CHAPTER THREE

International Trade and the Performance of U.S. Labor Markets

DALE BELMAN AND THEA M. LEE

Introduction

The U.S. economy has become progressively more open to international trade during the last several decades, with successive rounds of tariff reductions through the General Agreement on Tariffs and Trade (GATT) and the implementation of various regional trade agreements (with Israel, Canada, and Mexico). Since 1973 average real wages in the United States have stagnated or fallen, and since 1980 the gap between the wages of college-educated and non-college-educated workers has widened dramatically. What, if any, connection is there between these two trends?

The economics profession has attempted to answer various versions of this question in recent years. What impact does freer trade have on wages and employment in the United States? To be more precise, have lower trade barriers (or the growing trade deficit or growing trade with developing countries) been responsible for some portion of the decline in wages for non-college-educated American workers? Has trade exacerbated growing inequality in the distribution of income between the highest- and the lowest-paid workers? Has increased trade been a cause of declining employment in manufacturing? What impact does increasing the volume of balanced trade (i.e., increasing exports and imports by equivalent amounts) have on the quality of jobs available? In other words, are export jobs superior to import jobs on average? What will be the consequences for U.S. workers of increased trade with less developed countries (LDCs) that have large and rapidly growing labor forces?

To many Americans—especially those living in the communities hardest hit by import competition—it seems intuitively true that an influx of cheap imports from countries where wages are a small fraction of U.S. wages puts downward pressure on domestic wages and leads to a loss of domestic jobs. Certainly, many workers have been laid off from plants unable to compete with imports, while

The authors would like to thank Robert Blecker, Steve Beckman, Larry Mishel, and Robert Scott for helpful comments.
others have been confronted with a choice between deep pay cuts and plant relocation abroad. Furthermore, the trend of rising wage inequality in the United States roughly coincides with the rapid growth in the trade deficit and the expansion of trade with developing countries (see Batra 1993). Nor has the recent growth in U.S. exports brought clear gains in jobs and wages (see, for example, University of Illinois at Chicago 1994).

As Harvard University economists Jeffrey D. Sachs and Howard J. Shatz have acknowledged,

both the Heckscher-Ohlin-Samuelson ... model [of trade] and standard models of international capital mobility predict that internationalization will narrow the gap between U.S. and rest-of-world wages and widen the gap between wages of skilled and unskilled workers within the United States. Moreover, these standard theories predict that U.S. manufacturing sectors that are intensive in low-skilled workers will shrink in the face of increased integration with developing countries abundant in low-skilled workers. (1994, pp. 2–3)

Yet many international trade economists have resisted accepting these conclusions, apparently because their political implications appear to imperil the free trade agenda. Jagdish Bhagwati, a prominent trade theorist at Columbia University, writes that “the fear that has grown in the United States and in Western Europe that the freeing of trade with the poor countries of the South will hurt the real wages of the unskilled” is one of two great threats to free trade today—along with demands for a “level playing field” (Bhagwati and Dehejia 1994, pp. 36–37). These economists point to other theoretical possibilities, such as economies of scale or dynamic gains in productivity, that could more than compensate for the wage-reducing effects of trade liberalization predicted in the standard models.

A few influential articles have appeared in the last few years claiming to resolve this issue by exonerating trade (see especially Lawrence and Slaughter 1993; Krugman and Lawrence 1993; Bound and Johnson 1992). International trade is not responsible for the increasingly unequal distribution of wages, these authors argue. Rather, the true culprit is alleged to be technological change, which has increased demand for skilled workers, thus bidding up their wages relative to the wages of less skilled workers. Moreover, international trade is argued to be too small relative to the aggregate economy to possibly account for any dramatic changes in employment, wages, or income distribution (Krugman 1994a).

The mainstream business press responded to these claims with evident relief, immediately seizing upon these (still preliminary) results. “The Victim Has a Blue Collar, but Free Trade Has an Alibi,” proclaimed a New York Times headline (Passell 1992). Business Week joined in, concluding that “technological advances—not a flood of cheap goods from abroad—led to an increase in manufacturing productivity and resulted in a decline in manufacturing employment” (Ullmann 1993).

This chapter will assess the current body of economic literature on the topic
of trade, employment, and wages, critically reviewing the most important articles. The conclusions that emerge from this review are fairly strong; most of the research, using a range of empirical methods and theoretical assumptions, has found that increased trade (or import competition) is associated to some extent with reduced domestic employment and/or wages, with the employment effect usually estimated to be several times larger than the direct wage impact. Some of these studies focus on specific industries or the manufacturing sector; others attempt to measure the aggregate impact of trade. Trade appears to have a more significant effect on the distribution of wages than on the average wage, although there is some disagreement about what portion of the widening wage gap between college-educated and non-college-educated workers is accounted for by trade. There is also evidence that the negative connection between increased imports and employment tends to be stronger than the positive connection between exports and employment.

In our judgment, it is inappropriate to conclude at present—on the basis of current research—that trade "has an alibi" or that the debate is closed. As will be argued below, the research that supports the view that only technology is to blame is both conceptually and technically flawed. If anything, the preponderance of evidence indicates that increased trade has had a negative effect on wages in manufacturing and has accelerated the decline in employment in this sector. The consequent movement of jobs out of manufacturing and into lower-wage service sectors has also contributed to the declining average real wage in the U.S. economy as a whole. By eliminating high-quality jobs for non-college-educated workers, this process has also exacerbated wage inequality between the most and least educated workers during the last decade. Trade is by no means the only factor that has contributed to these trends; technology may also have played a role. It is difficult to distinguish the effects of trade and technology because they are not necessarily independent of each other (especially if new technologies are adopted partly in response to international competitive pressures).

Given the accelerated entrance into world markets of large, labor-abundant developing countries like China and India, as well as the Eastern European economies, increased trade flows can be expected to exert even more influence in the near future than they have in the past. Increasing flows of direct foreign investment to developing countries, reinforced by liberalized investment rules under the North American Free Trade Agreement (NAFTA) and the Uruguay Round of GATT, will also magnify the effects of international trade on wages and employment. Thus, the issues addressed in this chapter are of critical importance for assessing the current direction of U.S. trade policy and global economic trends.

**Trade, Wages, and Inequality:**
**Some Descriptive Statistics**

It is useful to begin with a brief description of the circumstances that have led to so much interest in the possible linkages between increased trade and worsened
labor market performance. In 1960, merchandise exports and imports combined represented 6.7 percent of U.S. gross domestic product (GDP); by 1993, this trade share had more than doubled to 16.5 percent.\(^1\) Imports have grown far more dramatically than exports, particularly since the early 1980s. By 1993, the United States had a $132.5 billion merchandise trade deficit. The current account, which takes into account income from abroad and the trade surplus in services, registered a deficit of $103.9 billion in the same year. In contrast, in 1980 the United States had a merchandise trade deficit of only $25.5 billion and a $2.3 billion surplus on the current account.\(^2\)

Since 1980, U.S. trade with fast-growing developing countries has also risen rapidly, again with import growth outstripping exports by a wide margin. While trade with Japan still accounts for over half of the U.S. overall trade deficit, the newly industrializing countries (NICs), along with the next tier of developing countries, are increasingly competing in a broad range of industries. Imports from the Asian NICs, plus China, Brazil, and Mexico, grew 121 percent from 1980 to 1992, while U.S. exports to these countries grew by only 52 percent.\(^3\) Consequently, the U.S. merchandise trade balance with this group swung from a $7 billion surplus in 1980 to a deficit of $23 billion in 1992 (measured in 1992 dollars). Compared to both Europe and Japan, the United States imports a significantly larger share of manufactured goods (relative to GDP). This is especially true with respect to low-wage countries: manufacturing imports from low-wage countries made up 2.6 percent of U.S. GDP in 1991, compared to 1.7 percent for the European Community (EC) and 1.2 percent for Japan (Howes and Markusen 1993, p. 26).

Growth in international trade has been both complemented and spurred by a rapid rise in direct foreign investment and a growing role for multinational enterprises (MNEs). The stock of worldwide direct foreign investment approximately doubled between 1987 and 1992, to almost $2 trillion, according to United Nations Conference on Trade and Development (UNCTAD) data (cited in Sengenberger 1994, p. 398). Sengenberger points out:

> Overseas investment by multinationals has become a bigger force in the world economy than world trade. In 1992, sales generated by multinationals outside their country of origin totalled $5.5 trillion, compared with total world exports of $4 trillion. MNEs control one-third of the world’s private sector assets ... [and account for] about 20 per cent of paid employment in non-agricultural activities in OECD countries. (1994, pp. 397–98)

During the recent period of steadily increasing trade volume, gradual (although uneven) reduction in trade barriers, and rising direct foreign investment, the employment prospects and earnings of the majority of Americans have deteriorated.\(^4\) Real hourly compensation has been stagnant since 1973 and falling since 1977. Growth in median family income also slowed over this period. While real family income (in 1991 dollars) rose by $5,000 between 1967 and
1973, it rose by only $1,530 between 1973 and 1989, and all this increase was a result of increasing hours of work. The same period has seen an increase in the rate of unemployment, from 3.8 percent in 1973 to 5.3 percent in 1989; a decline in the rate of employment growth, from 3.6 percent in the 1970–73 expansion to 3.0 percent in the 1982–90 expansion; decreases in coverage of health and pension benefits in the private sector; increased earnings inequality; and an increased proportion of the population living in poverty, from 11.1 percent in 1973 to 12.8 percent in 1989.

There are many indicators of rising inequality among workers as well. The proportion of the labor force earning between 125 and 300 percent of the poverty wage fell from 54.5 to 48.3 percent between 1973 and 1993. The only two income categories that expanded were those earning over 300 percent of the poverty wage, which rose from 9.2 to 10.3 percent, and those earning between 100 and 125 percent of that wage, which expanded from 12.5 to 14.5 percent of the labor force. Between 1979 and 1989, pension coverage of the labor force declined from 50 to 42.9 percent, and health insurance coverage declined from 68.5 to 61.1 percent. Even the upgrading of employees into better occupations does not have the beneficial effects of past decades. Occupational upgrading produced a 0.18 percent annual increase in wages between 1972 and 1979, a 0.23 percent annual increase between 1979 and 1989, but only a 0.09 percent annual increase between 1989 and 1993. Trends such as these have led to concern about the disappearance of the middle of the income distribution.

The manufacturing sector in particular suffered severe loss of both jobs and output during this period, regaining only some of the lost ground when the trade deficit fell in the late 1980s and early 1990s. Although not the highest-paying sector in the economy (that distinction goes to construction), manufacturing pays better than the service sectors, such as retail trade, that have experienced the most rapid employment growth over the past few decades. In 1979, prior to the large increase in trade deficits, the average wage in manufacturing was $6.70, 32 percent more than retail trade ($4.53), 21 percent more than finance ($5.27), 20 percent more than services ($5.36), and 5 percent more than wholesale trade ($6.39). Even after a decade of buffeting by trade, production and nonsupervisory employees in manufacturing, who on average earned $11.74 an hour in wages in 1993, earned 38 percent more than those in retail trade ($7.29), 3.3 percent more than those in finance ($11.35) and 8 percent more than those in services ($10.79). Wholesale trade paid the same hourly wage as manufacturing in 1993. In 1993 the three lowest-paid industries in the manufacturing sector—apparel at $7.06, leather and leather products at $7.62, and textile mill products at $8.88—paid wages similar to or better than the average wage in the retail trade sector.

While the wage performance of the manufacturing sector has been modest over the past decade, its employment performance has been far worse. Private sector employment increased by 99 percent between 1960 and 1993, but manu-
facturing employment grew by only 6 percent over this period. Even this impression is too favorable; manufacturing employment peaked at 21 million in 1979, contracted by 1.6 million by 1982, recovered to a level of 19.4 million in 1988, and then declined to 17.8 million employees in 1993.

In the manufacturing sector, wages and employment are sensitive to an industry's place in trade patterns. In 1983 the typical worker in an exporting industry earned $9.55 per hour, while the typical worker in an import-competitive industry earned $8.28 per hour. After adjusting for individual characteristics affecting wages, Katz and Summers (1989) found that wages in export-intensive industries were 11 percent above the average manufacturing wage, while wages in import-intensive industries were 15 percent below the manufacturing average. If attention is restricted to the ten industries with the largest volume of exports and an equal-sized set of import-exposed industries, the exporting industries pay a premium of 16 percent more than the average manufacturing wage, while the importing industries pay 27 percent less (Katz and Summers 1989, p. 262).

In terms of employment, however, imports appear to have a negative impact not offset by exports. Examining data on employment by manufacturing establishments for the period 1972 to 1988, Davis, Haltiwanger, and Schuh (1994) find that manufacturing plants in industries faced with high levels of import penetration have heightened rates of job loss. The 20 percent of establishments (plants) in industries with the highest levels of import penetration had annual employment losses averaging 2.8 percent, while the other 80 percent of establishments had average employment losses of only 0.9 percent annually.

The poor jobs performance of import-exposed industries is not balanced by the superior performance of exporting industries. Rearranging establishments into quintiles according to export performance, the 20 percent of plants in industries with the largest export share perform only marginally better than the remaining 80 percent of establishments. Average job losses were 1.0 percent in establishments in the top exporting industries, only slightly better than the 1.2 percent annual losses recorded for the remainder of establishments. The effects of trade on employment thus seem to be asymmetrical: imports appear to accelerate employment decline in manufacturing and to increase instability in employment, while exports do little to ameliorate these problems. The sources of these differences are not readily apparent from descriptive statistics and will be discussed at length below.

**Trade Theory and Possible Causal Channels**

The coincidence of the aforementioned trends in trade, wages, and employment does not, of course, prove the existence of causal relationships among them. In order to understand how increasing trade could be related to changing labor market conditions, it is useful to review the potential causal mechanisms of how trade can affect income distribution and job creation. Over the years, economic
Theorists have developed a number of models of trade-distribution linkages. This section will review some of the most important theories of trade and distribution in order to lay the ground for the review of empirical studies in the following section. While theories of trade and employment are less well developed (especially since most trade theories tend to assume full employment), we will also comment on employment issues here; they will receive a fuller treatment in the review of the empirical literature later in this chapter.

The most widely accepted trade theory is based on the Heckscher-Ohlin-Samuelson (HOS) model, which was originally intended to illuminate the effects of trade on the distribution of income between owners of different "factors of production" (such as labor, land, and capital). The standard "2 x 2" version of the HOS model portrays a world consisting of two countries, each capable of producing the same two commodities using inputs of the same two factors of production (usually capital and labor or land and labor). Product and factor markets are assumed to be perfectly competitive, with prices automatically adjusting so that supply equals demand. This rules out market "imperfections," such as monopolistic pricing, long-term trade imbalances, and chronic unemployment. Since the model assumes full employment, all the effects of trade on the demand for labor are reflected in wage changes.

Within the context of the HOS model, trade arises because countries differ in their "endowments" (supplies) of factors and thus are relatively better suited to the production of different goods. For example, if country A has an abundance of capital and a scarcity of labor (relative to country B), then, as long as there are some barriers to trade, capital will be cheap relative to labor in A. (Essentially, A will be a "high-wage" country.) As a result, country A can produce the more capital-intensive good at lower relative cost, and therefore has a "comparative advantage" in that product. The labor-intensive good will be more expensive in A, however. The opposite applies to country B. If the two nations specialize according to their respective comparative advantages, they can both benefit from trade in the sense that their total consumption will be greater in the absence of trade barriers than in the presence of trade barriers. Free trade benefits both countries because it allows all resources to be used in their most productive capacities.

However, this theory neither promises nor predicts that every individual in both countries will find himself or herself better off under free trade. The owners of the two factors of production (in this case, capital and labor) will be affected in opposite directions. In the HOS model, the owners of the relatively scarce factor will be made worse off by a reduction in trade barriers, while the owners of the abundant factor will be made better off. Intuitively, the scarce factor is seen to become less scarce in a more open global economy, so its price (the wage rate) adjusts downward accordingly. This result is known as the Stolper-Samuelson (SS) theorem (after Stolper and Samuelson 1941).

For example, if country A lowers a tariff on its labor-intensive good, then the
domestic price of that good falls. Consequently, the wage of labor, which is used relatively intensively in the production of that good, also falls, while the return to the other factor, capital, rises. The loss to labor is more than offset by the gains to capital, leading to the net national gains from trade.

Trade theorists often gloss over these distributional difficulties by arguing that it is possible to redistribute income after trade liberalization so that every individual is better off under free trade than with trade barriers. Although theoretically possible, such redistribution of the gains from trade has never been part of the standard policy package accompanying trade liberalization. Certainly, there is no automatic mechanism that compels the winners to compensate the losers.

In applying the simple, two-factor theorem to the United States, we would assume that this country is relatively abundant in capital and scarce in labor, compared to the rest of the world. In this case, trade liberalization in the United States causes the domestic price of capital-intensive goods to rise relative to the price of labor-intensive goods. As a result, we would expect to see returns to capital rise and workers’ wages to fall. Expanding on the basic model, it is also possible to designate the two factors of production as skilled and less skilled labor (as in Wood 1994), or to expand the model to encompass three factors (e.g., capital, professional and technical labor, and “other labor,” as in Leamer 1993). In these cases, the model would predict increased wage inequality as a consequence of liberalized trade, with the wage of the more skilled labor (the abundant factor) rising (possibly along with returns to capital) and the wage of the less skilled labor (the scarce factor) falling. In empirical terms, these two categories are typically translated into college graduates and workers without college degrees, approximately one-quarter and three-quarters of the U.S. labor force, respectively.

A second theorem that also bears on the distributional impact of trade is factor price equalization (FPE). FPE predicts that, in the absence of any trade barriers (including transportation costs, tariffs, quotas, and any other impediments), perfectly free trade that equalizes commodity prices will result in the equalization of factor prices as well. In other words, if goods are allowed to cross national borders freely, then eventually the returns to factors of production (in the trading countries) will be equalized, even if the factors themselves are not allowed to move internationally. This would imply, for example, that wages in the United States, Mexico, and China would be completely equalized if trade barriers were completely removed.

The conditions under which the FPE theorem holds are more stringent than those required for the SS theorem. In a two-country model, it is also necessary that both countries produce both goods (neither may completely specialize), that there be “constant returns to scale” (no economies or diseconomies of scale), and that both countries employ identical technology. The factors must be able to move freely between sectors within each country, and the quality of the factors must be identical in the two countries.
How relevant is FPE today? Obviously, not all factor prices are actually equalized internationally, especially wages. This is not surprising theoretically, since the stringent conditions required for the FPE theorem are generally violated in practice. The relevant question, then, is whether there is a tendency for factor prices (particularly the wages of "unskilled" workers) to converge internationally as the world moves closer to fulfilling the conditions for FPE (for example, through reductions in trade barriers and the diffusion of modern technology to LDCs). If so, this could have potentially serious implications for the United States and other high-wage nations, if their wages have to fall for convergence to take place.

Laying out the basic model and accompanying assumptions makes it quite clear that neither of these theorems should be accepted literally. Most of the necessary assumptions for the whole HOS model of trade are frequently violated: there is not always full employment and balanced trade (so markets are not adjusting as smoothly as assumed); there are often economies of scale, especially in manufacturing; technology does differ between countries; factor endowments are not fixed, but are constantly changing; countries do sometimes specialize completely (e.g., the United States produces no bananas, while Honduras produces no airplanes); capital is increasingly mobile between countries, and even labor mobility seems to be on the rise; and prices of both commodities and factors tend to reflect institutional and market-structure factors as well as pure supply-and-demand forces.

Explicitly taking some of these factors into account could dampen or reverse the standard predictions of both SS and FPE. There may be positive effects of trade liberalization beyond those incorporated in the standard model (see the discussion in Bhagwati and Dehejia 1994). These are sometimes called "lifting-all-boats" effects. For example, if production is characterized by economies of scale (advantages of large-scale production) rather than constant returns, as the standard model assumes, then freer trade can reduce per-unit costs by expanding the size of the market. This will increase the gains from trade over the standard efficiency gains. If this effect is large enough, it could result in rising returns for both factors of production, eliminating the SS prediction of falling wages in response to a reduction in the tariff on the labor-intensive good. A similar effect can arise if, as is sometimes argued, international competition compels companies to improve their productivity and the productivity gains are passed on to workers (these are often referred to as dynamic gains from trade, since the requisite technological and organizational improvements take time to be implemented).

Although most of the recent theoretical writing has focused on these forces that tend to offset SS and FPE effects, other sometimes neglected forces could actually strengthen their predictions. Factor mobility in particular can achieve the same distributional outcome as FPE even if there are still some barriers to trade. Labor migration tends to relieve downward pressures on wages in the
low-wage countries from which workers emigrate and to contribute to downward pressures on wages in the high-wage countries into which they immigrate. Capital mobility has a similar effect, by lowering the demand for labor and thus tending to reduce wages in capital-exporting (high-wage) countries, and by doing the opposite in capital-importing (low-wage) countries.

There are other trade models in which the predictions about wage effects are more ambiguous. When some factors of production are not mobile between sectors within a country (contrary to the HOS assumption), then their incomes depend only on the relative price of the good they help to produce. This is called a specific factors model. For example, in a model in which capital and land are specific to particular sectors (manufacturing and agriculture, respectively), but labor can be used in both industries, trade liberalization has an ambiguous effect on the real wage, depending on the relative importance of the two goods in workers’ budgets and other parameters of the model (see Deardorff and Hakura 1994; Caves, Frankel, and Jones 1993). Alternatively, there could be a model in which different types of labor would be specific to particular industries (e.g., textile and aerospace workers would not be interchangeable). In these situations, trade would benefit workers in whichever industry produced for export, and would injure workers in whichever industry competed with imports. However, to the extent that these two groups of workers roughly correspond to the skilled/unskilled distinction, then the distributional predictions of such a model are similar to the predictions of an HOS model with two types of labor.

Trade can also affect wages through a variety of channels that are not readily captured by any conventional trade models. First, trade may slow wage growth or reduce wages through an implicit (or sometimes explicit) threat effect: workers may be threatened with outsourcing or runaway shops if they do not accept pay cuts. This can occur in the absence of actual changes in international trade or investment, although certainly experience with some import competition or foreign investment helps to make the threat “credible.” Basically, this mechanism assumes that wages are determined by labor-management bargaining in which the relative strength of employees and employers affects the outcome of the negotiations, rather than in the perfectly competitive “auction” markets of standard trade theory. Import competition or a threat of job relocation can reduce workers’ bargaining strength and therefore reduce wages. We might think that export success would put a parallel and offsetting upward pressure on wage rates in export sectors, and there is some evidence that workers in export industries do better than average on this score (Galbraith and Calmon 1994). Exports may not be symmetrical to imports in this respect; employers in export industries may try to keep the lid on wages in order to remain competitive in global markets—or they may relocate production abroad in order to lessen the bargaining strength of labor at home.

Second, the movement of capital to low-wage countries may be motivated in part by lower trade barriers (i.e., companies may move plants in order to take
advantage of lower wages and continue selling in the domestic market). Often, this outflow of capital goes hand in hand with transfers of technology that raise productivity in the export sectors of the low-wage countries to competitive levels. The resulting outflow of capital lowers the domestic capital stock, thus reducing the demand for labor and putting downward pressure on wages at home. Although the outcome is similar to that induced by capital mobility in an HOS-type model, the motivation is different. While, in an HOS model, capital mobility substitutes for commodity trade (because either one tends to eliminate differences in factor prices), the mechanism alluded to here suggests that capital mobility and commodity trade can be complements (and hence that trade liberalization can encourage rather than discourage capital mobility).

Third, standard trade models often do not take account of the fact that large parts of domestic economies consist of nontradable goods and services (e.g., goods that do not meet international quality standards, personal and government services, etc.).\(^{12}\) When workers are displaced from tradable goods industries by import competition, they may get jobs in nontradable sectors such as services rather than in higher-wage export sectors. If the service jobs pay lower wages, then economywide average wages can be lowered by trade even if wages of those who remain in the traded goods sectors do not fall.

This type of concern arises especially in light of the evidence for the existence of "labor rents" in many manufacturing activities: wage premiums that are received by workers who are lucky enough to have jobs in these industries, regardless of their individual characteristics (see Dickens and Lang 1988; Katz and Summers 1989; Dickens 1994). While the sources of labor rents are still debated by economists, one of the most likely reasons is the prevalence of oligopolistic market structures in some branches of industry that enable firms to reap abovenormal profits (called "oligopoly rents")—and the potential for workers in these industries to win a share of these rents through wage bargaining (Borjas and Ramey 1994). This line of reasoning suggests that import competition that displaces workers from oligopolistic, rent-paying industries is likely to lower average wages as the displaced workers are reemployed (if at all) in lower-wage competitive industries or in the service sector.

Finally, standard trade models assume balanced trade and full employment overall, which is why their predictions center on changes in commodity and factor prices (which have to be flexible in order for markets to "clear" and thus maintain full employment with balanced trade). In reality, prices and wages are not so flexible, and imbalanced trade and unemployment frequently coexist. Under these circumstances, trade can have a variety of effects not contemplated in conventional models. For example, the impact of trade can be felt more on employment than on wages. Trade deficits, especially if concentrated in high-wage sectors such as manufacturing, can have an especially depressing effect on both employment and the average wages of those employed. As we shall see below, the empirical studies thus far have found more evidence for negative
employment effects of trade than for wage effects, although there may be some statistical biases in the currently used methods that make it hard to measure the latter accurately.

As the preceding discussion illustrates, small alterations in the analytical framework used can cause considerable variations in the predicted effects of trade on income distribution. Wages may rise or fall, or become more or less unequal, depending on the sizes of the various offsetting effects. We cannot look to theory to provide definitive answers to the questions we are examining. Instead, we must turn to the empirical research that tries to measure the impact of these offsetting changes.

**Empirical Studies of Trade and Labor Market Performance**

The literature on international trade and labor market performance is large and growing. This section organizes the literature into five topics. The first deals with studies of the effects of increasing trade on wages and employment in the manufacturing sector. The second topic is the effect of growth in international trade on the quality of jobs, both within the manufacturing sector and in the economy as a whole. The third topic is whether and how trade has influenced the average wage level throughout the economy. The fourth topic is whether trade is a source of increased wage inequality among different groups of workers, especially those with different levels of skill or training. The fifth and last topic is studies that have explicitly tested the relevance of the Stolper-Samuelson and factor price equalization theorems from trade theory.

**The Effects of Trade in the Manufacturing Sector**

The impact of trade is likely to be felt first and most strongly in the manufacturing sector. Although manufacturing accounted for only 18.5 percent of U.S. GDP in 1991, manufactured goods accounted for 63 percent of the value of trade in goods and services. Duchin and Lange (1988) found that the trade deficit of 1987 was associated with the loss of 5.1 million job opportunities, of which 3.1 million were lost in the manufacturing sector. More recently, Sachs and Shatz (1994) have found that the increase in the trade deficit in manufactured goods between 1978 and 1990 reduced employment of production workers in manufacturing by 6.5 percent, compared with a reduction of 2.7 percent in nonproduction employment.

Befitting the importance of trade in goods, the literature on international trade in manufacturing industries is extensive and varied. Industry-level studies of the effects of international trade in manufacturing vary considerably in how trade is measured, the period under study, the specification of models, and estimation techniques. Table 3.1 (pages 74–75) summarizes the most important recent studies.

Using measures of import and export quantities for 428 manufacturing indus-
tries for the period 1958 to 1984, Freeman and Katz (1991) find that a 10 percent increase in imports reduces wages within an industry by 0.0 to 0.64 percent and employment by 5 to 6 percent. Equivalent increases in exports raise wages by 0.0 to 0.76 percent and employment by about 7 percent. Using the same data set as Freeman and Katz, Brauer (1990) examines both the within-industry and the between-industry effects of imports and exports on wages. Between industries, an industry with a 10 percent greater volume of imports would have a 3 percent lower wage; a similar difference in the volume of exports would cause the wage to be 1.3 percent higher. Within an industry, a 10 percent increase in the volume of imports would reduce the wage by 1.0 to 1.8 percent. Exports do not have a statistically significant within-industry effect on wages.

Some studies have looked only at the import side. Grossman (1987) estimated the wage and employment consequences of trade within nine import-sensitive industries for 1967–79. He found that declining import prices reduce hours of employment in eight of the nine industries (the exception was photographic equipment). A 10 percent decline in real import prices was found to cause hours of work to fall by 30 percent in radio and TV equipment, 6 percent in the pottery industry, 7 percent in hardwood veneers, and 5 percent in leather tanning. Smaller effects were found for footwear (2.6 percent) and ball bearings (3.2 percent). Estimated wage elasticities also varied considerably between industries, but all were much smaller than the employment effects. Grossman’s estimates show that wages declined by between 0.07 and 1.3 percent in response to a 10 percent decrease in the price of imports, depending on the industry.

Based on these figures, Grossman concluded that imports have not had a major effect on hourly wages and, excepting radios and televisions, have not cost the United States a significant number of jobs. However, given the import price decreases actually experienced during Grossman’s sample period, imports had negative employment effects in the range of 10 to 23 percent for four of the nine industries covered, and 71 percent in the radio and television industry. These are not negligible employment effects.

In later research that focused on the effect of import volume on the wages of individuals between 1981 and 1986, Heywood (1991) and Heywood and Broehm (1991) found that a 10 percent increase in imports was associated with a 1 percent lower wage. Revenga’s (1992) study of thirty-eight importing industries for the period 1977 to 1987 estimates that a 10 percent decline in the real import prices faced by an industry is associated with a 2.4 to 3.9 percent decline in employment and a 0.6 to 0.9 percent decline in wages in the industry. This study is especially noteworthy for the careful attention paid by the author to some of the statistical problems that are inherent in the estimation of the trade-jobs and trade-wages relationships.

That imports reduce both wages and employment is not surprising; what may be surprising is that the employment effects are consistently larger than the wage effects. In all the studies that consider both employment and wage effects, esti-
Table 3.1

Studies of Wage and Employment Effects of Trade in U.S. Manufacturing

<table>
<thead>
<tr>
<th>Study</th>
<th>Issues and Methods</th>
<th>Estimated Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grossman (1987)</td>
<td>Employment and wages in nine import-sensitive industries from 1967 to 1979. Limited numbers of observations and large numbers of variables make estimates subject to substantial variation.</td>
<td>A 10% decline in the price of imports causes a 2.6–30% decline in employment and a 0.07–1.3% decline in wages, depending on the industry.</td>
</tr>
<tr>
<td>Freeman and Katz (1991)</td>
<td>Use data on 428 four-digit SIC(^2) industries to calculate changes between 1958 and 1984. Regressions include controls for unionization, percentage of production workers in the labor force, and two-digit industry. Some models include controls for value added.</td>
<td>A 10% increase in imports causes wages to fall 0.0–0.6% and employment to fall 5–6%. A 10% increase in exports causes wages to increase 0.0–0.76% and employment to increase 7%. Imports have a negative effect on within-industry earnings during 1958–70 and 1980–84. Exports have a positive effect on wages before 1970, but no effect after that.</td>
</tr>
<tr>
<td>Freeman and Katz (1991)</td>
<td>Part of the previous study using CPS data for 1974 and 1984.</td>
<td>A 10% increase in imports reduces wages 2.3%. Exports do not have a positive effect on wages.</td>
</tr>
<tr>
<td>Brauer (1990)</td>
<td>Extends Freeman and Katz (1991) by using more flexible forms to allow for time effects.</td>
<td>Effect of imports on reducing wages increases steadily during the 1970s. By the end of the decade, a 10% increase in imports reduces wages 2.3%. Effects of exports on wages show no trend through the decade and are unstable.</td>
</tr>
<tr>
<td>Heywood (1991), and Heywood and Broehm (1991)</td>
<td>Use Panel Study of Income Dynamics to look at the effect of individuals shifting between industries affected by different levels of imports.</td>
<td>An industry with 10% higher imports has wages that are 1% lower.</td>
</tr>
<tr>
<td>Source</td>
<td>Summary</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Revenga (1992)</td>
<td>Instrumental variables estimates using panel data for 38 industries for 1977-87. Import prices are instrumented exchange rates. A 10% decline in the price of imports causes a 2.4-3.9% decline in employment and a 0.6-0.9% decrease in wages.</td>
<td></td>
</tr>
<tr>
<td>Martines (1993)</td>
<td>Analyzes how market structures and product differentiation affect the relationship between international trade and wages. Uses data on 22 industries in 12 OECD countries for 1970-90 to estimate country-specific, within-industry wage equations. Imports reduce wages in industries with little product differentiation and competitive market structures; exports have some tendency to increase wages under these conditions. Results with other market and product structures are too mixed to support any theory.</td>
<td></td>
</tr>
<tr>
<td>Gaston and Trefler (1994)</td>
<td>Uses 1984 CPS data with appended industry trade data to measure between-industry effects on wages. Imports do not reduce wages, but a 10% difference in export shares between industries will raise wages 44%. A 10% higher rate of growth of imports reduces wages 13.7%. A 1 standard deviation increase in tariff rates would reduce wages 3.4%.</td>
<td></td>
</tr>
<tr>
<td>Davis, Haltiwanger, and Schuh (1994)</td>
<td>Effect of imports and exports on job loss and job stability. The 20% of establishments in industries most affected by imports have 3 times the rate of job loss as the remaining 80% of establishments, but the 20% of establishments with the largest exports do not have lower rates of job loss than the remaining 80% of establishments.</td>
<td></td>
</tr>
<tr>
<td>Sachs and Shatz (1994)</td>
<td>Consider how trade, particularly with developing countries, has affected employment and the employment of skilled and unskilled workers. In manufacturing, 5.2% of employment was lost due to trade between 1978 and 1990. Of this, 4.2% was lost due to trade with developing countries. All loss of nonproduction employment during this period is ascribed to trade with developing countries.</td>
<td></td>
</tr>
</tbody>
</table>

---

^Standard Industrial Classification.

^Organization for Economic Cooperation and Development.
imated employment effects are considerably larger than wage effects regardless of whether imports are measured by prices or volumes. If these results are reliable, then, at least in manufacturing labor markets, responses to changing trade conditions are dominated by shifts in quantity (employment) rather than price (wage).

If the employment shifts consequent to international trade are not realized mainly as shifts in the level of unemployment or labor force participation, there is an additional implication that increased trade will reallocate employment between industries. "Taken together with the findings of Murphy and Welch [1991] among others, these results suggest that workers are highly mobile across industries . . ." (Revenga 1992, p. 277). By shifting the labor supply of industries outside the traded goods sector, international trade will affect wages and workers throughout the economy. Measurement of the full impact of international trade on labor markets will involve accounting for such shifts in employment and wages.

However, it is also possible that the small estimated effects of imports on industry-level wages in all the existing studies reflect a statistical difficulty in estimating this type of effect. It should be recalled that the jobs in any given industry offer a range (or "distribution") of wages, not a single wage rate. Brauer and Hickok (1994) and Wood (1994) suggest that increases in trade, particularly with low-wage countries, are likely to have their largest effects on low-productivity, low-wage U.S. producers and will drive some of these producers from the market. Under such a scenario, if the wages of the surviving employees remained unchanged, then increases in imports would lead to an increase in the industry-average wage, since many of the lowest-wage jobs would be eliminated. It may be that the small measured effects of imports on average wages are a consequence of this "selection effect," counterbalancing import-induced wage declines for the remaining workers.17

There is also some evidence that the negative effects of imports on wages at the industry level have increased over time. Exploring an unexpected lack of relationship between trade and wages in a particular data set, Freeman and Katz (1991) reestimated their model over the three subperiods 1958–70, 1970–80, and 1980–84.18 Import shares have the expected negative effect on within-industry earnings for the periods before 1970 and after 1980, but no effect during the middle period. The estimate for 1980–84, that a 10 percent increase in import volume would cause a 0.7 percent decline in industry wages, is comparable to estimates for 1958–84, reported earlier. In contrast, exports had a positive wage effect prior to 1970 and no statistically measurable effect after that. Analysis of Current Population Survey (CPS) data confirms these patterns. Aggregating wages by two-digit industry, Freeman and Katz find that between 1974 and 1984 a 10 percent increase in imports was associated with a 2.3 percent decline in wages, but that there was no statistically detectable relationship between exports or domestic demand and wages.19
Brauer (1990) confirms and extends these estimates. Brauer finds that imports had no measurable effect on wages prior to 1970. The effect increases steadily in the 1970s until, by the end of the decade, an industry with a 10 percent higher volume of imports would have 2 to 3 percent lower wages. The effect of exports has no trend, but there is considerable annual variation. Depending on the year, an industry with a 10 percent higher volume of exports would have wages that were 1.5 to 8.5 percent higher than those of an otherwise comparable industry. Brauer also compares the effect of imports and exports in two periods: 1983–85 and 1975–77. His estimates indicate that exports did not have a statistically significant effect on wages in either period, but that the effect of imports increased between the two periods. While a 10 percent increase in imports reduced wages by 1.1 percent in the mid-1970s, a similar increase in imports reduced wages by 1.8 percent in the mid-1980s.

Such findings, which suggest that trade is undergoing structural changes unfavorable to American workers, is consistent with the work of Sachs and Shatz (1994) on trade with developing countries. This research finds that increased trade with developing countries has been the source of most trade-related employment loss over the last decade. Thus, it appears that research from the 1960s and the 1970s no longer accurately represents the effects of trade.

As noted earlier, contemporary theory explains how economies of scale and imperfect competition may limit or reverse the wage and employment consequences of the SS and FPE mechanisms. An implication of these theories is that industry and product market structures mediate the effects of trade. In particular, industries in which producers have control over price and in which there are high levels of product differentiation will perform better in export markets and in markets in which they face competition from imports.

Martines (1993) investigates the role of industry and product-market structure in mediating the effect of imports on wages. Using industry data on twenty-two consistently defined industries for twelve industrialized countries between 1970 and 1990, he finds a negative effect of imports on wages in industries with competitive market structures and little product differentiation. There is a strong negative relationship between imports and within-industry wages for competitive industries selling undifferentiated products. For the United States, a 10 percent increase in imports would cause a 2.4 percent decline in industry wages. The effect of exports under this market structure is less certain; there is a positive relationship in half the countries, but there is no statistically significant relationship in the other half. For the United States, a 10 percent increase in exports would cause U.S. wages to rise by 3.5 percent in competitive industries with undifferentiated products. Martines’s results for other industry and market structures (competitive with differentiated products, oligopolistic with undifferentiated products, and oligopolistic with differentiated products) are less certain, however. To the degree that any general conclusion may be reached from Martines’s study, it is that imports depress wages in competitive industries.
As noted earlier, some trade theories predict that increased trade with developing countries, which have large endowments of low-skilled workers, will have negative effects on less skilled workers in American manufacturing, particularly in industries with a large proportion of low-skilled employees. This is confirmed by Sachs and Shatz (1994). They find that, from 1978 to 1990, trade with developing countries was concentrated in industries that required lower levels of worker skill and paid relatively low wages. Trade deficits with the developing countries were largest in the industries with the highest proportion of low-skilled employees.  

Industries with the smallest proportion of low-skilled workers frequently have trade surpluses. Industry trade deficits are particularly large where industry skill requirements are low and the wages of trading partners are low relative to the wages paid by the U.S. industry. Job loss is also closely associated with trade with developing countries. Almost all of the manufacturing employment lost to trade between 1978 and 1990 (5.7 percent out of 5.9 percent) is associated with trade with developing countries. Virtually all trade-associated loss of non-production-worker employment is due to trade with developing countries.

What conclusions may be drawn from this literature? First, there is evidence that international trade affects both wages and employment in the manufacturing sector and that the employment effects are several times the size of the wage effects. Although the estimated effects of trade on wages have been moderate, increased trade has reduced employment in manufacturing by about 6 percent, or about 1 million jobs, since 1978 (Sachs and Shatz 1994). Second, the negative consequences of imports for wages seem to have been increasing through the 1970s and the 1980s. Third, the relatively large employment effects of trade suggest considerable mobility of workers between jobs, which in turn implies that the problems of manufacturing are unlikely to remain within that sector. By displacing labor from manufacturing, international trade increases the supply of labor to other sectors that generally pay lower wages, and also places downward pressure on wages in those sectors.

Loss of wage leadership from the manufacturing sector may also be a source of poor wage performance throughout the economy. As recently as the early 1980s, pattern bargaining, wage contours, and wage emulation linked national wage trends to the negotiated wages and benefits of autoworkers, steelworkers, and others in the manufacturing sector. The continued existence of wage linkages between manufacturing and other industries is confirmed in the work of Galbraith and Calmon (1994), who find that wage movements in men’s and women’s clothing, department stores, and shoe stores are similar to those in the textile industry; wage movements in grocery stores are similar to those in bakeries and breweries; and wage movements in auto dealerships are similar to those of autoworkers. Given such linkages, slackening job and wage growth in manufacturing might well have disproportionate influence on wages throughout the economy.
Trade and Job Quality

One aspect of the poor performance of the U.S. labor market has been its flagging capacity to create "good" jobs, as reflected in the slippage in income and benefits over the last twenty years, documented above. Also as discussed previously, jobs in export industries tend to pay higher wages than those in import-competing industries. Some economists have therefore suggested that balanced expansion of international trade could play an important role in improving the quality of jobs by shifting workers from lower- to higher-wage industries. Historic evidence cited by Katz and Summers favors this argument:

Between 1960 and 1980 the number of jobs displaced by imports was approximately equal to the number of jobs created by exports. Particularly during the 1970s increased imports led to a reallocation of labor out of the lowest-wage jobs in the manufacturing sector, and increased U.S. exports led to a rise in employment in high-wage sectors of the economy. (1989, p. 266)

The dynamic by which increased imports eliminate the lowest-wage jobs in the manufacturing sector is also apparent even through the early 1980s:

During the 1980s the fraction of workers employed in producing tradable goods declined as the trade deficit increased. Between 1980 and 1984, ... the increase in the trade deficit was associated with a reduction of 1.4 million workers producing traded manufacturing goods. More than 600,000, or 45 percent, of these workers had been employed in the quartile of industries that paid the lowest wages. This reflects the substantial increase in import penetration in industries like apparel during the early 1980s. (Katz and Summers 1989, p. 266)

Katz and Summers estimate that if the $150 billion manufacturing trade deficit were reduced through increased exports, rather than a reduction of imports, labor income would increase by $13 billion.

This favorable view of export jobs is, in part, an artifact of a focus on manufacturing, but international trade also involves industries and jobs outside manufacturing. Export growth has been an important source of employment growth in several low-wage industries, particularly agriculture and wholesale warehousing. Allowing for employment outside manufacturing in the calculation of trade-associated wage premiums reduces the wage difference between importing and exporting industries to five cents per hour, less than one-twentieth of Katz and Summers's estimate (Dickens and Lang 1988, pp. 100–105). As noted previously, the shift of some workers out of manufacturing and into services as a result of trade further weakens the case for job improvement via trade expansion, since even import-competing manufacturing jobs tend to pay better than nonmanufacturing jobs.

The work of Katz and Summers (1989) and of Dickens and Lange (1988),
which considers the average consequences of trade, implicitly compares a manufacturing sector with trade to one without trade. An alternative approach, more relevant to foreseeable policy decisions, is to examine the consequences of moderate (marginal) changes in the amount of imports and exports. The econometric studies reviewed previously in this chapter find that, even within manufacturing, there is little evidence for a favorable trade-off between export-producing and import-competiting jobs at the margin. The only study clearly favorable to exports is Gaston and Trefler (1994), which finds the positive effects of exports to be substantially larger than the negative effect of imports and import growth. However, this study seems to suffer from a number of econometric flaws, especially in regard to a problem of omitted variables. In contrast, Freeman and Katz (1991), Brauer (1990), and Martines (1993) find that parallel expansion of imports and exports would have largely offsetting wage effects. Freeman and Katz and Brauer also find that the detrimental effects of imports on wages have been rising over the last two decades, while the effects of exports have been stable or declining.

The literature is not united in demonstrating that balanced growth in trade will lead to job upgrading either in the economy as a whole or within manufacturing. The evidence on the effect of moderate increases in trade finds that balanced increases in exports and imports would, at best, have slightly positive effects on wages, but this may differ for trade with different groups of countries. Even here, the long-run trend toward larger trade deficits in the manufacturing sector makes gains from exporting moot, unless this trend is turned around.

Trade and the Performance of Average Wages

Of all the topics covered by this review, the effect of international trade on average wages in the U.S. economy is the least researched. Most economists now agree that average real wages stagnated, the real wages of the majority of employees declined, and wage inequality rose during the last decade. However, there is no consensus on whether factors related to international trade, such as increased import penetration, foreign productivity growth, or the rising trade deficit could account for any part of these trends in average wages. Robert Z. Lawrence and two coauthors (in Lawrence and Slaughter 1993; Lawrence 1994; Krugman and Lawrence 1993) have argued strenuously that trade cannot be part of the explanation because real wages, properly measured, have closely tracked labor productivity. The slow growth in wages observed over the last decade is therefore caused by sluggish growth in productivity rather than by forces such as international trade, which would have caused divergence between wages and productivity, according to these authors.

The crux of this argument is that real wages have not been measured in a correct fashion for comparisons with productivity. Lawrence and his coauthors argue that the usual measure of real wages underestimates growth of total labor
compensation because it does not include benefit costs, because the survey of wages on which it is based excludes 20 percent of the workforce, and because it is deflated by consumer rather than product prices. According to these economists, there is no gap between wage and productivity growth when total compensation is deflated by product prices, and hence there is no "puzzle" to be explained by international competitive forces.

This argument is illustrated in Table 3.2, which shows how Lawrence, Slaughter, and Krugman move from a standard measure of the real wage to their preferred measure. Between 1979 and 1991, labor productivity as measured by the Bureau of Labor Statistics (BLS) rose by a total of 10.4 percent. The standard measure of the real wage, which is the ratio of the wage rate for production and nonsupervisory workers in the BLS Employment, Hours, and Earnings series to the BLS consumer price index (CPI), fell by 11.0 percent. This leaves a productivity-wage gap of 21.4 percent, which is the apparent excess of the increase in productivity over the increase in the real wage (and this number is larger than the productivity increase since the real wage as conventionally measured actually fell).

Lawrence and his coauthors claim that this entire gap is illusory. If the standard wage measure is replaced by a measure of total compensation that includes benefit costs and covers both wage and salary workers (along with sole proprietors),24 the compensation per hour actually rose by 1.5 percent between 1979 and 1991. Half of this increase is attributable to inclusion of benefit costs, the other half to inclusion of employees outside the production and nonsupervisory classification. The second correction is to shift from deflating wages by consumer prices to deflation by a measure of producer prices. Although consumer prices are appropriate for the evaluation of consumer welfare, producer prices are the appropriate deflator in an evaluation of how closely wages have tracked output per worker-hour (labor productivity). The shift from the CPI to the GDP output deflator causes the increase in total real compensation per hour to rise from 1.5 to 9.5 percent. Since labor productivity rose by 10.4 percent between 1979 and 1991, there is only a negligible productivity-wage gap of 0.9 percent over a twelve-year period. In other words, by this calculation there is virtually no productivity-wage gap to explain, and hence there is no reason to believe that trade has depressed wage (compensation) growth.

We could certainly challenge the inclusion of the salaries of managers, executives, and other "overhead" employees, as well as the income of self-employed proprietors, in the "total compensation" to be attributed to U.S. "workers." The self-employed are not employees by definition, and managers, executives, and other professional employees certainly do not fit commonly accepted notions of who "workers" are. Moreover, the "salaries" of many managers and executives contain elements that mimic returns to ownership rather than to labor effort. Even leaving this issue aside, other problems of measurement remain.

The appropriateness of the GDP deflator used by Lawrence and his coauthors has been questioned by Hall (1993), who argues that it is better to use the final
Table 3.2

Alternative Measures of Real Wage Change and the Productivity-Wage Gap 1979–91 (except as indicated)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Real Wage Change</th>
<th>Productivity-Wage Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard measure (ratio of EHE* wages to the CPI)</td>
<td>-11.0%</td>
<td>21.5%</td>
</tr>
<tr>
<td>Replace EHE wages with BEA/BLS measure of total compensation</td>
<td>1.5</td>
<td>8.9</td>
</tr>
<tr>
<td>Replace CPI with GDP deflator</td>
<td>9.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Replace GDP deflator with final output deflator</td>
<td>5.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Replace BEA/BLS measure of total compensation with current-weighted ECI (1977–89, private sector only)</td>
<td>-7.4</td>
<td>17.1</td>
</tr>
</tbody>
</table>

Sources: Lawrence and Slaughter (1993) for the first four measures. The last measure was constructed by the authors from data reported in Mishel and Bernstein (1993, table 3.2, p 132) after converting from a CPI deflator to the NIPA final output deflator.

Notes: All numbers in the table are total percentage changes for the years indicated. The productivity-wage gap is the difference between the productivity growth rate of 10.4% from 1979 to 1991 and the growth rate of the real wage for the same period (according to each definition shown in the table), except in the last row, where the years are different. All CPIs referred to in this table are for all urban consumers.

*Employment, hours, and earnings.

product deflator (excluding investment goods) from the BLS National Income and Product Accounts (NIPAs), rather than the total GDP deflator (from the same accounts), which includes investment goods that are properly regarded as a type of intermediate good. With this correction, the increase in real compensation is reduced to 5.1 percent, and a small wage-productivity gap (of 5.3 percent over 12 years) is opened up.

There are also measurement issues with the total compensation index used by Lawrence and Slaughter, which we call the BEA/BLS index. Lawrence suggests that rapid growth of this index reflects the faster growth of benefit payments relative to wages. The data underlying the BEA/BLS index show nominal, per capita benefit costs growing about 20 percent faster than nominal wages (91.9 versus 71.1 percent) between 1979 and 1991. However, this large gap is not consistent with other indexes of wages and benefits. The methodologically superior fixed-weight Employment Cost Index (ECI) of the BLS indicates that the difference between growth in wages and total compensation was only 9 percent.

An alternative measure of total compensation from the NIPAs indicates that benefit costs rose only 3 percent faster than wages. Movements in both the fixed-weight ECI and the NIPA compensation series are consonant with the finding of Bosworth and Perry (1994) that, as rapid increases in some compo-
ments of total benefit costs (medical care) have been offset by declining costs in other areas (notably pension costs), total benefit costs have risen only slightly more rapidly than wages. 29 Further confirmation is found in Bound and Johnson (1992, p. 372), who report that benefit increases accounted for only one-eighth of the change in total compensation between 1979 and 1988. Benefits are unlikely to explain a substantial portion of the gap between wages and productivity.

Thus, it appears that the BEA/BLS index of total compensation overestimates increases in total compensation. 30 This suspicion is confirmed by comparison of the BEA/BLS index to a current-weighted version of the ECI, which adjusts for changes in the distribution of employment between occupations and industries. Using this variant of the ECI for the period 1977–89 31 and deflating by the NIPA final output deflator, real compensation per hour fell by 7.4 percent. This contrasts with the 6.6 percent rise in total real private sector compensation found by the similarly deflated BEA/BLS measure, and opens up a wage-productivity gap of 17.1 percent between 1977 and 1989. In other words, an accurately measured wage-productivity gap is nearly as large as the gap implied by the standard measure of real wages rejected by Lawrence and his coauthors.

Apart from all these measurement issues, there are two conceptual problems with the argument of Lawrence and his coauthors. First, in their view, trade can affect wages only if it opens up a wedge between growth in productivity and in the real product wage. Another way of stating the same point is that trade-induced wage reductions must be associated with a decline in labor's share of national income. These authors therefore take the apparent stability of labor's share between 1979 and 1991 as further evidence that trade has not influenced wages.

However, stability of the wage share does not necessarily mean that wages are not being affected by trade. Consider once again the Lawrence argument against the use of CPI-deflated real wages. This argument hinges on the (correct) presumption that the prices of consumer goods and services (as measured by the CPI) have risen relative to the average price of total output (whether measured by the GDP deflator or the final output deflator, although more so with the former). Why has this relative price change occurred? The CPI includes many nontradable goods and services, such as housing and health care, as well as food products that have prices linked to agricultural supply and demand conditions. But national output as a whole includes many manufactured goods that are traded in highly competitive global markets (including investment goods, if we use a GDP measure as Lawrence does). This could be one reason why, as Clarida and Hickok report,

A rebound in manufacturing productivity [in the 1980s] did not translate into a significant rise in real manufacturing wages—or profits, but instead resulted in a substantial fall in the relative price of manufactured goods. (1993, p. 175)
If international competitive pressures restrain or reduce the prices at which domestic producers can sell these products, this could help to explain why their prices have fallen relative to a typical "basket" of consumer goods and services. Firms whose ability to set prices is thus constrained may, in turn, pressure their workers to agree to lower nominal wages than they would otherwise accept. In this case, both labor and capital income (real wages and profits) could be reduced by trade, and as a result the wage share of total income would remain fairly stable.

A second point is that, even if real wage increases have closely tracked productivity increases, trade could have affected the slowdown in productivity growth and thus impacted on real wages as well. Indeed, the average annual rate of productivity growth for the nonfarm business sector fell from 2.8 percent in 1960–69 to 1.4 percent in 1970–79 and 1.0 percent in 1980–89.\textsuperscript{32} If the shift of manufacturing overseas (part of which is attributable to U.S. companies' investing abroad rather than at home) has contributed in any way to the productivity growth slowdown at home, then this could be causing real wage growth to falter even without workers getting a lower share of total income. Both of these points are speculative at present and cannot be decided without further empirical research. These points are raised here merely to show that the type of argument put forward by Lawrence and his coauthors is not sufficient to rule out possible negative effects of trade on average wages without additional types of evidence beyond what these provide.

\textit{International Trade and Relative Wages}

International trade can affect the wages of large parts of the working population without affecting the average wage. If trade simultaneously reduces wages for some groups of employees and induces counterbalancing increases for other groups, then the average wage may be unchanged while the economic condition of large parts of the population shifts dramatically. Such shifts in the structure of wages will be reflected in movement in income inequality. In fact, the body of research on the effect of trade on wage inequality is much more extensive and better developed than the research on how trade affects average wages. The existing research focuses in particular on how trade may have served to worsen the economic position of less skilled workers.\textsuperscript{33} Table 3.3 (pages 86–87) provides a summary of the most important studies in this category.

One approach to the issue of wage inequality is to calculate, first, the effect of trade on the effective supply of labor for various parts of the population and, second, how changes in their labor supply have affected wages. Borjas, Freeman, and Katz (1991) use data for the period 1964–88 from the Current Population Survey (CPS) to estimate worker-hours, employment, and wages for sixty-four skill groups defined by gender, education, and experience. These figures are then combined with data on imports and exports from the Annual Survey of Manufac-
tures (ASM) to determine the labor supply needed to produce exports and the implicit increase in the supply of labor associated with the import of goods from abroad.

The results indicate that international trade had different effects on aggregate labor markets before and after 1983. Before 1983, trade had little effect on implicit labor supplies. With some exceptions, labor supply was either unaffected or reduced by the net effect of imports and exports. This changed beginning in 1983, when increased imports added 0.5 percent to the domestic supply of labor. By 1984 the increase in the trade deficit increased labor supply by 1.3 percent; in 1985 this figure rose to 1.6 percent. Although these numbers may appear to be small, they represent 7.0 percent of hours in the manufacturing sector, which is where most of the increased trade deficit occurred. Results are not altered if labor supply is measured in efficiency units, a skill-adjusted measure of labor supply.

The effects of trade were not spread evenly by education or gender. For male high school dropouts, the trade deficit of the 1980s increased the implicit supply of labor by between 4 and 8 percent; for female high school dropouts, the increase was 8 to 13 percent. The implicit supply of high school graduates rose by 2 to 3 percent for males and by 2 percent for females. Depending on the period under consideration, trade either did not affect or reduced the supply of college-educated workers. Effects within the manufacturing sector were larger, with trade increasing the supply of employees without high school diplomas by 14 to 27 percent for men and by 24 to 40 percent for women. Overall, increases in the trade deficit increased the relative supply of non-college-educated labor.

How did this affect relative wages? Drawing on outside estimates of the elasticity of the wage with respect to labor supply, Borjas, Freeman, and Katz (1991) calculate that increased relative labor supply associated with trade and immigration explains between 14 and 27 percent of the increase in inequality between high school and college graduates for the period 1980–85 and between 8 and 15 percent for the period 1980–88. How are these effects divided between trade and immigration? For both years the increase in the supply of high school–equivalent employees relative to college-degreed employees is entirely attributable to trade; immigration did not contribute to the increase in the supply of labor.

The effects of trade and immigration on the wages of employees without high school educations are larger, accounting for about 40 percent of the relative wage decline suffered by this group between 1980 and 1988. Between 1980 and 1985, trade and immigration together caused an increase in wage inequality of 28 to 68 percent between those with less than a high school education and the remainder of the labor force. Trade contributed one-third of the increase in the supply of non-high-school-educated labor relative to all other employees, with immigration accounting for the remaining two-thirds. Thus, from 9 to 23 percent of the increase in wage inequality between U.S. dropouts and all other employ-
### Table 3.3

**Studies of International Trade and Relative Wages**

<table>
<thead>
<tr>
<th>Study</th>
<th>Issues and Methods</th>
<th>Estimated Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borjas, Freeman, and Katz (1991)</td>
<td>How international trade and immigration have affected the supply of labor of various skill levels.</td>
<td>International trade shifted from decreasing to increasing the effective supply of labor in the United States in the early 1980s. By 1985, trade added 1.5% to the labor supply. For male high school dropouts, trade increased the labor supply by 4–6%; for high school graduates, the figure was 2–3%. Trade did not affect or reduce the effective supply of college-educated labor during this period. Effects within manufacturing were much greater. The ratio of the wages of high school graduates to college graduates fell 8–15% due to trade. The wages of those who had failed to complete high school declined 9–23% relative to the rest of the population because of trade.</td>
</tr>
<tr>
<td>Murphy and Welch (1991)</td>
<td>CPS data for 1979–86 are aggregated into four industry groupings: nontraded goods, durable goods, nondurable goods, and traded services. Data on trade patterns are then used to calculate the effects of trade on labor demand.</td>
<td>Trade accounts for 0.80–1.36% of the 3.43% decline in male wages, and 1.35–2.31% of the 5.81% increase in women's wages between 1979 and 1986. By level of education, 1.55–3.14% of the 7.33% fall in the wages of those with less than a high school education is accounted for by trade. Trade caused 0.36–0.45% of the 3% decline in wages of those with high school educations.</td>
</tr>
</tbody>
</table>
### Table 3.3 (continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katz and Murphy (1992)</td>
<td>Similar to Murphy and Welch but uses less aggregate data. Estimates allow only for the immediate effects of trade and do not allow for input-output linkages. Measured effects of trade are smaller than the earlier article. For males with less than a high school education, trade reduced employment by 0.63–1.48% from 1979 to 1985; for women in this group, the trade-induced reduction in employment was 2.2–4.0%. For male high school graduates, the reduction was 0.28–0.71%; for female high school graduates, it was 0.16–0.27%. Trade increased demand for those with at least some college education.</td>
</tr>
<tr>
<td>Wood (1994)</td>
<td>Factor content analysis modified to allow for trade-induced changes in factor utilization and induced technological change. International trade has reduced demand for manufacturing labor in developed countries by 12% and increased demand for skilled labor by about 5.5%. Induced technological change has doubled these effects.</td>
</tr>
<tr>
<td>Borjas and Ramey (1994)</td>
<td>Uses cointegration to measure the relation between a variety of factors, including the trade balance in durable goods and the ratio of high school to college wages. The trade balance in durable manufacturing is the only cointegrating factor related to wage inequality. Imports have a large effect on increasing wage inequality, while exports reduce inequality in a less pronounced fashion.</td>
</tr>
</tbody>
</table>

Ees in the period 1980–85 can be attributed to changes in the trade deficit.

An alternative to the labor-supply approach of Borjas, Freeman, and Katz is to model the effects of trade on the demand for labor of different types. This approach, developed by Murphy and Welch (1991), recognizes the fact that there are substantial interindustry variations in worker characteristics such as the level of education and racial and gender composition. Given such differences, trade that is concentrated in certain industries will have a large effect on groups of workers disproportionately employed in those industries. Dividing industries into those producing traded durable goods, traded nondurable goods, traded services,
and nontraded goods, Murphy and Welch calculate the effect of trade on the product demand for each sector and then translate that shift into demand for labor in that industry.

Using this method, Murphy and Welch find that the increase in the trade deficit between 1979 and 1986 and the consequent decline in employment in manufacturing reduced the demand for and depressed the wages of the employees with less than a college degree but had little effect on the college educated. The authors estimate that the trade deficit caused employment to decline by 14.7 percent in durable goods manufacturing and by 1.8 percent in nondurable goods manufacturing; it increased employment slightly in traded services and by 4.1 percent in nontraded services. Translating these sectoral changes into changes in demand for different qualities of labor, international trade decreased employment for men with less than a high school education by between 2 and 3.5 percent. Men with high school diplomas saw a 1.25 to 2.3 percent decrease in labor demand, while trade increased demand for college-educated males by 0.7 to 1.5 percent. For women with less than a high school education, trade decreased demand by 0.6 to 2.2 percent. Women with high school education had a 1.0 to 2.2 percent increase in demand, while demand for women with college degrees increased by 3.3 to 4.3 percent.37

Murphy and Welch do not explicitly link labor demand and wages, but they report that the changes in demand comport with the changes in wages observed between 1979 and 1988. The wages of men with less than a high school education declined 10 percent between 1979 and 1986; for women the decline was 7.3 percent. In contrast, men with a college education saw their wages increase by 7.8 percent, and college-educated women saw a 9.4 percent increase. Those who faced declining demand due to trade also faced declining wages; those whose demand was buoyed by trade saw increasing real wages. The pattern of wage change on groups within the working population parallels the impact of trade.

The strongest statistical linkage between trade deficits and wage inequality is found by Borjas and Ramey (1994). They use the ratios of the wages of (1) college graduates to high school graduates and (2) college graduates to people with less than a high school education as measures of wage inequality. In their statistical analysis, the trade deficit in durable goods manufacturing is the only variable that is significantly correlated with these measures of wage inequality for the period 1963–88. Further estimates find asymmetries in the magnitude of the effects of imports and exports: imports increase wage inequality while exports decrease inequality in a less pronounced fashion.38

The durable goods manufacturing sector emphasized by Borjas and Ramey includes many industries that have historically operated in oligopolistic markets and earned “monopoly” rents. As discussed earlier, when compelled by unions to share these rents with workers, firms in these industries have paid high wages and provided generous benefits. Increased competition from imports reduced the rents and decreased both employment and wages. Production employees were
displaced into lower-wage sectors of the economy, thus reducing both average wages and the relative wages of workers with less than college degrees and the less skilled.

This explanation is incomplete, as it addresses only durable goods and, within that sector, firms with market power. Some of the industries most affected by trade, such as apparel and auto parts, produce under relatively competitive conditions. While not including monopoly rents, wages in these industries are higher than the wages available to workers outside manufacturing. Increased import competition based on lower wages and labor standards has displaced employment from these industries into other sectors with lower productivity and wages. This movement would have its largest effect on the wages of non-college-educated American workers.

Tests of the Factor Price Equalization and Stolper-Samuelson Effects

As discussed earlier, standard international trade theory implies that trade liberalization with developing countries that are abundant in (less skilled) labor can depress real wages in a more capital- and skill-abundant country like the United States. The FPE theorem predicts that wages of unskilled workers in rich and poor countries will tend to converge as trade barriers fall. The SS theorem also predicts that reducing tariffs on labor-intensive products will tend to reduce the wages of less skilled labor. As the earlier theoretical survey also showed, these propositions have been challenged by newer theories in which trade "lifts all boats" and raises wages. The magnitude of FPE and SS effects relative to other, offsetting effects is therefore an empirical question. This section reviews the studies that have explicitly sought to measure or test the importance of FPE and SS effects.

Lawrence and Slaughter (1993) and Lawrence (1994) have argued that the evidence is not consistent with SS effects in the U.S. economy. They argue that, in order for the SS theorem to hold, increased relative wages for more skilled workers must be associated with both a decline in the ratio of skilled to unskilled workers within each industry and an increase in the international price of skilled-labor-intensive products. Using scatter plots of disaggregated manufacturing industries, the authors argue that there is no relationship between relative wages and relative employment. Similarly, they conclude that the prices of skilled-labor-intensive goods fell, rather than rose, in the 1980s. In their view, some greater force such as technological change (which increases the demand for skilled labor) must have overshadowed the effects of trade on wage inequality predicted by SS.

This line of argument has been criticized by Leamer (1994) and by Sachs and Shatz (1994). Among other things, Lawrence and Slaughter do not control for the general increase in skill levels in the economy over the period under study.
In addition, the import and export price indexes used by Lawrence and Slaughter are not consistent, since the indexes for different industries cover different time periods (Sachs and Shatz 1994, pp. 36–37). Using more carefully constructed price indexes and controlling for the trend toward higher levels of skill, Sachs and Shatz find that the predicted inverse relationship between the proportion of unskilled employees in the labor force and changes in product prices holds for the 1980s.

More explicit research on factor price convergence comes to varying conclusions, but all studies find some evidence of wage convergence. Tovias (1982) found convergence in wages associated with the formation of the EC but divergence in the period 1969–77. Extension of this work by Gremmen (1985) indicated that greater economic integration reduced the tendencies toward factor price convergence. Mokhtari and Rashek (1989) found convergence in wages in sixteen countries of the Organization for Economic Cooperation and Development (OECD) during the period of increasing trade openness, 1961–84.

In some of the most recent research on this topic, Burgman and Geppert (1993) examine wage convergence between the United States, Canada, Germany, France, Japan, and the United Kingdom between 1950 and 1989 by testing for long-run equilibrium relationships and the speed of the convergence toward that equilibrium. Using a new econometric technique based on the cointegration of time-series data, the authors conclude that the economic linkages among these six countries are sufficiently strong that their wages are tied to one another and move in tandem. Further, if some event causes wages of one of these countries to diverge from this international equilibrium, they will realign over time. Germany, which has the most rapid rate of adjustment, would eliminate 29 percent of any deviation from the long-run equilibrium in the first year. Canada, with a much slower speed of adjustment, would offset only 8 percent.

Further evidence for relative wage convergence is reported by Davis (1992). He finds common, if not universal, trends in wage inequality, returns to education, and experience in the United States, Japan, the United Kingdom, France, Canada, Sweden, West Germany, Brazil, South Korea, Venezuela, and Colombia. Evidence for convergence is particularly strong in returns to education. In the 1980s, lower trade barriers were associated with reduced gains to education in middle-income countries and increased gains in more advanced countries where there was a higher proportion of educated workers in the labor force. However, the decrease in returns to education in the advanced countries in the 1970s does not comport with convergence in factor returns.

Davis’s results show that increased trade openness decreases the deviation of wages around the world mean. While his estimates vary among different models, on average a 10 percent increase in net trade as a percentage of gross national product (GNP) decreases the standard deviation of the wage residuals by 2 to 3 percent. Convergence occurs only in high-income countries; trade does not have an effect on relative wages in middle-income countries. The effects of imports
and exports are asymmetrical: imports produce a large and statistically significant convergence toward average wage structure, while exports induce a divergence from world wages that is smaller in absolute value than that of imports. Although the results are generally consistent with the FPE, the effect of exports is unexpected.

Leamer (1993) produced measures of SS effects in a study of the prospective distributional effects of NAFTA. According to Leamer’s calculations, a falling relative price of labor-intensive goods causes a small increase in the return to capital, a large increase in the earnings of professional and technical labor, and a substantial decline in the real wages of “other workers.” While acknowledging that his specific estimates were subject to considerable uncertainty, Leamer concluded that:

the numbers are in the right ballpark, and at least they serve to focus attention on the important fact that everyone need not benefit from increased international commerce. Indeed, if the reason for the expansion of international commerce is increased access to low-wage unskilled foreign labor, it is virtually certain that our low-skilled workers will have their earnings reduced. Reductions in annual earnings over the next decade on the order of $1000 seem very plausible. (1993, p. 122)

Challenges to the Trade and Wages Connection

While the evidence linking trade to declines in manufacturing employment and increases in wage inequality has been mounting, the studies pointing in this direction have not gone without challenge. We have already discussed some of the challenges here, but two major points have been asserted so widely that they require a more detailed discussion. The first, already alluded to above, is the argument that rising wage inequality is caused entirely by changes in technology rather than by increases in trade. The second is the contention that, even if some of these negative effects have been identified, they are “too small” to matter.

The Role of Technology

Some economists have asserted that technology, rather than trade, is responsible for rising wage inequality. The first Clinton administration Economic Report of the President endorses this technological determinist view:

Since the use of more-educated labor has increased in all industries, a logical explanation of this trend is technical change. For example, one study shows that people who work with personal computers earn a substantial wage premium over those who do not, and that this can account for half of the increasing gap between the wages of college and high school graduates. (U.S. Council of Economic Advisors 1994, p. 119)

Table 3.4 summarizes the few studies that actually support this position, along with some contrary studies of the same issue.
<table>
<thead>
<tr>
<th>Study</th>
<th>Issues and Methods</th>
<th>Estimated Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bound and Johnson (1992)</td>
<td>Uses 1973–74, 1979, and 1988 CPS data to examine the effects of structural shifts in labor demand, structural shifts in employment between industries, and specific and general technological change on wage inequality. General technological change is measured as a residual, and specific technology is interpreted as occurring in manufacturing, mining, transportation, and utilities.</td>
<td>General technological change accounted for 120% of the change in gross wages between high school and college graduates in 1979–88, and industry-specific technological change accounted for 11.7%. The increase in the supply of college men decreased wage inequality by 61%. Without offsetting factors, technological change would have increased gross wage inequality by an additional 31%.</td>
</tr>
<tr>
<td>Berman, Bound, and Griliches (1993)</td>
<td>Data on 450 industries for the period 1979 to 1987 are used to determine the sources of change in the ratio of production to nonproduction wages and employment.</td>
<td>10% of the increase in the ratio of nonproduction employees in manufacturing is associated with imports and exports. Only 3.3% of the decline in the earnings of production employees relative to nonproduction employees is accounted for by imports and exports.</td>
</tr>
<tr>
<td>Borjas and Ramey (1994)</td>
<td>Uses cointegration to measure the relation between a variety of factors, including the trade balance in durable goods and the high-school/college wages ratio.</td>
<td>There is no cointegrating relation between per capita R&amp;D expenditures and the high-school/college wage ratio or the less-than-high-school/college wage ratio for the period 1963–88.</td>
</tr>
<tr>
<td>Mishel and Bernstein (1994)</td>
<td>Uses ASM data for 1973–79 and 1979–89 for 34 two-digit industries and regressive measures of wage inequality on capital investment, investment in computers, and the proportion of employment in scientific and engineering positions.</td>
<td>There is no evidence that investment in technology was related to the acceleration of inequality in the 1980s or that investment in computers had a different effect from investment in other capital goods.</td>
</tr>
</tbody>
</table>
Table 3.4 (continued)

| Howell (1994) | Investigates whether the shift away from production employment in manufacturing came after investment in new technologies, particularly computers. | The decline in production employment was completed by the early 1980s and preceded the rapid increase in investment in computer technologies in most industries. |

The most frequently cited study in support of this view is by Bound and Johnson (1992). They consider various explanations of changes in the structure of relative wages, including changes in industry wage structure and unionization, changes in the structure of labor demand, shifts in employment between industries, industry-specific technological change, and general technological change. These authors find that adverse changes in wage inequality in the 1980s were almost entirely associated with what they call general technological change. By their calculations, general technological change accounted for 120.0 percent of the gross increase in the ratio of wages of college-educated to high school-educated men; industry-specific technological change accounted for another 11.7 percent. Thus, without offsetting factors, the technology factor alone would have caused wage inequality to increase 31.7 percent more than actually occurred between 1979 and 1988. By these calculations, technological change is the predominant source of increased wage inequality.

The biggest problem with Bound and Johnson's study, and it is a serious one, is their method of measuring technological change. In fact, these authors do not have an actual variable that measures general technological change; instead, they rely on a method that uses the "residuals" from a regression model, which they try to control for all relevant factors except technology, as the measure of technology.\(^{42}\) In other words, whatever part of the variation in relative wages is not explained by the factors actually included in Bound and Johnson's model is assumed to be explained by general technological change.\(^{43}\) In this method, any factor that is omitted will be reflected in the residuals of the model. Building a statistical model in which the only factor of consequence that is omitted is technology would be a difficult if not impossible undertaking. It is unlikely to be achieved by any specification, no matter how sophisticated. Despite the effort to remove the effects of changing patterns in industrial wage structure and product demand, factors such as unionization and trade likely remain part of the residual. That the estimated 120 percent residual effect includes technology is not in question; the issue is whether it also includes other factors such as trade. The authors are aware of this limitation in their method, as they admit here:

The major difficulty with this explanation, unlike the explanations involving industry wage effects, supply, and product demand, is (as in the analysis of
the sources of economic growth) that it involves the residuals of the intra-factor demand function rather than directly observable phenomena. (Bound and Johnson 1992, p. 383)

Unfortunately, the journalists and politicians who have cited Bound and Johnson’s study as proving that trade is a small or an irrelevant factor contributing to wage inequality have failed to note this important qualification.

Berman, Bound, and Griliches (1993) also find that technology, rather than trade, has been the preeminent force increasing both employment of nonproduction workers and wage inequality between production and nonproduction employees in manufacturing. The first step in their analysis is to distinguish the effects of international trade on wages and employment from those originating from domestic sources including technological change. Analyzing data on 450 industries, Berman and his coauthors find that trade accounted for only 18.0 percent of the increase in the proportion of nonproduction employees (i.e., skilled workers) in the labor force between 1979 and 1987, while changes in domestic, nonmilitary consumption account for 73.4 percent of that increase. Parallel results are obtained for the relative wages of nonproduction employees. These authors find that only 2.4 percent of the improvement in the relative wage position of nonproduction employees is attributable to trade, while 83.5 percent is attributable to domestic nonmilitary consumption. Given this weighty role for domestic conditions, technological change is a prime candidate for explaining increasing inequality.

Like Bound and Johnson (1992), Berman, Bound, and Griliches (1993) use a method that tends to minimize the estimated impact of trade. Basically, Berman and his coauthors assume that the causes of changes in the average ratios (the proportion of nonproduction workers in the labor force and the relative wage of nonproduction workers) are fundamentally domestic, and that only the differences between changes in this ratio in a given industry and the average change for all industries are due to foreign trade or defense spending.44 This is not an innocent assumption, and it strongly biases the results toward finding that the effects of trade are minimal.

An example may help to clarify this problem. Suppose there are two industries, one of which (industry A) only exports and one of which (industry B) only produces for domestic consumption. Each industry employs half of the labor force. Suppose in the first period the nonproduction wage ratio is equal to 1 in both industries, and in the second period the wage ratio triples in industry A but only doubles in industry B. The nonproduction ratio for the country increases from 1 to 2.5 between the first and second periods. What proportion of the change is attributed to trade? This depends on the method used to calculate the answer. Using the method adopted by Berman and his coauthors, one-third is attributed to industry A, the traded goods industry. Using the method that does not subtract out the average shift in the domestic consumption sector, two-thirds of the change in the wage ratio is attributed to the traded goods industry.45
Sachs and Shatz (1994) provide more explicit evidence for the view that technology has been a key factor in reducing production employment. Explaining changes in employment at the industry level between 1978 and 1990, Sachs and Shatz find that a 1 percent increase in R&D expenditures is associated with a 4 percent reduction in the employment of production workers. According to their findings, R&D expenditures have no measurable association with total or nonproduction employment. Their model also finds that the loss of production employment is highest in industries with large capital shares and a high proportion of production employees in their labor force. As no trade variables are included, it is not possible to compare the effects of trade and technology in this part of Sachs and Shatz's study, but at least they used actual measures of technology instead of econometric residuals.

In contrast, some new research (also using explicit measures of technology) suggests that technology has not contributed to increasing wage inequality. Borjas and Ramey (1994) find that per capita R&D expenditures have no meaningful statistical relationship to either the high-school/college wage ratio or the less-than-high-school/college wage ratio. Mishel and Bernstein (1994) find that, although measures of technology are related to increased wage inequality in a sample of thirty-four industries over the 1973–89 period, there is no evidence that technology is related to the acceleration of inequality experienced in the 1980s compared with the 1970s. Similarly, they find no evidence that computer equipment had a different effect on wage inequality compared to other forms of capital investment (Mishel and Bernstein, 1994, pp. 28–30).

In what he calls a "very preliminary" study, Leamer (1994) finds that capital-using technological change (i.e., increases in the capital/output ratio) actually increased the wages of production workers between 1976 and 1986. Building on a theoretical model in which wages of skilled and unskilled workers are determined by technology, factor input requirements, and product prices, Leamer develops an econometric model that estimates the determinants of payroll savings (reductions in labor costs) across a sample of 450 industries. Using payroll savings for the entire labor force (production and nonproduction workers), increases in capital/output ratios caused wages of production workers to rise by 19.5 to 22.4 percent, depending on the specification. Using payroll savings for production workers only, Leamer finds that increases in capital/output ratios caused wages of production workers to rise by 18.5 to 43.5 percent, also depending on the specification. Although he expresses reservations about using the data on production and nonproduction workers as a proxy for the unskilled/skilled distinction, Leamer concludes that "technology has led to a larger increase in wages for production (unskilled?) workers than for the nonproduction (skilled?) workers, completely the opposite of the conclusions of Lawrence and Slaughter (1993) and Krugman and Lawrence (1993)" (1994, p. 20, italics in original).

The timing of the introduction of new technologies also argues against technology-determinist theories. The technology explanation is premised on new
technologies in manufacturing, particularly computers, displacing low-skilled employees into lower-wage positions outside manufacturing. For this to be sensible, investment in new technologies must accelerate prior to the decline in nonproduction labor in manufacturing. The timing was, however, reversed (Howell 1994). The increase in the ratio of nonproduction to total employment in manufacturing was completed by 1981; the rapid increases in investment in office, accounting, and computing machinery began no earlier than 1980 and, in many industries, occurred in the mid-1980s. Given such a pattern, there must be a strong presumption against the technology explanation.48

A deeper problem in the whole dichotomy of technology versus trade explanations of wage inequality is that technological innovation is not necessarily independent of international trade relations and competitive pressures. This is an especially serious problem if trade accelerates the adoption of labor-saving technologies.49 Imports of goods from low-wage countries compel producers in developed countries to reduce unit labor costs. This reduction can be achieved by increasing labor productivity, typically by investing in new capital and new technologies, as well as by trying to cut workers’ wages (or limit their wage increases). Such improvements will result in reduced demand for labor, and yet, by many of the empirical methodologies discussed above, the ensuing decrease in employment will be attributed to “technology” rather than to trade. While there are other possible connections between trade and technology as well, it is at least likely that part of what has been ascribed to technology is, at the least, trade-induced.50

That technological advance has affected wages and may have had an effect on wage inequality is not controversial. What is in dispute is whether technological change is the sole source of increases in wage inequality over the past decade, as well as whether technology itself is independent of trade. The empirical evidence supporting the monocular position is weak; the evidence that technology has not increased wage inequality (and may even have reduced it) is as strong or stronger. Central questions about the timing and acceleration of new investment remain to be addressed by the advocates of the technological explanation. Certainly, the ascription of growth in wage inequality to technology alone has been premature.

Are Trade Effects "Small"?

Some economists have argued that even if trade may have a negative impact on wages, the effect is so tiny as to be irrelevant. For example, Paul Krugman (1994a) has recently argued that trade could not induce large-scale wage changes. Basing his calculations on the 30 percent differential between average wages in manufacturing and services and noting that 1 million employees account for less than 1 percent of the U.S. labor force, he finds that trade-induced displacement of 1 million manufacturing workers would reduce economywide wages by 0.3 percent. Krugman comments:
This is too small to explain the 6 percent real wage decline by a factor of 20. Or to look at it another way, the annual wage loss from deficit induced de-industrialization, which [Lester] Thurow clearly implies is at the heart of U.S. economic difficulties, is on the basis of his own numbers roughly equal to what the U.S. spends on health care every week. (1994a, p. 36)

Such calculations do not take account of the dynamics of the labor market or of the role of manufacturing in establishing employee expectations for wage increases throughout the economy. Trade effects that induce this scale of displacement do more than reduce the wages of displaced workers. An increase of 1 million persons in the supply of labor to nonmanufacturing industries will place downward pressures on wages in those sectors. Weak wage leadership from the manufacturing sector may also reduce wage growth throughout the economy. All these factors argue that the effect of trade on wages is likely to be substantially larger than estimated by Krugman.

It is not difficult to label fractions “small” if we choose a large enough denominator. For example, by comparing manufactured imports from newly industrializing countries to the combined gross domestic products (GDPs) of all the OECD nations, Krugman (1994b, p. 116) can argue that trade with low-wage countries comes to “only” 1.2 percent. However, U.S. imports from developing countries made up 36 percent of U.S. manufacturing imports in 1990, up from only 29 percent in 1978 (Sachs and Shatz 1994, table 4, p. 12). The rate of growth of certain types of trade, as well as its concentration in certain sectors or regions, can magnify its impact significantly. If one of our tasks is to explain increasing inequality in the wage distribution, in addition to changes in the average wage level, then the concentrated impact of trade on a few sectors within manufacturing may be quite relevant.

In the regression analyses used to identify the various factors affecting the wage distribution, trade is usually found to account for between about 10 and 20 percent of the increase in wage inequality during the 1980s. Borjas, Freeman, and Katz (1991) find that trade increased the gap between the wages of workers with high school and college educations by 8 to 15 percent; trade also accounted for between 9 and 23 percent of the decline in wages of those with less than a high school education. Testing a number of theories of wage inequality, Borjas and Ramey (1994) find that the trade deficit in durable manufacturing is the only statistically significant correlate of measures of wage inequality for the period 1963–88. Whether this is “large” or “small” depends on the other factors included and the total variation explained by the regression.

Wood (1994) suggests that measurement of trade with developing countries involves conceptual and measurement problems that, because of the approach typically adopted, generate systematic understatement of the volume of trade. In Wood’s view, trade between developed and developing countries is motivated by differences in the costs of skilled and unskilled labor. As predicted in the HO theory of trade, developed countries import labor-intensive manufactures built
with less skilled labor and export capital- and skilled-labor-intensive products. Over time, trade will cause developed countries to specialize in capital- and skill-intensive production. Even if the developed and developing countries produce related goods, developed countries will produce variants that are amenable to capital- and skill-intensive production, products that will not compete directly with those from developing countries.

Studies such as those of Borjas, Freeman, and Katz (1991) use factor input coefficients (ratios of labor to output) to calculate the implicit labor supply associated with trade. However, due to trade with developing countries, currently produced goods use more capital and less unskilled labor than did the goods replaced by imports. For example, imports of low-cost shoes from abroad will compel American manufacturers to specialize in high-quality shoes manufactured by highly trained workers using up-to-date capital. The new capital and the high level of training will increase output per employee. The contemporary ratio of labor to output will not be representative of the ratio that existed in the shoe industry prior to the extension of trade. Thus, using factor content coefficients based on developed countries’ current production practices will systematically underestimate the labor content of trade. Wood (1994) argues that appropriate factor content coefficients can be developed by adjusting factor content coefficients to reflect the relative prices faced by developed countries.

Finally, it is worth noting the asymmetry inherent in the “too-small-to-matter” line of argument. When trade economists argue that our present tariffs cost consumers tens of billions of dollars, these costs are never described as “small,” even if they are only 1 percent of GDP or less. When the business press discusses international competition, there is never any doubt that international differences in labor costs are big enough to matter for U.S., European, and Japanese companies. For example, a recent Washington Post article stated that:

Faced with escalating competition as global barriers to capital have fallen, European employers are pleading for a rollback in obligatory benefits ... that have pushed wage costs up to a level 80 percent above those in the United States or Japan. In Third World nations such as India and Vietnam, labor costs as little as one-tenth the level in Europe. (Drozdiak 1994, p. A1)

Losses to workers that are proportionally as large as (or larger than) the aggregate gains from trade cannot be dismissed as insignificant if the losses are the flip side of the coin of the gains. It seems doubtful that competitive pressures, which seem obvious to business leaders and journalists, to reduce labor costs by cutting wages or benefits could not be having appreciable real effects.

Conclusion

This chapter has found significant support in the literature for the proposition that greater openness to trade may be one of the sources of the poor U.S. labor
market performance for many workers over the last decade. Although the evidence is yet incomplete and more research remains to be done, there is a body of evidence on hand to demonstrate that international trade has caused wages and employment to decline in U.S. manufacturing; that international trade accounts for about 10 to 20 percent of the increase in wage inequality in the United States in the last decade; that increased international trade with labor-abundant developing countries has a particularly negative effect on U.S. employment and possibly on wages as well; that balanced growth of exports and imports will not automatically improve the wages or quality of jobs available to American workers; that unemployment and wage problems in the United States are not solely a consequence of new technology; that these deleterious consequences do not affect just some small minority but, using the standard definitions of "unskilled" labor, could touch 70 to 80 percent of American wage earners. The balance of research supports the view that the consequences of trade are real, they are not negligible, and they affect far more than a few.

Notes

1. Authors' calculations, based on export and import data taken from the international transactions accounts and GDP figures taken from the national income and product accounts, as reported in U.S. Council of Economic Advisors (1994) and U.S. Congress, Joint Economic Committee (1994). All data in this paragraph are from these sources.
2. For further discussion of the U.S. trade deficit, see chapter 6 in this volume.
3. Hong Kong, Singapore, and South Korea are included here; data for Taiwan were not available for the earlier period. Statistics were calculated by the authors using data from International Monetary Fund (1987, 1993).
4. Data in this paragraph are from Mishel and Bernstein (1993, pp. 33, 132, 224, 274).
5. Data on wages relative to the poverty level and pension coverage in this paragraph are from Mishel and Bernstein (1993, pp. 124, 133).
6. Data on sectoral wages and employment in this paragraph and the next are from U.S. Department of Labor, Bureau of Labor Statistics (1989, tables 68, 80, and 81), plus updates from the U.S. Department of Labor, Bureau of Labor Statistics, Monthly Labor Review (various issues), and the authors' calculations.
7. Import penetration in this study is measured by the ratio of imports to total sales at the industry level. Individual establishments (plants) are classified into quintiles according to the import penetration ratios of the industries to which they belong. The quintile of establishments with the highest import penetration ratios accounts for 17.7 percent of employment in the whole sample.
8. For some of the original sources of this theory, see chapter 1 in this book.
9. For modern textbook presentations of this type of model see, for example, Caves, Frankel, and Jones (1993); Krugman and Obstfeld (1994); or Appleyard and Field (1995). In more complex models with more than two goods, factors, and countries, it is not a simple matter to categorize countries or goods in terms of their factor proportions. Multiple factors of production such as different skill grades of labor, different types of natural resources, and the degree to which the "services" of these factors are incorporated in net trade flows must be taken into account in determining countries' comparative advantages. See Learner (1984) for a comprehensive theoretical and empirical treatment of a multidimensional HO model.
10. Adjustment assistance for displaced workers is a transitional measure designed to help workers who lose their jobs in the short run, not a permanent compensation paid to losers by winners—and even adjustment assistance is often incomplete or nonexistent.

11. See Krugman and Obstfeld (1994, chapter 6) for a presentation of models of trade with scale economies. For examples of how models emphasizing scale economies were used in the analysis of the effects of NAFTA on U.S. wages, see chapter 5 in this book.

12. Models with nontradables sectors abound in the open-economy macroeconomics literature but are less commonly used for microeconomic analysis of the effects of trade on income distribution.

13. The estimating equations are based on a model of labor supply, labor demand, product demand, the relation of wages to product price, and wage determination. Employment and wages are determined by the three determinants of sales: total domestic demand, exports, and the import share of domestic demand. Controls for unionization, the proportion of production workers in the industry labor force, and for year and industry effects are included in all models, as is a measure of the ratio of immigrants in the industry labor force. Control for value added per employee is incorporated into some models. Models are estimated in the log of rates of change rather than levels, although some controls are incorporated as both changes and levels. Inclusion of a value-added measure may be a source of simultaneity as employment, the dependent variable in some equations, is incorporated into the denominator of this measure.

14. Grossman’s work (1987) has some unusual results, and many estimates are not statistically significant. This is a consequence of an elaborate specification and extensive lag structure, which leave the regression equations with very limited degrees of freedom for hypothesis tests. More statistically significant results were later obtained by Revena (1992), who corrected many of the purely statistical flaws in Grossman’s study.

15. These studies, which use the Panel Study on Income Dynamics, follow individuals over time. The coefficients may be interpreted as indicating the wage change that occurs when individuals are subject to changing levels of imports over time or because of a change in industries. Omission of controls for occupation may be a source of bias in estimates.

16. Revena’s work regresses measures of the change in the average production wage; the average weekly volume of worker-hours; or the average weekly employment, on an industry-specific weighted average of production prices of major exporting countries, an index of materials prices, the reservation wage, a measure of the business cycle, and two-digit industry dummies. The regression equation is estimated as a reduced form with corrections for autocorrelation and the use of instrumental variables to correct for correlation between the import price index and the error term. In particular, Revena used exchange rates as an instrument for actual import prices due to the endogeneity of the latter.

17. This type of issue, one of sample selection, is common to many areas of economic research. No current research on trade attempts to correct for the nonrandom loss of employment in import-affected industries.

18. The results reported for Freeman and Katz (1991) are for a model comparing wages and employment in 1984 with wages and employment in 1958. The unexpected results were found in panel data for annual data for the period 1958–84.

19. A related analysis indicates that wages of union members are more sensitive to changes in imports than are wages of employees who are not members of a union.

20. Each industry or product market categorization contains a mix of positive, negative, and nonsignificant wage effects of both imports and exports.

21. Skill was proxied by the proportion of production employees in the industry labor force.

22. These authors estimate an equation using data on individuals from the 1984 Current Population Survey and appending data on tariffs, nontariff barriers (NTBs), exports,
imports, import growth, and intra-industry trade. Although this approach is potentially interesting, omission of other dimensions of industry structure such as unionization, capital/labor ratios, and market concentration can cause substantial bias in the equation (see Belman 1988 for a discussion of the specification of industry variables for this type of model). Such omissions are sufficiently important to raise serious concerns about the bias of the coefficients on the trade variables. The authors acknowledge that addition of other industry variables to a restricted data set, covering fifty-four rather than eighty-two industries, produced unusual results. The consequences were not further specified.

23. Implicitly, this argument assumes that trade can affect wages only if it changes the wage share of total output. The possibility that trade could affect the growth of total output (including the returns to capital as well as the wages of labor) is thus dismissed by these authors.

24. This measure is produced by the BLS productivity division using data on employee compensation taken from the Bureau of Economic Analysis (BEA). The BLS adjusts the data in various ways, such as by adding an imputation for the labor income of proprietors. See U.S. Department of Labor, Bureau of Labor Statistics (1988, p. 72) for details. The actual data series can be found in U.S. Council of Economic Advisors (1994, table B-47).

25. The prices of intermediate products, which are not purchased by final consumers but are used in the further production of other goods, are not directly incorporated into any of the output deflators for the national income accounts (either GDP or final output). Of course, any effects of changes in their prices are incorporated as they affect the prices of final goods.

26. Lawrence and Slaughter (1993) include an index that deflates wages by the GDP deflator less investment, but they do not discuss it. Lawrence (1994) presents this index and omits the index that incorporates investment goods.

27. See note 24 for details on this index.

28. The ECI uses data collected directly from employers and does not include any imputations as the BEA/BLS measure does. However, the fixed-weight ECI may overestimate wages and benefit costs in the 1980s, since it does not adjust for shifts in the distribution of employment between industries and occupations. See below for a discussion of a new, alternative ECI that is current-weighted.

29. Inclusion of self-employment income and problems in the measurement of the hours of employees not included in the production and nonsupervisory classification may also impart an upward bias to the BEA/BLS total compensation index.

30. Taking the period 1987–93, the BEA/BLS index indicates that total compensation increased by 3.1 percent. In contrast, the current-weighted ECI index, which adjusts for changes in the distribution of employment by industry and occupation, shows costs declining by 2.9 percent. The fixed-weight ECI index, which is more commonly used, uses constant industry and occupation distributions. The current-weighted version that allows for changes in industrial and occupational composition of the labor force has been available only since 1987.

31. The shift in years is necessary because estimates of current-weighted compensation are only available for selected years in the 1970s (when the current-weighted ECI was not calculated).

32. Authors’ calculations based on data from U.S. Council of Economic Advisors (1994, table B-47).

33. Categorization of employees by skill is central to all of these studies. Those using the CPS categorize employees according to educational attainment, typically whether employees have less than a high school education, a high school diploma, some college, a college degree, or education beyond college. Other studies, which employ the Census of
Manufactures (CM) or the ASM, proxy the skilled/unskilled distinction with that between production and nonproduction employees. Leamer (1994) questions the accuracy of this categorization as a proxy for skill, but Berman, Bound, and Griliches (1993) find rough correspondence between this classification. Sachs and Shatz (1994) find the production/nonproduction division generally corresponds to a white-collar/blue-collar division and correlates with more sophisticated indexes of skill. Under any scheme the majority of the U.S. labor force is classified as “low-skilled”: 80 percent of the U.S. labor force are production workers; 75 percent have less than a four-year college degree.

34. Authors’ calculation based on data from U.S. Council of Economic Advisors (1994, tables B-44, B-45).

35. Efficiency units are measures of labor supply that are weighted by wages to adjust for differences in productivity for different groups within the population. Prior to 1982, trade decreased the supply of labor efficiency units as exports increased demand for the products of skilled workers. After 1983 this reversed, with net imports adding about 1 percent to labor efficiency units in 1984 and 1.3 percent in 1985.

36. For example, according to the data cited by Murphy and Welch, 28 percent of men with less than a high school diploma were employed in the traded durable goods sector, but only 15.2 percent of men with a college degree were employed in this sector between 1967 and 1988. Among women, 18.3 percent of those with less than a high school education were located in traded durable goods, but only 3.3 percent of women with college degrees were in this industry. The traded nondurable goods industry employed 24 percent of women with less than a high school diploma but only 3.8 percent of women with high school educations.

37. Similar, if somewhat smaller, estimates are found in Katz and Murphy (1992). In the period 1979–85, Katz and Murphy find that trade in manufactured goods caused a 0.63 percent decrease in the demand for male dropouts, a 0.3 percent decline in the demand for male high school graduates, and an increase in the demand for males with some college and college degrees. Among women, demand fell by 2.2 percent for dropouts and by 0.1 percent for high school graduates, while demand for college graduates increased by 1.3 percent. If trade in manufactures is assumed to have its main effect on production workers, demand for male dropouts fell by 1.5 percent, demand for male high school graduates fell by 0.7 percent, and trade caused an increase in the demand for men with some college or with college degrees. Under this same assumption, demand declined by 4 percent for female dropouts and by 0.3 percent for women with a high school education; it rose for the remaining education classes. One explanation for these relatively small effects is that the measures include only direct effects; upstream effects on supplier industries are not incorporated into the calculations.

38. These results appear to be at odds with the prior conclusion that wages in importing and exporting industries are similar. However, if the effect of trade is to displace workers from the traded goods sector into other parts of the economy, then the Borjas and Ramey finding is compatible with the rough equality of wages in importing and exporting industries. Likewise, it is possible that increased trade deficits increase within-industry wage inequality rather than the between-industry measures that are studied by Katz and Summers (1989) and by Dickens and Lang (1988).

39. Auto parts producers who were not part of the big three operated in oligopsonistic rather than competitive markets. Workers in auto parts, including workers employed by General Motors (GM), Ford, and Chrysler, earned 87 percent of main auto wages in 1983. Workers in truck bodies earned 67 percent of main auto wages.

40. The SS theorem assumes that technology and factor endowments are fixed; accurate measurement of SS effects requires control for this and other conditions that violate the assumptions of the theorem.
41. See chapter 5 in this book for further discussion of Leamer's study and other analyses of the distributional effects of increased U.S.-Mexican trade under NAFTA.

42. Bound and Johnson's analysis of wage inequality compares the change in real average hourly wages of thirty-two demographic groups defined by education, potential labor market experience, and gender. The groups were defined by four education groupings (dropouts, high school diploma, some college, and college or more), potential labor market experience (0–9 years, 10–19 years, 20–29 years, 30+ years), and two genders. The effect of generalized technological change is modeled by changes in the annualized proportionate change in the wage of these thirty-two groups as the outcome of the annual proportionate change in their labor supply, industry-specific technology, change in industry-average wage effects, and shifts in product demand. The residual from this model is used as the measure of general technological change, and it is this residual that underlies the statement that 120 percent of the increase in wages is attributable to general technological change. Bound and Johnson conclude that:

It is apparent from inspection of the estimated values of GEN (the general technology variable) for the 1980's that our major conclusion, which will be discussed more completely below, is that the principal cause of the significant wage-structure changes of the past decade was a shift in the structure of the bh's (the technology effect) that were extremely favorable to certain groups, especially women and the highly educated. (1992, p. 386)

They note, however, that these results might also be the result of increasing hours of work by women, declining effectiveness of education for younger workers, or competition from undocumented immigrants.

43. The measure of industry-specific technology suffers a related problem of interpretation. Lacking a measure of sector-specific technological change, Bound and Johnson (1992) interpret the large changes in the relative wages in "four of the five traditional blue collar industries (durable/mining, nondurables, transportation, and public utilities)" as the consequence of industry-specific technological change. As in the case of general technological change, this measure may include the effects of technology, but cannot be distinguished from any other factor, such as trade, that had a particularly large effect in these sectors. The authors' approach is also problematic because they use their data on relative wage change to define the group of industries most affected by technological change.

44. The analysis by Berman, Bound, and Griliches (1993) begins with a shift-share decomposition of the ratio of the change in the ratio of nonproduction employee wages to average wages in manufacturing. The change in the nonproduction wage ratio is decomposed into the change that occurs because industries have altered their use of nonproduction employment (e.g., aerospace increases its employment of engineers) and the change that occurs because employment has shifted toward industries that use more nonproduction employees (e.g., employment falls in apparel but rises in aerospace). These two components of change are then further decomposed into four sources: exports, imports, defense, and domestic consumption (to simplify, imports and exports will be referred to as trade). The resulting equations answer the question: What proportion of the change in the nonproduction wage ratio is explained by changes in trade (or defense or domestic consumption)?

Unfortunately, Berman et al. take an additional step and, in doing so, alter the question they address. In the equation for the change in the within-industries wage ratio, they calculate the change in this ratio for domestic consumption for all manufacturing and then subtract this average from each of the four components of demand. The "average" change is then added back into the domestic consumption effect. The between-industries equation is transformed in a similar manner. With this step, that part of the change in the wage ratio in trade or defense that is similar to the change in the wage ratio for domestic consumption for all manufacturing is attributed to the domestic sector. The equations now answer
the question, What is the additional effect of trade and defense, the effect beyond the average change in manufacturing in the domestic production sector, on the nonproduction wage ratio? The consequence of this transformation is to increase the proportion of change in the wage ratio attributed to domestic consumption and, conversely, to decrease the proportion attributed to trade or defense.

45. Using the method of Berman et al., the equation for calculating the change in the wage ratio is 
\[ 1.5 = 0.5(2-1) + 0.5(1-1) + 1 \]
and the ratio of the change in the traded goods industry to the total change is 
\[ 0.5(2-1)/1.5 = 1/3. \]
If we use the equation that does not subtract out the mean of the change in the domestic goods industry, the equation is 
\[ 1.5 = 0.5(2) + 0.5(1) \]
and the ratio of change in traded goods to total change is 
\[ 0.5(2)/1.5 = 2/3. \]

46. Growth in technology was proxied by the annual growth in equipment per full-time employee, in computer equipment per full-time employee, and in the employment share of scientists and engineers.

47. The independent variables in this model include the utilization of production labor, nonproduction labor, and capital stock at the beginning of the period (1976) and the change in the capital stock from 1976 to 1989.

48. The issue of timing could not be addressed by Bound and Johnson (1992) or Berman et al. (1993), since their measures span the period from 1979 to the late 1980s.

49. Considering all developing and developed countries, Wood (1994) estimates that international trade has reduced the demand for manufacturing labor in the developed countries by 12 percent and increased demand for skilled labor by about 5.5 percent. The effects of induced technological change are not computed precisely, but Wood speculates that it has doubled the impact of trade on the demand for skilled and unskilled labor in the developed countries.

50. Contrary to Wood (1994), Deardorff and Hakura (1994) argue that the consequences of trade-induced technological change should not be counted as trade effects. In their view, trade merely serves as a conduit in this case for technological effects that would eventually occur anyway. Thus, technology is the true source of the declining demand for less skilled labor. However, with the sole exception of Wood, none of the researchers to date have included technological effects in their estimates of trade effects.

51. Since many OECD countries restrict imports of manufactured goods to a greater extent than the United States, aggregate import figures for the OECD are not a good representation of the import of manufactured goods into the United States.

Bibliography

Bhagwati, Jagdish, and Vivek H. Dehejia. 1994. "Freer Trade and Wages of the Un-