed up male earnings inequality in the 1970s were factors 2 and 3. The premium for additional schooling actually fell moderately through most of the 1970s, especially among younger men. In the 1980s, all three factors tended to boost male earnings inequality, and they pushed up female inequality as well.

Many analysts, including Kosters, interpret the growth in earned income inequality as equivalent to a rise in skill premiums and an increase in economic returns to skills. This interpretation is uncontroversial in the case of the bigger wage differentials for extra education, occupational skill, and work experience. Also, the growth in earnings inequality among men who have identical levels of schooling and job experience could signal an increase in the payoff to unmeasured skill among these men. On the other hand, it could signal a spurt in inequality related to factors that have no connection to the unmeasured skills of the workers involved. Interpreting the growth in the residual variance of earnings is a matter of some consequence. Based on tabulations reported by Chinhui Juhn, Murphy, and Pierce (1993), Kosters shows that more than half of the rise in male inequality between 1963 and 1989 is attributable to the growth in the unexplained variance of earnings. Only about a third is accounted for by growing disparities between identifiable groups, such as workers with a high school diploma and those with a college degree (Kosters 1994, pp. 12–14).

Kosters also provides a helpful summary of evidence about earnings inequality in other OECD countries. As in the United States, the college earnings premium in many rich industrialized economies shrank during the 1970s but then rose at least moderately in the 1980s. The wage differential for additional work experience rose during the 1980s in nearly all OECD countries. Unlike the

---

United States, most rich countries saw a decline or no change in overall earnings inequality during the 1970s. Like the United States, many rich countries saw an increase in earnings inequality in the 1980s, but the increase was typically far smaller than it was in the U.S. As Kosters points out, employment growth generally has been much less robust outside the United States than it has been in this country.

Kosters ends his essay with a brief evaluation of the leading explanations for increased inequality. His discussion focuses mainly on developments in the United States. Along with most other economists who have examined the evidence, Kosters concludes that changes in the composition of labor supply can explain some of the trends in relative wages, especially during the 1970s, but little of the overall trend after 1981. Other plausible explanations for the trend include changes in the structure of industrial demand for workers, changes in wage setting institutions (such as minimum wages and unions), industrial deregulation, innovations in technology, and developments in international trade. Kosters does not believe the first three sources of inequality are very important, but he suggests that changes in technology could be a major source of extra inequality. Unfortunately, the statistical evidence about this factor is indirect and not very satisfying. Kosters withholds judgment on the importance of trade in explaining the growth in inequality.

Kosters’ paper offers a reasonably comprehensive summary of wage developments that may have been influenced by trade, but most analysts concentrate on just one or two of the main developments. Borjas, Freeman, and Katz (1992), for example, focus on the relative pay difference between college graduates and high school graduates and on the pay difference between high school dropouts and all workers who have completed high school. Borjas and Ramey (1994) look at similar measures of inequality—the relative wage differential between men with a college diploma and those who are high school dropouts and the differential between male college graduates and male high school graduates. In contrast, Karoly and Klerman (1994) try to explain the trend in a more inclusive measure of inequality, namely, the variance of the logarithm of hourly wages. Because overall male wage inequality edged up in the 1970s while the college pay premium shrank, Karoly and Klerman are attempting to explain movements in different indicators of inequality from those examined by Borjas, Freeman, and Katz (1992) and Borjas and Ramey (1994). Recent papers by Lawrence and Slaughter (1993) and Sachs and Shatz (1994) focus on comparative trends among people classified as “production” and “nonproduction” workers, where production workers are assumed to be less skilled than nonproduction workers.

Wood (1994) is the most ambitious in attempting to explain recent labor market developments. He examines trends in a wide variety of countries, including those in the developing world, and he attempts to explain movements in the largest number of variables, including college pay premiums, the premium for extra work experience, overall income and earnings inequality, and trends in unemployment and labor force participation among workers in different skill classes.

2. Theories of Trade and Wages

The most commonly invoked theory to explain the link between trade and wages is the Heckscher-Ohlin model of international trade. This model explains the pattern of international trade by reference to the relative abundance of factors of production among trading partners. The model predicts that between two countries, A and B, which share the same technology, country A will export commodities that are produced with relatively more of the factor of production that is relatively abundant in country A and will import commodities produced with relatively more of the factor of production that is relatively abundant in country B. Two theorems derived from the Heckscher-Ohlin model, the factor price equalization theorem and the Stolper-Samuelson theorem, deal explicitly with the effect of trade on wages, land rents, and other factor prices.

The factor price equalization theorem, proved by Paul Samuelson in a pair of celebrated articles, asserts that under the as-
assumptions of the Heckscher-Ohlin model and a regime of unrestricted free trade, prices of the factors of production will be equalized among trading partners (Samuelson 1948 and 1949). That is, if the assumptions of the model hold, free trade between the United States and Mexico will equalize U.S. and Mexican wages for equivalent labor and will equalize rents for a standardized unit of land, even if the factors of production cannot move across the Rio Grande. If one accepts the assumptions of the theorem, the North American Free Trade Agreement represents good news for most Mexican workers and bad news for U.S. workers whose skills are equivalent to those of average workers in Mexico. Because Mexican workers' skills are probably equivalent to those of a less-skilled U.S. worker, factor price equalization will require that less-skilled U.S. workers accept a reduction in their real wage when NAFTA is fully implemented.\(^2\)

The Stolper-Samuelson theorem asserts that an increase in the domestic price of a commodity, brought about by a higher tariff or additional protection, will raise the real price of the factor of production that is used relatively intensively in producing that commodity (Stolper and Samuelson 1941). If watches are produced using labor intensively and land sparingly, whereas wheat is produced using land intensively and labor sparingly, then an increase in tariff protection for watches will boost the real wage received by laborers. By implication, a reduction in the protection of watches will lower the real wage. Accepting for a moment the assumptions of the theorem, a reduction in protection of apparel and footwear, which use less-skilled labor relatively intensively, will tend to reduce the real wage received by less-skilled U.S. workers.

Although the Heckscher-Ohlin model frequently is invoked to explain the effect of trade on wages, it is mentioned much more often by trade economists than it is by labor economists. The model occupies center stage in the essays by Bhagwati and Vivek Dehejia (1994) and Alan Deardorff and Dalia Hakura (1994) in *Trade and Wages*; it is not mentioned at all in the essay by Kosters (1994) in the same volume. Wood (1994, pp. 27–61) devotes a lengthy chapter to explaining a variant of the Heckscher-Ohlin model that permits him to analyze rising exports of manufactures from developing countries. Labor economists Borjas and Ramey (1994) mention Heckscher-Ohlin theory in passing but then dismiss it as a useful model for explaining recent wage developments. Karoly and Klerman (1994) do not mention the Heckscher-Ohlin model at all. Both Lawrence and Slaughter (1993) and Sachs and Shatz (1994) emphasize the theoretical implications of the Heckscher-Ohlin model. Murphy and Welch (1991) make no mention of the model, and Borjas, Freeman, and Katz (1992) mention it only briefly.

Although trade economists are confident of the implications of the Heckscher-Ohlin model (given its assumptions), they are not very confident that its assumptions are true. One goal of Bhagwati and Dehejia's (1994) essay is to call several crucial assumptions into question. The authors ridicule the assumption that the identical technology is available in rich and poor countries, and they are skeptical of the hypothesis of constant returns to scale, which is essential to some of the model's predictions. They take seriously the possibility of "factor intensity reversal."\(^3\)

The conclusions of the model also depend on

\(^2\)Samuelson proved the factor price equalization theorem with a model in which exactly two commodities are produced with two factors of production. However, the result is also valid under appropriate assumptions for additional commodities and factors of production so long as the number of commodities exceeds the number of factors of production. My discussion of Mexican-U.S. trade assumes the existence of at least two factors of production—skilled and unskilled labor—and a number of freely traded commodities that is no less than the number of factors of production.

\(^3\)Factor intensity reversal occurs among two countries sharing the same production technology when, for example, one country produces a commodity using a relatively labor intensive technique whereas the other country produces the same commodity using a relatively land intensive technique. Factor intensity reversal is ruled out by assumption in the Heckscher-Ohlin model, though Bhagwati and Dehejia believe it is a "distinct possibility" (p. 43).
the assumption that trading partners will not completely specialize in the production of some of the traded commodities, an assumption that is a poor approximation to reality in many cases.

Although Bhagwati and Dehejia believe that changes in production technology offer the simplest explanation for growing inequality, they sketch out an alternative trade-based model to explain the phenomenon. They note that increased integration and convergence of technology among OECD countries has brought many industries within the grasp of most or all of the rich trading partners. Small movements in costs can then cause rapid and erratic shifts in comparative advantage, leading to employment instability, rapid job turnover, and lower accumulation of on-the-job skills. Though educated and less educated workers are both affected by the slowdown in skill acquisition, educated workers are hurt less because their skills are more easily transferred out of industries suffering a loss in comparative advantage. Consequently, high school dropouts suffer larger earnings losses than workers with college degrees. Bhagwati and Dehejia offer little direct evidence to support this model, but they suggest that improved information about shifts in the job tenure distribution, by skill category, would be helpful in determining whether it can help explain the trend in relative earnings.

Wood (1994) also rejects some of the assumptions of the classical Heckscher-Ohlin model, leading him to reject one of its important implications, the factor price equalization theorem. In Wood's model, free trade between high-wage countries (the North) and low-wage countries (the South) leads to a tendency toward relative factor price convergence rather than to absolute factor price equalization. Wood distinguishes three factors of production, uneducated labor, labor which has received a basic education, and highly skilled labor. The South is richly endowed with uneducated labor, as well as a growing supply of workers who have a basic education. It is poorly endowed with highly skilled labor. The North is richly endowed with highly skilled labor, but it has a relatively smaller endowment of workers with basic education and almost no workers who are totally uneducated. Because the variation in factor endowments is large relative to the variation of factor intensities among goods, the North produces some goods which are not produced in the South, and vice versa, invalidating one of the assumptions of the Heckscher-Ohlin model, which assumes that both North and South will produce all commodities. For that reason, as well as the existence of transport costs, the factor price equalization theorem fails.

Wood argues that both North and South have access to the same capital at the same rental price, because most kinds of capital are freely mobile across international frontiers. North and South also have access to the same technology, at least to the extent that technology can be embodied in traded capital and intermediate goods. If technology is proprietary, firms from the North simply build plants in the South to take advantage of favorable factor prices in that region. The South's apparent backwardness in technology arises as a result of its workers' lack of skill. As these skills are improved through the expansion of basic education, developing countries can begin to produce manufactured goods whose production requires a relative abundance of workers with basic education. Newly industrializing countries then increase their production of such goods, reversing the flow of these commodities in North-South trade. Manufacturing in the North becomes even more specialized in the production of goods that are relatively intensive in the use of highly skilled labor.

Though both North and South benefit from this trade, workers with only a basic education in the North may suffer. The tendency toward relative factor price convergence will raise the relative wages of workers with a basic education in the South but reduce them in the North. By contrast, the relative wage of highly skilled workers will fall in the South but rise in the North. If union bargaining power or social institutions prevent the relative wages of less-skilled workers from adjusting in the North, unemployment will grow, especially among the less skilled. In essence, Wood attributes the decline in the relative wages of less-skilled Northern workers to two trade-related phenomena: the elimination of
manufacturing trade barriers and increasing relative abundance of workers who have a basic education in the South. His model rests firmly on insights derived from classical Heckscher-Ohlin theory.

Labor economists who examine the effects of trade on earnings patterns rarely base their analysis on the Heckscher-Ohlin framework. Some do not describe any clear theoretical framework at all. The paper by Borjas and Ramey (1994) is the most explicit of the labor economics studies in describing a model in which a shock originating in foreign trade can affect the overall earnings distribution. The authors focus on wage developments in the United States. They observe that most U.S. workers in manufacturing have not obtained any schooling beyond high school. Workers in highly concentrated manufacturing industries receive substantial wage premiums as a result of the large rents earned in these industries, which are divided between workers and owners. When foreign firms develop the technology and capital to enter the favored industries, foreign competition will erode the rents formerly enjoyed by U.S. producers. As it happens, much of the increase in net U.S. imports after 1979 occurred in durable manufacturing industries, which are heavily concentrated. Increased net imports eliminated U.S. employment opportunities in these industries and reduced the wage premium received by the workers who remained. Workers who were forced out of the favored industries sought employment in other industries, where they pushed down the equilibrium wage received by similarly skilled workers. The shifts in the wage distribution inflicted particular harm on less educated workers because, by assumption, most workers in the durable goods industries had less education than average.4

Borjas and Ramey’s model rests explicitly on partial equilibrium analysis. Unlike the Heckscher-Ohlin model, it does not attempt to explain the determination of factor and commodity prices among trading partners within a general equilibrium framework. The effect of trade developments on the earnings distribution is almost accidental. If American trading partners had developed the capacity to export goods produced by highly competitive U.S. industries or industries that employ large proportions of highly educated workers, the effect of the trade innovation on American wages would have been quite different. Although Murphy and Welch (1991), Borjas, Freeman, and Katz (1992), and Karoly and Klerman (1994) are not explicit in laying out a model of trade and wages, their views on this one point seem generally similar to the one just described. The effects of trade developments on wages depend on the specific character of the U.S. industries facing increased competition. These labor economists offer no explanation for the industries that are affected or for the relative magnitude of the net change in imports across industries. They accept these patterns as given and trace out their influence on the distribution of employment across industries or on the pattern of wage rates across skill classes. It is hardly surprising that trade economists, who tend to favor general equilibrium models, show some exasperation with this viewpoint.

3. Evidence

Trade and labor economists have used a variety of approaches to detect the influence of international trade on the distribution of earnings. Deardorff and Hakura (1994) offer a helpful survey of some common approaches as well as a shrewd critique of the methods favored by labor economists. One goal of their paper, implied by its title, is to define precisely some interesting questions about trade and to describe the questions analysts have actually attempted to answer. The paper bears close reading by any economist setting out to estimate the relationship between trade and wages. As the authors point out, in standard trade models it is just as accurate to say that international trade occurs as a result of wage (and other cost) differences as it is to say that trade affects wage patterns within in-

---

4 This assumption appears to be untrue. Concentrated industries, which pay above-average wages for an equivalent level of measured skill, attract workers with above-average educational attainment. However, the conclusions of Borjas and Ramey’s model could still be correct if those industries offered larger rents to less-skilled workers than to more-skilled workers.
individual countries. Deardorff and Hakura stress the importance of weighing carefully the comparison that empirical economists make when they attempt to measure the influence of trade on wages.

A comparison that Deardorff and Hakura find meaningful is the one between the distributions of earned incomes before and after a trade barrier is removed. The difference between these two distributions may be difficult or impossible to measure, but the interpretation of the difference is reasonably clear. Analysts might also legitimately seek to determine how changes in economic conditions in country B have influenced the distribution of wages in country A, through the channel of trade. Even though trade barriers between the two countries might remain unchanged, actual trade flows can vary widely as a result of developments in either or both countries. Without the link provided by international trade, developments in country B would almost certainly have a smaller (and possibly zero) influence on the distribution of earnings in country A. Thus, it is reasonable to ask how the earnings distribution in country A has changed as a result of developments in country B, although a basis for comparison is still needed.

The implicit basis for comparison selected by many analysts is not very satisfying, according to Deardorff and Hakura. Analysts often have in mind a comparison in which volumes of trade, perhaps as a share of national income or industrial output, remain fixed at some baseline level. No policy is specified to achieve this state of affairs, yet different policies—new tariffs, quotas, a contraction in aggregate demand—that produce constant trade volumes could produce different effects on the distribution of earnings in country A. Moreover, the effects of these policies might differ depending on the nature of the development in country B that has caused trade volumes to rise. This point is even more compelling if trade volumes increase because of a development in country A rather than country B. It might be reasonable to ask how this development has influenced wages in country A compared with a situation in which trade volumes are not permitted to rise. However, the answer to this question will depend on the nature of the domestic shock that has caused trade volumes to rise as well as the exact content of any policy enacted to prevent trade volumes from increasing above the baseline level. Even if the domestic shock is described with some care and the policy alternative specified clearly, many observers would challenge the interpretation that the shift in country A’s wage distribution has been “caused” by international trade. If the reason for growing imports into country A is an increase in aggregate domestic demand, for example, it is not obvious that the resulting shift in country A’s earnings distribution should be attributed to foreign trade, even though the availability of foreign products has affected the real wage response to the surge in domestic demand.

Studies of the factor content of trade. Many economists have sought to understand the effects of trade by measuring the factor content of imports and exports, a method that comes under criticism from Deardorff and Hakura and other trade economists. (See also Bhagwati and Dehejia 1994; Lawrence and Slaughter 1993; and Sachs and Shatz 1994.) The idea behind factor-content-of-trade calculations seems straightforward when applied to relative wages. The analyst estimates the amount of skilled and unskilled labor that is embodied in a nation’s exports and then estimates the amount of skilled and unskilled labor that would be needed to produce domestically the goods that are imported. The skilled and unskilled labor embodied in exports represents an addition to the domestic demand for those classes of labor; labor embodied in imports represents a subtraction from domestic demand. The influence of trade on relative wages of skilled and unskilled labor can then be inferred by calculating the net differences in demand for the two

---

5 Without the trade channel, the distribution of earnings in country A could be affected if developments in country B influenced the level or composition of international migration.

6 A more subtle comparison is with the situation in which international prices, rather than trade volumes, are held constant. Deardorff and Hakura argue that this comparison is fraught with almost as many problems as a comparison in which trade volumes are assumed to remain at their baseline level.
classes of labor that result from imports and exports.

Factor-content-of-trade calculations are the basis for the influential estimates of the effect of trade on wages produced by Murphy and Welch (1991) and Borjas, Freeman, and Katz (1992). This method is also a source for the much higher estimates of the impact of trade produced by Wood (1994). The following explanation of the procedure is based on Wood’s description of a typical set of calculations (Wood 1994, pp. 67–69).

The factor content coefficients, \( z_x \), for the exports of country A to country B (or to the rest of the world) are calculated as

\[ z_x = C_A s_x \]  

(1)

where \( z_x \) is a vector of factor quantities per dollar of exports, with one element in the vector corresponding to each of the \( q \) input factors (in this case, skill levels). \( C_A \) is the matrix of coefficients showing the quantity of each of the \( q \) skill levels needed to produce a dollar of output in each of the \( r \) industries, and \( s_x \) is a vector whose elements represent the share of country A’s exports produced by each of the \( r \) industries. As Wood puts it, \( z_x \) is simply country A’s sectoral factor input coefficients weighted by the share of each industry in total exports. Factor input coefficients for country A’s imports are calculated in a similar way:

\[ z_m = C_A s_m \]  

(2)

where \( s_m \) is a vector whose elements represent the share of country A’s imports accounted for by each of the \( r \) industries. If exports from country A, \( X_A \), always finance an equal value of imports from the rest of the world, \( M_A \), the impact of trade on factor demands in A can be estimated as

\[ Z_A = X_A (z_x - z_m). \]  

(3)

In an era with a substantial trade imbalance, an alternative approach is to estimate

\[ Z_A = X_A z_x - M_A z_m. \]  

(4)

Both Murphy and Welch (1991) and Borjas, Freeman, and Katz (1992) estimate the effects of rising net U.S. imports through the middle to late 1980s. Murphy and Welch examine factor demands for a large number of labor skill categories in four broad industrial groups—traded durables, traded nondurables, traded services, and all nontraded goods and services. Borjas, Freeman, and Katz look at factor demands for a large number of skill classes, defined by gender, schooling attainment, and work experience, but they make a finer distinction among industries than Murphy and Welch. Both sets of authors reach a roughly similar conclusion: The changing factor content of trade shifted the demand for labor against less-skilled U.S. workers (especially men) and in favor of highly skilled workers.

Murphy and Welch do not provide any estimates of the effect of changing trade flows on absolute or relative wages, but they do show that the implied additions to or subtractions from labor demand for different skill categories of U.S. labor are correlated with the actual pattern of relative wage gains and losses experienced by workers in these skill classes. The correlation could be accidental, though this seems unlikely. While trade may or may not have been the main cause of growing wage inequality in the 1980s, Murphy and Welch’s results suggest at a minimum that trade changes tended to reinforce U.S. wage inequality that was occurring as a result of other causes. Borjas, Freeman, and Katz undertake the more ambitious task of trying to estimate the implications of labor demand shifts for relative wages. Their procedure is to multiply their estimated effect of trade on relative skill demands times an estimate of the effect of relative labor supply on the relative earnings of more skilled versus less-skilled workers. They conclude that 8–15 percent of the 1980–1988 increase in the college/high school wage differential is attributable to the combined effects of trade and new immigration into the United States, with nearly all of this effect attributable to trade alone. About 26–67 percent of the rise in the wage differential between school dropouts and other classes of labor is explained by trade and immigration, with roughly one-third of this effect attributable to trade and the remaining two-thirds attributable to immigration.

Deardorff and Hakura (1994) and other trade economists are skeptical of these estimates. Deardorff and Hakura argue that the
estimates are not plausibly derived from the relevant general equilibrium theory. In the Heckscher-Ohlin model, factor prices in country A are jointly determined with output prices; “they do not depend on factor supplies independently of goods prices” (Dear-dorff and Hakura 1994, p. 92). Lawrence and Slaughter (1993) emphasize that trade influences domestic factor prices through its effect on the product prices received by domestic producers. By focusing on trade volumes, analysts who perform factor-content-of-trade calculations can easily miss the important role of international trade in determining product prices:

If international competition forced U.S. workers to lower their wages, domestic firms might be able to hold on to their domestic market shares. By examining only trade flows, however, one might conclude that trade had no impact on wages. (Lawrence and Slaugh-ter 1993, pp. 191–92)

For that reason, Lawrence and Slaughter prefer to track the influence of trade through trends in relative prices of goods produced by skill-intensive and less-skill-intensive industries.

It is easy to exaggerate the flaws of the factor-content-of-trade studies. The strengths and weaknesses of this approach should be compared with those of other practical approaches to estimation, not with those of the ideal study, which so far as I know has not yet been done. Though I think it would be dangerous to rely exclusively on factor-content studies to predict the effects of trade developments on wages, criticisms of these studies based on the Heckscher-Ohlin model or other general equilibrium models of trade often seem overdrawn. Trade economists use the Heckscher-Ohlin model as a tool for thinking about the effects of trade on factor prices because it is a model where the link between trade and factor prices is spelled out clearly. They do not seem to use the model because they believe it explains a large percentage of the world’s trade. Many trade economists, like Bhagwati and Dehejia (1994), doubt the model’s basic assumptions. For several decades, most economists were deeply skeptical of one of its most important predictions—factor price equalization. If the Heckscher-Ohlin model has uncertain status as a useful description of international trade, it is hardly a damning indictment to say that a particular study treats evidence in a way that is inconsistent with that model.

Few economists—and almost no labor economists—take literally a common assumption of general equilibrium theory that factor and product prices adjust instantaneously and completely to a shock in the system. If trade barriers between country A and country B are removed, or if country B suddenly develops the capacity to produce a particular new commodity, the effects of the change might be visible in trade volumes before they are visible in commodity prices. Whether the initial effects are visible in trade volumes or commodity prices, everything we know about wage determination suggests that the response of average and relative wages will be far from instantaneous. The factor-content-of-trade estimates produced by Murphy and Welch (1991) and Borjas, Freeman, and Katz (1992) are consistent with the view that a shift in the factor content of U.S. exports and imports has reduced the relative demand for less-skilled workers and raised the demand for skilled workers. The estimates do not tell us whether this shift occurred because of reductions in trade barriers, economic developments overseas, or developments here in the United States. And, as Deardorff and Hakura (1994) show, the estimates do not offer a reliable basis for inferring how large the effect on relative wages has been. They do suggest that an effect has been present.

Some proposed alternatives to factor-content-of-trade calculations have turned out to have practical shortcomings of their own. One alternative approach, often mentioned by trade economists, is to analyze the trend in commodity prices rather than the trend in volumes of trade. Citing Lawrence and Slaughter (1993), Bhagwati and Dehejia (1994, p. 48) argue that the relative U.S. prices of unskilled-labor-intensive commodities have risen in comparison with prices of skilled-labor-intensive commodities. This is the opposite of the trend that would be expected in the Heckscher-Ohlin model if less-skilled American workers were exposed to in-
creased competition from unskilled foreign workers.

The evidence is less persuasive than Bhagwati and Dehijia apparently believe. Unlike Lawrence and Slaughter, Sachs and Shatz (1994) find a slight decline in the relative price of commodities that are intensive in the use of unskilled labor. More to the point, both Lawrence and Slaughter (1993) and Sachs and Shatz (1994) base their estimates on a definition of "skill" that differs substantially from that used in most labor economics studies. They classify nonproduction workers as "skilled" and production workers as "less skilled," evidently because their data sources permit them to make this kind of distinction. It turns out, however, that the trend in the skilled/unskilled wage ratio has been much less noticeable under this definition than it has been under other definitions. Relative commodity prices may have moved in the wrong direction or varied only slightly because the price of skill, under this definition, has changed very little. Under most definitions of skill, however, the wage premium offered to highly skilled workers rose sharply in the first half of the 1980s.

Wood (1994) relies on factor-content-of-trade calculations to support his contention that the elimination of North-South trade barriers and the expansion of basic education in developing countries have reduced substantially the relative demand for less-skilled workers in the North. Unlike the other analysts whose work is mentioned here, Wood is also interested in explaining the trend of relative wages in the South. In Chapter 3 of his book, he reviews a large number of previous studies based on the factor-content-of-trade methodology and argues that these studies consistently find that the manufactured exports of the North to the South are concentrated on goods whose production needs a higher ratio of skilled to unskilled workers than the manufactured goods which the South exports to the North. (p. 119)

The earlier evidence also supports his view that the specialization within manufacturing occurs as a result of the large difference in the relative cost of skilled and unskilled labor in the North and the South. However, previous studies do not support the view that the effect of North-South trade on the relative demand for skilled and unskilled labor in the North is particularly large. Most of the studies cited by Wood suggest that the impact is small, a conclusion he acknowledges. His assessment of these studies is that they substantially understate the impact of trade.

Wood sees two main shortcomings in the previous studies.8 The more important error occurs because of the assumption that goods produced in the same industry are identical whether produced in the North or the South. Wood believes this assumption is unwarranted. Even if goods are produced by the same industry, differences between the specific goods produced in the North and South make them "noncompeting." Firms in both Mexico and the United States produce textiles, for example. However, the textiles they produce are not the same. U.S. firms specialize in producing skill-intensive textiles; Mexican firms specialize in producing textiles that are intensive in the use of unskilled labor. Firms in the two countries specialize in this way because relative factor prices favor this

---

7 Sachs and Shatz (1994, p. 8) estimate that the wage premium received by the average nonproduction worker rose just 4 percent between 1979 and 1986, when it increased from 53 percent of the average wage of a production worker in 1979 to 55 percent of the average production worker's wage in 1986. In contrast, Kosters shows that the average wage premium received by a white male college graduate rose 53 percent in the same period, rising from 36 percent of the average white male high school graduate's wage in 1979 to 55 percent of that average wage in 1986. The weekly earnings premium of a male at the 90th percentile of the wage distribution rose 33 percent between 1979 and 1986, rising from 247 percent of the weekly wage of a male at the 10th percentile of the wage distribution in 1979 to 339 percent of the 10th percentile wage in 1986 (Kosters 1994, pp. 12 and 14). One reason for the difference may be that the standard definition of production workers includes many workers with advanced skill, whereas many workers who are classified as "nonproduction" have few measurable skills.

8 Although he does not specifically cite the papers by Murphy and Welch (1991) and Borjas, Freeman, and Katz (1992) in his discussion of factor-content-of-trade studies, the problems Wood describes would also apply to those papers.
kind of specialization. It would be a mistake, however, to assume that the United States could produce Mexican textiles using the same skill-intensive technique it uses to produce its own current mix of textile output. Unfortunately, that assumption is critical to usual estimates of the factor content of imported goods; see equation (2).

One approach to this problem is to assume that if the United States produced textiles now manufactured in Mexico, it would produce them with the relative factor proportions used by Mexican textile firms. The factor input coefficients for U.S. imports would then be calculated as

\[ z_m^* = C_B s_m \]  

(2')

where \( s_m \) is defined as it was earlier and \( C_B \) is the factor-proportion matrix for Mexico (country B) rather than the United States (country A). This assumption is implausible, because relative factor prices differ in the two countries. U.S. firms would presumably choose to produce Mexican textiles using a technique that is more sparing in its use of less-skilled labor and more intensive in its use of skilled labor and capital. Wood attempts to get around this problem by assuming that U.S. producers would adjust the Mexican factor proportions to reflect the differences in relative prices between the United States and Mexico. He uses a CES production function, and applies a range of assumed elasticities of substitution of skilled for less-skilled labor, to make this adjustment. Wood realizes that U.S. consumers might not purchase as many textiles if textiles formerly produced cheaply in Mexico had to be produced more expensively in the United States. Therefore, he makes a second adjustment in \( Z_m^* \) to reflect lower consumption of the imported products, basing this adjustment on an assumption that the price elasticity of demand for the imported products is one-half.

In combination, these two adjustments reduce substantially the factor content of U.S. imports below what they would be if we assumed Mexican factor proportions must apply, as in equation (2'), and assumed a constant level of textile consumption in the United States. Nonetheless, Wood estimates that the labor content of Northern imports of manufactures from the South is much greater than the content estimated using conventional methods. As a result, the net impact of North-South trade on manufacturing employment and the skill intensity of manufacturing employment in the North is roughly ten times what the conventional estimates imply. The effect of trade on manufacturing employment in the South is also very large. Overall, Wood's central estimates imply that North-South manufacturing trade depresses the demand for Northern workers with a basic education by over five percent while increasing the demand for skilled Northern workers modestly (Wood 1994, pp. 149–50). Trade outside of manufacturing depresses the relative demand for less-skilled Northern workers still further.

Wood suggests that even this estimate must understake the effect of North-South trade on the relative demand for less-skilled Northern workers, for it ignores unskilled-labor-saving technology that Northern firms are forced to adopt in order to remain competitive with firms based in the South. Imports of Southern manufactures into the North would be much greater in many industries if firms did not adopt new technologies that use unskilled labor sparingly and skilled labor more intensively. Using fragmentary and admittedly weak evidence, Wood argues that defensive technological change probably doubles his earlier estimate of the effect of North-South trade on relative demand for unskilled Northern labor.

While Wood's insight is reasonable as far as it goes, it overlooks the possible influence of North-South trade on technological change outside the traded goods industries. If relative wages adjust to the decline in demand for unskilled labor in the North, Northern firms will find that unskilled labor is relatively less dear. Firms that produce neither traded goods nor inputs for traded goods should try to find new technologies that use unskilled labor relatively intensively. Of course, such technologies may be difficult or impossible to find. But induced technological change, which shrinks the relative demand for unskilled workers in the traded goods industries, should boost demand for such work-
ers in nontraded goods and services. It is not clear whether the overall bias will reduce the relative demand for unskilled workers in the aggregate.

There is a sense, too, in which Wood's argument about induced technological change undermines his earlier argument that many similar goods produced in the North and South are noncompeting. If they are truly noncompeting, and hence cannot substitute for one another in final consumption, Northern producers will be much less inclined to discover new technologies that economize on unskilled labor. In seeking markets for their products, Northern firms compete mostly with one another, not with producers in the South. Assuming they are forced to seek out new technologies to reduce their use of unskilled workers, one might infer the goods they produce are substitutable for those produced in the South. If Northern and Southern goods are substitutable, however, we should be able to use equation (2), rather than a variant of equation (2'), to estimate the factor content of imports, contrary to Wood's actual procedure. It is plausible to argue that some Northern and Southern goods produced in the same industry are noncompeting, in which case it is inappropriate to use equation (2) to estimate the factor content of imports. Other goods produced in the same industry are good substitutes, so it is reasonable to use equation (2) to estimate the factor content of imports. In the latter case, however, the availability of good substitutes manufactured in the South places pressure on Northern producers to discover techniques that economize on unskilled labor. Both of Wood's arguments have merit, but they do not apply with equal force to all goods. While I am inclined to accept his view that standard factor-content-of-trade studies underestimate the impact of North-South trade on the relative demand for less-skilled Northern workers, it seems doubtful that the understatement is as large as claimed in his book.

Other evidence. Wood examines a range of evidence to see whether North-South trade has produced the predicted effect on relative demands for less-skilled labor, both in the North and the South. I will consider only his evidence for the North. As we have already seen, wage differentials between highly skilled and less-skilled workers increased in the 1980s in many advanced industrialized countries, and especially in the United States. The timing of this increase seems consistent with the trade explanation, according to Wood, because manufactured exports from the South to the North rose particularly strongly in that decade. Increases in earnings inequality and joblessness among the less skilled tended to be larger in those advanced countries where manufactured imports from the South rose fastest, also corresponding with the trade explanation. Wood argues that wage flexibility in the United States permitted relative wages to adjust much more fully to declining demand for the less skilled than was the case in Europe, where relative wage inflexibility caused joblessness to rise. While I find this comparison of the U.S. and Europe convincing, it does not shed much light on the underlying cause of higher inequality and joblessness. Biased technical change, both in the U.S. and Europe, could have caused the relative demand for less-skilled workers to decline in both places, with the same apparent effect on inequality and joblessness in the two labor markets.

Wood recognizes that biased technical change can account for many of the same phenomena he explains with North-South trade. He argues that the time pattern of increased inequality and joblessness favors the trade explanation. The secular increase in joblessness and inequality was strongest when exports from the South rose fastest. In contrast, crude measures of technological progress—labor productivity and total factor productivity—actually slowed during the period when inequality began to climb. Though slow technical change can still represent biased change, it is surprising that sharply slower overall progress is associated with a steep increase in the bias of technological change. Wood also believes the pattern of increase in skill differentials across Northern countries favors the trade explanation. As noted, differentials and joblessness increased fastest where Southern import penetration rose most strongly. In contrast, Wood finds
no cross-country association between increasing skill differentials and crude measures of technical progress.

Economists already convinced that biased technical change offers the simplest explanation for the relative decline in demand for less-skilled workers may not be impressed by Wood's evidence. It should be emphasized, however, that Wood is one of the first analysts to examine systematically the pattern of inequality growth across countries. He brings much more information to bear than other economists, who typically analyze developments in only a single country (usually the United States). His evidence persuades me that North-South trade plays an important role in determining the demand for less-skilled workers in the United States and other advanced industrialized countries. I remain deeply skeptical, however, that North-South trade can explain more than half the decline in demand for less-skilled workers, an estimate Wood seems to favor.

One reason for my skepticism is the apparent shrinkage in demand for less-skilled U.S. workers across a range of industries, including those that do not produce goods and services that are traded internationally. Katz and Murphy (1992) report that relative use of skilled workers has increased across a wide variety of industries in the face of growing wage premiums for workers with advanced skill. This does not seem consistent with the view that growing wage premiums are driven mainly by increased competition from foreign firms. Firms which do not produce internationally traded goods and services (or inputs for internationally traded goods and services) should take advantage of the declining price of less-skilled workers by hiring more of them. The fact that they instead adopt techniques that use skilled labor relatively more intensively suggests that biased technical change or some other development has reduced their demand for less-skilled workers. International trade cannot explain the reduced appetite for less-skilled workers in these industries.

The last two empirical studies we examine are by Borjas and Ramey (1994) and Karoly and Klerman (1994). Borjas and Ramey (1994) focus almost exclusively on the influence of international trade. They attempt to explain the trend in the relative wage of male college graduates compared with the wage received by male high school graduates and that received by male high school dropouts. Their statistical tests show that the U.S. trade deficit in durable goods, measured as a percent of GDP, has the same trend as the relative pay differential for male college graduates. Moreover, changes in the deficit lead changes in the pay differential, suggesting that movements in net durable goods imports may "cause" the movements in the pay differential. A regression of the college pay differential on net durable imports over the period from 1963 through 1979 accurately forecasts the growth in the pay differential between 1980 and 1988. The authors seem to imply that changes in imports of durable goods can explain all of the huge rise in the college pay premium after 1979.

Karoly and Klerman (1994) examine changes in the pattern of overall male and female wage inequality within 20 U.S. states and regions over the period between 1973 and 1988. In one part of their paper, the authors estimate a panel model of the determinants of wage inequality within the regions and across the 16 years under study. In a variety of specifications, merchandise imports into the United States and durable goods imports (each measured as a percent of GNP) are found to have a large and highly significant effect on both male and female wage inequality. Depending on the specification, the trade variables account for between 55 and 141 percent of the rise of the variance in hourly wages between 1973 and 1988. Unlike Borjas and Ramey, however, Karoly and Klerman are cautious in interpreting this result. They note that the large, statistically significant coefficient on trade variables could simply reflect correlation between trends rather than a causal relationship between the two variables.

This caution strikes me as prudent. Before accepting the conclusion that fluctuations in merchandise trade or durable goods imports could explain a large move in wage inequality, most analysts would need to be persuaded that the number of workers affected by trade is large enough make a big differ-
ence in the overall distribution. Though Borjas and Ramey (1994) offer a model to explain how changes in trade can lead to large losses in rents in selected industries, it is not clear from their evidence whether there are enough workers covered by this model to explain the large move in relative wages that occurred over the past two decades. I suspect that neither the equation estimated by Borjas and Ramey nor the one estimated by Karoly and Klerman would accurately predict wage movements after 1988. U.S. merchandise imports and the net deficit in traded durables have declined as a share of national income since that year whereas most measures of earnings inequality have continued to climb. Under the assumptions of Borjas and Ramey's model, an explanation for the continued rise of inequality must be sought outside of trade. What both papers have uncovered, however, is a striking correspondence between growing wage inequality and growing net imports in the United States over the period from the early 1970s through the late 1980s. This evidence is consistent with Murphy and Welch's (1991) and Borjas, Freeman, and Katz's (1992) evidence described earlier, though the effect that is attributed to trade is much larger than what is implied by the earlier studies.

4. Policy Implications

Of the studies discussed, only Wood's considers carefully the implications of its findings for public policy. Wood's discussion of policy choice is one of the most impressive—and enlightening—contributions of his volume. Like the overwhelming majority of economists, Wood remains committed to the principle of free trade even though he believes that less-skilled workers in the North have suffered sizable losses as a result of manufactured imports from the South. He argues that the overall gains from North-South trade, especially for poor workers in the South, more than offset the harm inflicted on less-skilled workers in wealthy countries. He describes three policy alternatives to raising trade barriers against manufactured imports from the South: (1) Investing in education and skill training to reduce the supply of less-skilled workers; (2) Establishing public works projects or targeted employment subsidy schemes to boost public and private demand for less-skilled workers; and (3) Redistributing income directly from highly paid (skilled) workers to the poorly paid.

Wood mentions three motivations for improving the job market prospects of less skilled workers—efficiency, equity, and social cohesion. He then considers whether and under what circumstances the three suggested policies would achieve these efficiency and equity goals. Even though higher public investment in education and skill training is popular with economists, Wood points out a limitation of this strategy. Extra public resources will be needed to pay for higher investment. These resources are likely to be financed through higher taxation, which usually reduces the net-of-tax pay differential for skill and, thus, the incentive for workers to invest in skill acquisition. Offering earnings subsidies to employers who hire unskilled workers has few advantages in a labor market, like that in the U.S., where relative wages are flexible and presumably efficient. The scheme could improve efficiency, however, in markets where wage rigidity prevents the relative wage of less-skilled workers from fully adjusting to the shrunken demand for their services. Wood argues that a combination of the three policies is likely to yield better results than reliance on only a single one of them, and he notes that the combination of policies that is most effective in a labor market with rigid wages is likely to differ from the combination that would work best where wages are flexible.

Economists do not agree whether trade or
biased technical change offers the most convincing explanation for rising inequality. Three of the studies mentioned in this review suggest that trade has played the leading role, but most economists who have examined the evidence still believe that technical change accounts for a larger share of the rise in wage inequality.¹¹

Does the optimal policy choice depend on whether trade or biased technical progress is the primary contributor to increased inequality? For committed believers in free trade, the answer is probably "no." The only policy that might appear attractive if one believed that trade is responsible for growing inequality, but that appears unattractive if biased technical change is the main source of new inequality, is trade protection. Believers in free trade like Wood and most readers of this journal reject trade protection, whether or not they believe it is an important source of increased inequality. The other policies Wood mentions will be equally helpful whether the sagging demand for unskilled workers is caused by overseas competition or biased technical change.

The perspective of other participants in the policy debate is not the same as that of professional economists. Workers forced to accept a pay cut or an indefinite layoff because their skills are no longer wanted can certainly be helped by skill training, targeted earnings subsidies, or income redistribution. An important empirical question is whether they might also be helped by trade protection. The book by Wood and the recent studies by Borjas and Ramey and Karoly and Klerman suggest that benefits of trade protection to the unskilled could be sizable. These studies imply that liberal trade can affect adversely the real earnings of a wide class of workers, and not just those workers employed in a handful of hard-hit industries. Even if the new evidence does not affect the policy preferences of most economists, we should acknowledge that the evidence, if valid, offers powerful ammunition to the opponents of free trade.

REFERENCES


KATZ, LAWRENCE F. AND MURPHY, KEVIN M.


