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What Are the Questions?**

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Trade and Wages – What Are the Questions? *

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I. Introduction

Starting in the early 1970s, real wages in the United States ceased growing at their previous rate and may even have begun to decline. Around 1980, wages of skilled and educated workers began to rise relative to those of unskilled workers, thus leading to growing inequality among working groups.¹ These changes more or less coincided with an increase in the U.S. deficit on international trade, which grew steadily and then rose to unprecedented levels through the first half of the 1980s. Combined with the continued growth of both exports and imports in proportion to output that had occurred throughout the postwar period, these events naturally led to speculation that the cause of the decline in wages, and especially those of unskilled workers relative to skilled, was international trade. In just the past few years, therefore, interest in this age-old topic of the effects of trade on wages has been renewed, and many empirical papers have appeared on the subject in the literatures of both labor economics and international trade. Our purpose here is to have a look at this literature. We will be concerned primarily with how various investigators have framed the question of the effects of trade on wages and whether, once these questions are understood, one would want to know the answers. Our own view is that most of this empirical literature has failed to address the interesting questions and has instead answered easier questions that are of questionable relevance, both to policy and to economic understanding of the world.

Considerable analytical firepower has been directed at this issue of the empirical relationship between trade and wages. Our concern here will not be to sort out and evaluate the analytical techniques that have been used. Rather, we will try only to clarify what the questions are that these papers have been asking.

We begin in the following section by discussing several theoretical interpretations of the issue of trade and wages – various specific questions that one might expect an empirical investigation to answer. Our purpose is to provide a framework for the later discussion and to indicate that either some of the questions the literature has addressed are not well formed or their answers are not informative. We turn in subsequent sections

* We have received helpful comments on earlier drafts from Jagdish Bhagwati, John Bound, George Johnson, Jim Levinsohn, Marvin Kosters, Frank Stafford, Bob Stem, and other participants in both the AEI seminar and a seminar at the University of Michigan.

¹ See Kosters, chapter 1 of this volume, for a survey of the literature documenting these changes.

to a brief survey of some of the major contributions to this literature, organized in terms of these questions.²

How Does Trade Affect Wages?

The Question in Theoretical Terms. The question, How does trade affect wages? – or, How has it affected wages over some period of time? – is both a surprising and a natural question to ask from the point of view of an international trade theorist.³ We trade theorists study the determinants of trade and therefore think of trade as something endogenous, not exogenous. We typically think of trade as arising *because* of differences in wages or labor costs. We are accustomed also, however, to asking how trade affects all sorts of things, including welfare, factor prices, and outputs. Two of our classic theorems from the Heckscher-Ohlin (H-O) model of international trade theory—the factor price equalization (FPE) theorem and the Stolper-Samuelson theorem—deal precisely with the effects of trade on wages and other factor prices.

This suggests that, in any sensible model, the volume of trade and the level of wages are simultaneously determined.⁴ To ask about the effects of one upon the other without making clearer the context is not meaningful. Furthermore, as in the trade theorems, one can easily state the relationships in a rigorous and meaningful manner.

Thus, in the FPE theorem, when we say that free trade equalizes factor prices, we are referring to a well-defined situation in which all barriers to trade are eliminated. In that special case of free trade, if a number of other assumptions also hold, including that factors are perfectly mobile across industries and that factor endowments of different countries are sufficiently similar to permit incomplete specialization, then those countries will share the same prices of all factors. It is the *absence of trade barriers*, and not any measure of the volume or terms of trade, that affects factor prices here. This is a testable proposition in principle, although the difficulty of finding situations of truly free trade makes that difficult in practice. Note, however, that the FPE theorem does *not* say that a movement closer to free trade, if that could be defined, would draw factor prices closer together. It is a theorem about a static equilibrium with perfectly free trade; it is not a comparative static proposition.⁵

² In chapter 1 of this volume, Kusters has summarized many of the empirical patterns that have been observed in the labor market in recent years, and in chapter 2, Bhagwati and Dehejia have explored alternative theoretical rationales for some of these patterns.

³ It is possible that a labor theorist would have a different take on this than a trade theorist. Trade theorists have a long tradition of general equilibrium analysis and are likely to use that to confront this question. Labor theorists may be more willing to consider labor markets in isolation from the rest of the economy.

⁴ This is assuming, of course, that they can vary at all. If government policy were to constrain trade volumes through quotas or import licensing, then additional adjustments would be required through prices, and if policy were to constrain wages, there would be additional adjustment through employment. But the point is that equilibriums in trade and labor markets, however attained, are simultaneously determined.

⁵ Deardorff (1986) explored the theoretical difficulty of proving a tendency toward FPE when full FPE does not occur, as when countries move only part way toward free trade. Under the usual assumptions that would be needed for FPE, but without incomplete specialization, it is possible with more than two goods for a move toward free trade to draw factor prices further apart. Thus, while most trade theorists may believe that the FPE theorem is suggestive of a tendency toward FPE when full FPE fails, it is only suggestive. Such a tendency has not been proven theoretically except in very special cases.

Similarly, the Stolper-Samuelson theorem refers (depending on the version stated) not to the effects of some ill-defined thing called trade, but rather to the quite specific effects of changing or eliminating trade barriers such as tariffs. Wolfgang Stolper and Paul Samuelson showed that an increase in tariffs, in the context of the two-country, two-good, two-factor H-O model and again under certain assumptions that include factor mobility and incomplete specialization, will raise the real return to the country's scarce factor of production and lower the real return to the abundant factor. Here again it is not trade per se that alters factor prices, however, but rather the change in protection.

Stolper and Samuelson themselves spoke of the effects of protection on wages, but at the heart of their analysis was a relationship that must hold, under their assumptions, between the prices of goods and the prices of factors. As discussed by Jagdish Bhagwati (1959) and further elaborated by Ronald W. Jones (1965), the essence of the result is an implication of the zero-profit conditions in a two-sector economy. A rise in the relative price of a good must raise the return to the factor used intensively in its production more than in proportion to the price change,⁶ and it must lower the return to the other factor. This relationship is today often stated as the Stolper-Samuelson theorem, and often in the form of the change in the prices of goods *causing* the change in the prices of factors. Causation is not really part of the result, however; it is only a relationship that must hold under certain conditions. And even that relationship can fail if those conditions are not met, as for example if there is a change in technology .

In spite of these qualifications, the Stolper-Samuelson theorem has provided the motivation and focus for much of the recent empirical literature dealing with the effects of trade on wages. The empirical observations noted above seem to suggest it, after all. If trade in the United States has grown because trade barriers have been reduced (through successive rounds of trade negotiations under the GATT, for example⁷), then the theorem would seem to predict that the real wage of the scarce factor in the United States, unskilled labor, would fall, while that of our abundant factor, skilled labor, would rise.⁸ This may be a natural association, but the theorem does not say that it is *trade* that has these effects; rather it attributes them to the change in tariffs or perhaps the change in relative prices. Those studies that have related the changes in factor prices to, say, the volume of trade cannot therefore be said to have been necessarily applying the Stolper-Samuelson theorem.

A final theoretical contribution should be mentioned before we proceed, since many in trade theory would regard it as more relevant than the Stolper-Samuelson theorem for explaining effects on wages in the short run. That is the Specific Factors model, sometimes called the Ricardo-Viner model and reintroduced into the post-Heckscher-Ohlin literature by Samuelson (1971), Jones (1971), Wolfgang Mayer (1974),

⁶ This is commonly referred to as the "magnification" effect, after Jones (1965).

⁷ It is questionable, however, that barriers to trade did in fact fall, especially in the United States in the 1980s. Tariffs did fall slightly as the negotiated reductions of the Tokyo Round were implemented, but a wide variety of nontariff barriers were simultaneously erected and raised. See Deardorff (1991) for a discussion.

⁸ In fact, even this simple statement is not justified by theory if there are more than two factors. Allowing for capital, land, natural resources, and different types (perhaps more than two) of labor weakens the Stolper-Samuelson theorem considerably, though it still implies at least a weak relationship between factor abundance and the effects of protection on the corresponding factor prices. See Deardorff (1993) for an overview of the theoretical literature on the Stolper-Samuelson theorem.

and Michael Mussa (1974), among others. In that model, at least one factor is immobile among industries, and therefore a different factor price can be paid in each industry. With all factors specific in this way, the price of each factor depends only on the price of the output it helps to produce. If some factors are specific and others not, then the price of the nonspecific factor is the same across industries, but it responds to changes in goods prices differently from the Stolper-Samuelson theorem. In the most common version of the model, for example, capital is specific while labor is mobile within a two-sector economy. A rise in the relative price of one good then raises the real return to capital there, lowers the real return to capital in the other sector, and has an ambiguous effect on the real wage of labor depending on the importance of the more expensive good in the budgets of workers.

These theoretical results, as well as analogous ones that hold with more than two factors, suggest that the determination of wages is not as simple as the Stolper-Samuelson theorem suggests. But note that all of them have wages and other factor prices depending not on trade per se but on prices of goods. These in turn may be determined primarily in world markets, depending on the size of the country, and under special additional assumptions they may even vary systematically with the quantities of trade. But we know of no general and direct relationship between the volume of trade and wages that holds in any general-equilibrium theory of trade.

Finally, we also note that while various models relate wages to prices of goods rather than to trade, they typically relate them to the entire constellation of goods prices, not just to one of them. Only in the most extreme specific-factors model, where all factors of production are immobile across all sectors, are particular wages explainable by only the price of the output they help to produce. This model presumably applies, if at all, only to the very short run. With any mobility of factors across sectors, wages in general equilibrium depend upon all goods prices simultaneously, making any estimation of an empirical relationship problematic.

Taking into account these insights from international trade theory, let us now ask what one can make of the question, "How does trade affect wages?" We suggest that several interpretations, or versions of the question, can be meaningful. We discuss them here, and then look later in the chapter at the extent to which the literature has addressed them.

Consider the question first in the abstract, in theoretical terms and without reference to any particular historical episode. We will discuss how these interpretations and others carry over to empirical work in a moment. Three quite different interpretations can be placed on this question.

How does a reduction in trade barriers affect wages? This interpretation is motivated most directly by the theorems of trade theory. Since trade barriers may plausibly be taken as exogenous, barring political economy considerations, it is a sensible question. The answer may depend on the model used (with or without scale economies, for example); the time horizon (whether labor is mobile across industries, for example); and the pattern and type of trade barriers being considered (unilateral versus multilateral versus unilateral free trade, for example, or reductions in transport costs). But we know the meaning of the question.

How do changes in economic conditions abroad, transmitted to the domestic economy through trade, affect wages? Alternatively, the question could refer to any changes that might take place outside the country to the extent that these changes would, at unchanged trade barriers, lead to an increase in trade. As long as those foreign changes are themselves plausibly independent of events at home, then again this would be a well-defined question. We might for example ask about the effects on domestic wages of a rise in productivity abroad that will be transmitted to the domestic economy through increased trade.

This interpretation works only to the extent that the changes abroad are transmitted to the domestic economy through trade. If trade acts as the only or the primary conduit through which changes in one country affect another, then although the underlying cause of a change in wages is the change in technology abroad, it is also accurate to attribute the changes to trade. For without the increase in trade the domestic response would not have occurred. This is a "but for" interpretation of the effects of trade: "but for the increase in trade caused by the foreign productivity improvement and permitted by unchanged barriers to trade, domestic wages would not have declined."

Of course, over the past few decades we have seen the expansion of various other transmission mechanisms through which countries are dependent on one another. Thus it is no longer true, if it ever was, that all international effects are channeled through trade. International flows of capital, both financial and real, are increasingly important, as are flows of other sorts of trade such as services, and to a lesser extent migration of labor. It cannot be assumed that if trade were somehow prevented from expanding, then a country would be insulated from all changes abroad.

How do wages respond differently to changes in economic conditions at home when international trade is allowed to change too, as compared with being held constant? The but-for form of the second question suggests a third. Consider an exogenous change that originates *within* the home country and that raises imports. It could for example be an increase in total demand for goods, regardless of source, part of which shows up as an increase in imports. One can ask what would have happened instead if imports had not been permitted to increase. If wages would have gone up more, or down less, with imports somehow held constant, then one might attribute this wage effect to trade. Presumably this argument could be sensitive to the method that is implicitly used to hold imports constant, including how exports would be treated. But given that method, this is a well-defined interpretation of what trade means for wages.

To continue the above example, an increase in total demand will normally raise imports at the same time that it raises demands for other goods and factors. One could, however, place quantitative restrictions on all imports, so that their quantities would not rise but their prices would. One could alternatively vary tariffs on every import to achieve the same result. This would be a substantial difference in policy regime, and the implications for domestic wages would likely be very different. The third question seeks to identify this difference. These are the wage effects of the increase in total demand that would have occurred but for the permitted increase in trade.

As we will see, the literature on trade and wages does not usually answer exactly any of these three questions. Instead, various authors have answered questions that are related to these, but are not the same. The first is another "but for" question that in effect

combines the second and third questions above and includes both of them as special cases:

Regarding any exogenous change, at home or abroad, that might affect trade or wages, how would wages respond differently if the volume of trade were held constant? This is the most general interpretation possible: But for any change in trade, how would wages have behaved differently? It does not concern itself with the underlying causes of the changes in both trade and wages, including whether they are foreign or domestic. As such it is likely to be the easiest to answer empirically, since these causes do not have to be identified. But although it is a well-defined question, its broad scope makes it less interesting than any of the others. Its answer will be different for different situations, depending on the underlying causes for the change in trade. Unless one is seriously considering clamping down on the volume of trade, knowing how such a drastic policy would alter the course of wages does not have a great deal of policy relevance.

All the preceding questions, excepting the first, have used the volume of trade as the benchmark for identifying the effects of trade. Yet only in a small, open economy is it theoretically correct to take conditions of international trade as given, and therefore as a possible exogenous cause of changes in wages. In a small, open economy it is not trade volumes, but rather international prices, that are independent of domestic behavior. In such an economy, the volume of trade is entirely dependent on how domestic firms and consumers respond to international prices and to other domestic variables. It therefore seems inappropriate to define the effects of trade on wages in that model in terms of any measure of trade volume. Recognizing this, several investigators have used international prices, instead of trade volumes, as their explanatory variables. This suggests yet another variation on the "but for" question:

Regarding any exogenous change that might affect trade or wages, how would wages respond differently if the international prices were held constant? For a truly small, open economy, this question is an improvement over the preceding one, since it will attribute to trade only those changes that can alter world prices. Changes originating only domestically will be viewed as having zero effects. The effects of changes that originate both at home and abroad, however—such as a worldwide change in technology—will still be attributed to trade, much as in the other "but for" interpretations above. And here the question is perhaps even less plausible than in the others: But for the changes in world prices, how would wages have behaved differently? For it seems to assume that trade policy could in fact be used to hold prices constant, and that may not be true.⁹

Empirical Implementation. In dealing with various empirical episodes, each of the first three interpretations above could in principle be addressed. One could ask: (a) what the wage effects of a particular trade liberalization would be, or would have been; (b) what the wage effects in one country are for a particular change such as a productivity improvement in another country, these effects presumably being transmitted through trade; and (c) what portion of a wage decline due, say, to lagging productivity at home could have been prevented had the volume of trade been held fixed. There have been

⁹ Actually, it may only be the domestic equivalents of international prices that must be held constant. If so this can in principle be achieved by suitable variation in taxes and subsidies on exports and imports.

many studies of the first type, but most have addressed the question from a different perspective than that of the trade and wages literature considered here. Most of these studies have used computable general equilibrium (CGE) models, applying them to things like the Tokyo Round and the NAFTA, and they have typically examined these effects *ex ante* rather than *ex post*. We will not consider them further here.¹⁰ The only studies we know that have explicitly tried to examine the effects of trade liberalization *ex post* are by Bhagwati (1991a,b) and by Robert Lawrence and Matthew Slaughter (1993). The second and third questions do not appear to have been asked in the literature at all, perhaps because of the difficulty of isolating-or even settling upon-a single source of exogenous change.

Instead most of the empirical studies have asked one of the more general but-for questions, controlling for the effect of either a quantity or a price of trade, and not specifying the ultimate source of change in either. Some studies ask: (d) How have wages responded to the increased trade volumes of a particular period? In other words, if the volume of trade had been held fixed over the same period, how would wages have been different? Others ask: (e) How have wages responded to the changes in world prices over some period? This is to ask the same thing, but for prices instead of trade volumes.

As indicated, some empirical studies focus on episodes of changes in trade volume, others on changes in prices. A number of studies, however, put their focus more on particular changes in wages and try to explain them. To the extent that they try to explain the wage changes in relation to trade, this different focus has the same alternative interpretations available as before. That is, for example, if there has been a change in tariffs at the same time as the wage change being examined, then one can ask whether the former caused the latter. Or, using a but-for interpretation, one can ask whether holding trade quantities or prices constant would have prevented the wage change that was observed. This latter interpretation is a little awkward, since it requires an arbitrary baseline for comparison.

Looking only at trade to answer such a question is suspect, however. Many possible reasons can cause wages to change. If one had looked at all of them along with trade, using a comparable methodology for each, then one might well have explained either more or less of the wage change than actually occurred. One would then have to conclude that something was wrong, and perhaps to scale downward or upward all the separate estimates. By looking at trade only, one does not have the chance to find out what the errors are. Therefore it is surely better to explain the wage change by looking as far as possible at all the contributing factors at once.

A number of studies have taken this approach, estimating a wage equation that includes a variety of explanatory variables. These, including trade, are then evaluated in terms of their respective contributions to this regression. This approach contains a number of problems, however, including that the wage equations themselves are not usually well motivated by theory.

First, unless one focuses on trade policies rather than on trade *per se*, the trade variable is bound to be an endogenous one that is simultaneously determined with

¹⁰ See Srinivasan and Whalley (1986) for a survey of a broad spectrum of CGE models, and Brown (1992) for a more recent survey of models applied to the NAFTA.

wages.¹¹ Techniques for dealing with this simultaneity exist, of course, but they require more information about the structure of the economy than most investigators have.

Second, once multiple explanatory variables are included, the "but for" interpretation that we discussed above becomes less clear. Are we asking how wages would have behaved differently if only trade were held fixed, or are we also controlling for the other right-hand-side variables? The usual procedure is to speak of trade's contribution to the explanation of wages, but since trade is endogenous, it is not clear what this means. Does it mean that if trade had been held fixed, then the wage would have changed by a certain percentage less? That would be a reasonable statement, but is it really warranted by the estimation? When endogenous volumes or prices of trade enter as explanatory variables along with other exogenous variables that could themselves affect those volumes and prices, then the separate roles of both must be intertwined and difficult to interpret without estimating a structural model.

Examples. To illustrate some of these points more concretely, it is helpful to consider several theoretical examples of exogenous changes that would affect both trade and wages. These examples are chosen because they all lead to roughly the changes in trade and wages that have been observed, even though the exogenous changes that initiate them are quite different. They therefore underscore the point that looking at trade and wages alone cannot be enough to identify what is going on.¹²

There are five examples, all in the context of an H-O model of trade, with two factors, skilled S and unskilled U labor, producing a skill-intensive, high-tech good H and an unskill-intensive-low-tech good L . There is also an even more skill-intensive nontraded good N in the last of the five examples. Prices of goods and factors are p and w with obvious subscripts. The country, in each case, is small.

Example 1: tariff cut on imports of L. Consider the removal of a tariff on imports of the unskill-intensive-low-tech good. Effects on factor markets are shown in figure 3-1. The solid lines indicate unit-value isoquants and resulting employment and wages of factors in the presence of the tariff. The broken lines show the situation after the tariff is removed. The country's endowment is fixed at point E . Tariff removal shifts the L -isoquant outward, causing the wages needed for diversification to rise for S and fall for U . Effects on production and trade are shown in figure 3-2, panel A, which is the familiar textbook depiction of a tariff in terms of production possibilities and community indifference curves. Clearly, the tariff cut has raised skilled wages relative to unskilled wages and expanded the volume of trade.

Example 2: foreign expansion in production of L. Suppose that production of the low-tech good expands abroad, either because of factor accumulation there or because of technical change that occurs abroad but not at home. This will cause the relative price of the low-tech good to fall on world markets. Using good H as numeraire, effects on factor markets are exactly the same as in figure 3-1, the L -isoquant shifting outward. Effects on

¹¹ Even trade policies, such as tariffs and quotas, may be endogenous for political economy reasons, of course. This is especially important to take into account in estimation across industries.

¹² These are not by any means the only examples possible. Bhagwati and Dehejia (1993), for example, provide an explanation in terms of increasing labor turnover among the unskilled.

outputs and trade are shown in figure 3-2, panel B. Again, the foreign expansion has raised the skill differential and increased the volume of trade.

Example 3: technical progress at home in production of H. Let there now be a Hicks-neutral improvement in the technology for producing the high-tech good H in the home country only. This will shift the H -isoquant inward, toward the origin, rather than the L -isoquant outward, but the effects on factor markets are otherwise so similar to the previous cases that we do not show them separately. Effects on output and trade are shown in figure 3-2, panel C. This particular case of technical progress therefore has also raised the skill differential and increased the volume of trade.

Example 4: technical regress at home in production of L. If instead there were a deterioration in some technology, one could still get essentially the same effects.¹³ Suppose there is a Hicks-neutral worsening in the technology for producing the low-tech good L , again in the home country only. This will shift the L -isoquant outward, exactly as in figure 3-1. Effects on output and trade are shown in figure 3-2, panel D. Once again, the skill differential widens and the volume of trade increases.

Example 5: rise in expenditure at home. In figure 3-3 we add a nontraded good, production of which, in the initial equilibrium, uses up an amount of the factors indicated by the solid arrow pointing inward from the endowment point E . N^0 therefore indicates the amounts of factors that remain for production of the two traded goods, leading to factor prices and employment much as before. Now suppose that total expenditure on all goods rises, earned income remaining constant. At the macroeconomic level, this will of course create a trade deficit. At the microeconomic level, increased expenditure will raise demand for the nontraded good, production of which will therefore now require larger amounts of both factors. The arrow extending from E is therefore lengthened, leaving only the factors at N^1 available for producing traded goods. In the example shown, this so reduces the availability of skilled labor that the economy moves to complete specialization in L , and factor prices change. Once again, the skilled wage rises, both in real terms and relative to the unskilled wage.

The message of these five examples is simply this: there are many possible reasons for the skill differential to increase at the same time that the volume of trade increases. Showing that the two are related empirically does not therefore mean that trade is somehow responsible for the change in wages. If the examples were carried further, it would undoubtedly also be true that the wage changes would have been different had trade been held constant by some form of trade intervention. Nevertheless, the causes of the changes, except in example 1, would have been something other than trade.

With these uncertainties about both the accuracy and the interpretation of attempts to estimate the effects of trade on wages, let us now turn to our survey of the major contributions that have been made.

¹³ An institutional change or a regulation that lowers productivity could also have this effect.

Studies of Effects of Trade Volumes

Several studies in the past few years have attempted to infer wage changes from changes in trade volumes. We look at two groups of them. The first group infers wage changes indirectly by first calculating the labor content of changes in trade. That is, they use the factor requirements of production to infer the effects of trade on the quantity of labor demanded. Thus the primary emphasis of these studies is on a quantity-quantity relationship. Effects on wages are then deduced in a second step, by combining the quantity estimates with elasticities, usually from other sources. In contrast, the second group of studies that uses trade volumes looks at wages more directly, typically estimating a wage equation that includes trade volumes among other explanatory variables.

Calculations of the Labor Content of Changes in Demand. George Borjas, Richard Freeman, and Lawrence Katz (1991) do the most straightforward study of this type. For various periods in which the quantities of trade changed, they regard the labor needed to produce exports as being subtracted from the available domestic labor supply. The labor needed to produce substitutes for imports is viewed as additions to the labor supply. Using disaggregated data on trade and on the employment of various occupations in different industries, they therefore attribute the changes in this labor supply to trade during the 1980s. This terminology, identifying as changes in supply what were really changes in demand for labor, is apparently motivated by the desire in the second part of the analysis to link the quantity changes to wages on the basis of known responses to supply shifts. We will use net supply and net demand interchangeably in our discussion of this particular study.

We know of course that the U.S. trade deficit expanded dramatically during the first half of the 1980s. Therefore the Borjas, Freeman, and Katz methodology is guaranteed to generate the result for that period that the total demand for labor would decrease. Since the study does not allow for any other changes in the aggregate demand for labor that might have occurred during the same period, its implications for effects on total employment and wages should therefore be discounted.

The focus of Borjas, Freeman, and Katz, however, is not so much on the total labor market as on the different groups of labor within it. Here their calculations identify unskilled labor as being the group with the greatest increase in supply due to trade. From that they conclude that trade must have lowered the relative employment of unskilled labor—a conclusion that strikes us as valid, though only within the context of the but-for interpretation discussed above. That is, without attempting to identify the reasons for the changes in trade that took place during the 1980s, Borjas, Freeman, and Katz correctly identify the relative changes in demand for different types of labor that could be attributed to that trade. But for these changes in trade – if the changes in trade had been prevented by, say, changes in trade barriers—the demand for unskilled labor would have been substantially greater than it was.

The last link in the analysis, from changes in labor supply and demand to changes in wages, is perhaps more tenuous. Their approach is simply to multiply the notional changes in labor supply by selected elasticities taken from regressions they and others have estimated. Thus, in effect, they treat the labor market as though it could be solved in

partial equilibrium. This is inconsistent with much that we know from trade theory of how general-equilibrium models behave. In the H-O model, for example, under the assumptions that lead to the FPE and Stolper-Samuelson theorems, factor prices depend directly on output prices through the zero-profit conditions, and they do *not* depend on factor supplies independently of goods prices.¹⁴ With less intersectoral mobility of factors, as in the specific factors model, factor prices do depend on factor supplies as well as on goods prices, but the nature of that dependence depends crucially on the pattern of factor mobility. Only in the most extreme specific factors model, where *all* factors are immobile, can factor prices be inferred in a simple way from factor supplies. Therefore we would not place too much credence in the Borjas, Freeman, and Katz estimates of effects on relative wages.

Their analysis of changes in factor demands, however, is nonetheless useful for indicating in broad terms the directions of change in factor prices that are associated with trade. What they do in their calculations of the effects on net labor demand is to construct the factor-content of the change in trade between two general equilibria. A theoretical model by Alan Deardorff and Robert Staiger (1988) showed this to be correlated with the changes in factor prices that underlie those equilibria if technology and preferences are held constant.¹⁵ Thus by showing that the changes in trade in the 1980s involved a decrease in the relative demand for unskilled labor, Borjas, Freeman, and Katz also provide incidental evidence that the same changes in trade were associated with a fall in the relative wage of unskilled labor, relative to what would have occurred without the changes in trade.

What this means exactly depends on what caused trade to change, and Borjas, Freeman, and Katz do not identify that. To take just two possibilities, consider the theoretical examples 2 and 3 discussed above. In example 2, the increase in trade was due to an expansion of output of the low-tech good abroad. Since technology and preferences at home are constant in this example, the factor content calculation is indicative of the changes in factor prices that are also caused by this change, and which could have been prevented by fixing the quantities of trade and thus insulating the domestic market. In example 3, on the other hand, the cause is a change in technology at home. In this case the change in factor content indicates not the wage effects of that change itself, but rather the difference in effects of the technical change on wages if trade either is or is not allowed to change as well.

Note that in both of these cases the insight from the H-O model that goods prices and factor prices must go together continues to be valid. In example 2 the effect on wages occurs only to the extent that the foreign expansion alters world prices. In example 3, however, the relevant price change is not the observable one caused by the change in

¹⁴ This, in fact, is the central message of the FPE theorem.

¹⁵ Deardorff and Staiger (1988) use a simple, multi-sector, perfectly competitive, general equilibrium model to derive several relationships that must hold between changes in factor prices and changes in the factor content of trade between two trading equilibria with constant technology and preferences. The most general result is a positive correlation between relative changes in the factor content of trade, appropriately normalized, and proportional changes in factor prices. Thus, while it is not true that, say, an increase in the unskilled-labor content of net exports must necessarily be associated with an increase in the wage of unskilled labor in general equilibrium, it must nonetheless be true that, if factor prices change at all, then there is an average positive relationship between the factor contents of all factors and the changes in their factor prices.

technology, but rather the presumably unobservable difference in prices that *would have* occurred without a change in trade.

A second important study of this sort is that of Kevin Murphy and Finis Welch (1991). Like Borjas, Freeman, and Katz, they calculate the effects of changes in sectoral trade balances on the demand for labor at fixed prices,¹⁶ and they use that to infer the employment changes that can be attributed to changes in trade. They do not connect these employment changes directly with wages, although they do argue that the patterns they calculate for employment changes match the patterns of wage changes.

The biggest difference between Murphy and Welch on the one hand and Borjas, Freeman, and Katz on the other is the treatment of aggregate demand. As noted above, Borjas, Freeman, and Katz assume that any increase in imports reduces demand for domestic labor. In a period of rising trade deficit such as the early 1980s, this ensures that they will calculate a drop in employment. In contrast, Murphy and Welch recognize that an increased trade deficit is likely to reflect an increase in demand, and they therefore assume that an increase in the trade deficit has an additional, expansionary effect on aggregate demand. Thus an increase in net imports in a particular sector reduces labor demand in that sector, but at the same time it increases demand for goods and therefore labor across the economy. With this assumption, Murphy and Welch get a mixture of expansions and contractions in different sectors, rather than the more or less uniform contraction of demand that must characterize the Borjas, Freeman, and Katz calculations for the early 1980s.

This change in assumptions implies also a change in the nature of the question that the two studies implicitly address. Borjas, Freeman, and Katz implicitly compare employment to what it would have been if trade had been held fixed by policy and if aggregate spending nonetheless expanded by the amount that it in fact did. With trade deficits prevented and the increase in aggregate spending bottled up inside the U.S. economy, one gets a much greater expansion of employment than in fact occurred, and one attributes the shortfall from that expansion to trade. Murphy and Welch, however, compare employment to what it would have been if trade were fixed *and* if aggregate spending were prevented from increasing. The shortfall from this less expansionary path is of course much smaller.

Which of these approaches is more appropriate depends on how trade and aggregate spending are related. If one believes, for example, that trade flows could have been frozen by trade policy, including preventing the increase in the trade deficit of the early 1980s, without interfering with the growth of aggregate real spending, then the Borjas, Freeman, and Katz calculation is correct. If, conversely, one views the expanding trade deficit as the reason why aggregate demand could expand at all in what quickly became a fully employed economy, then the Murphy-Welch calculation is correct. We incline to the latter view.

Once again, however, it is important to understand what question was being addressed. Murphy and Welch attribute to trade both the sectoral expansions and contractions that corresponded to changed exports and imports, and the total expansion of

¹⁶ They refer to their calculations more appropriately as reflecting changes in demand, rather than supply, of labor. Regarding supply, they also provide an important argument that supply changes cannot account for the changes in wages that have been observed. They look for and fail to find the negative correlation between wage and employment changes that would be needed for changes in supply to drive wages.

aggregate demand that might not have been possible without trade. There is no sense, however, that either the sectoral changes or the aggregate change themselves were the result of changes in trade policy or of changes that originated abroad and were transmitted to the home market through trade. Quite the contrary, once the change in aggregate spending is recognized by Murphy and Welch, it seems most likely that both sets of changes arose in large part from the changed macroeconomic policies of the early Reagan administration. The calculation of trade effects indicates only how the Reagan policies may have affected U.S. labor markets differently in the presence of trade compared with what would have been possible in its absence.

Several other studies have used variants of the approaches of Borjas, Freeman, and Katz (1991) and Murphy and Welch (1991). Katz and Murphy (1992) apply a modified version of the Borjas, Freeman, Katz methodology directly to the United States from 1963 to 1987, and they focus especially on effects on different demographic groups based on sex and levels of education. John Bound and George Johnson (1991, 1992) also take off from the work of these authors, though in a variation that does not look so directly at international trade.

Seeking to evaluate alternative explanations for the observed changes in relative wages, Bound and Johnson group the trade effects of these other authors together with other possible shifts in demand. Rather than looking at the factor content of trade or of other demand shifts, however, they measure the actual shifts in industry employment, then use initial shares of different labor groups to calculate the implied changes in demands for different types of labor. Although this calculation, like those of the previous authors, accords well with observed changes in relative wages, Bound and Johnson argue that it inappropriately holds constant the shares of the different labor groups in the labor force. When they instead make a correction for these changes, then their calculation fails to generate changes in net labor demand that match with observations of the relative wages.

Bound and Johnson therefore conclude that changes in demand, including changes in trade, cannot explain the puzzle. In another part of their analysis, therefore, they examine changes in technology, and they conclude by attributing the larger part of the changes in relative wages to changes in technology that have increased the need for skilled labor.

Other Studies Relating Wages to Trade Volumes. A number of studies have estimated the relationship between trade volumes and wages more directly. Typically, these studies have estimated one or more wage equations with measures of trade volumes or trade balances among the explanatory variables on the right-hand side. Our main criticism of this approach has already been indicated. General-equilibrium theory does not imply such a relationship except in the very short run, and instead suggests that wages are determined by prices. Nonetheless, it is again possible to provide a loose theoretical justification for this approach in terms of the theoretical correlation between the factor content of trade and wages shown by Alan Deardorff and Robert Staiger (1988). In this sense, however, it would be preferable to use the factor content of changes in trade, and not trade itself, as the explanatory variable.

A first such study is Katz and Ana Revenga (1989). They look at U.S. and Japanese relative wages and regress them on the aggregate trade imbalance and other

explanatory variables. The question here is the same we have discussed before: whether wages would have been different but for certain changes in trade. In this sense, they identify trade as one of several causes of the changes in relative wages that were observed. In particular, they find that a high U.S. trade deficit helps the relative wages of educated and experienced workers in the United States, while favoring new entrants to the labor market in Japan.

Freeman and Katz (1991) examine U.S. wages in unionized versus nonunionized sectors. While they do not calculate the factor content of trade in the manner of some of the previous studies, they do allow trade to play a role. They relate changes in wages to changes in sales, and they decompose sales into three components that focus respectively on domestic sales, exports, and imports. They find that the industry wage structure does respond to changes in sales, with comparable contributions from each of these three components. Thus trade matters for wages in the same way as domestic sales. Regarding unionization, they find a greater sensitivity of wages to sales in unionized than in nonunionized sectors.

Another study by Murphy and Welch (1992) provides a much broader explanation of wages in relation to trade and other explanatory variables. They devote a great deal of attention to careful and elaborate econometric technique in ways that we will not attempt to cover here. The end result is that they find certain trade variables to be significant determinants of wages, though certainly not the only determinants or necessarily the most important. Murphy and Welch are quite explicit that, while they believe that they have established the importance for wages of shifts in demand, they have not been able to identify the primary cause of those shifts. It could be trade, but it could also as easily be skill-biased technical progress.

From our point of view, while these conclusions and the arguments leading to them are impressive, we find it difficult to know how the conclusions regarding trade and technical progress fit together. It seems plausible, for example, that technical progress could have altered wages, both total and relative, among different skill groups. But that same progress would surely also have altered trade. When trade is identified as a separate explanatory variable, what does this mean? That the effects of technical progress are being considered under the assumption that trade does not change? That trade is being considered under the assumption that technology does not change? If both of these, then what about the effects of technology when trade is allowed to change? We admit to being confused here to a degree that did not arise with the simpler studies.

We close this section with mention of a final study that also relates wages directly to trade, but in quite a different way. Steven Davis (1992) looks across a large number of countries to see whether relative wage structures in those countries have converged or diverged over time. He finds that they diverged. After controlling for year-specific effects, however, and allowing for the role of trade as a fraction of GDP, he finds that the more open countries, in terms of this trade share, have converging relative wages.

We mention this study last because it is one of the clearest in terms of the question it asks: Does greater openness to international trade cause a country's factor prices to converge to those of its trading partners? As we have noted, a positive answer to this question is not in fact implied by the FPE theorem, even though it may be suggestive of this result. Further, we could quibble with the use of the trade share of GDP as a

measure of openness.¹⁷ Still, it is refreshing to find a question so clearly asked and answered.

Studies of Effects of Prices

We have said that general equilibrium trade theory explains wages in terms of prices, not volumes of trade. Several studies have recognized this fact and have used it as the basis for explaining wages. Unfortunately, it does not follow from the existence of a theoretically sound relationship between prices and wages that estimating it is useful. Unless we know the sources of the price change, or unless the prices themselves are likely to be exogenous to the other behaviors we wish to study, knowing how they are related to wages may not be useful.

Consider two examples from other contexts, in one of which a price change is plausibly exogenous, and in the other of which it is not. First, suppose that the price change we were considering was the increase in the price of oil in 1973. Suppose further that this price change was the result of a deliberate action by a group of countries and is not best understood as a response to other changes in the world economy. Therefore it may make good sense to use economic analysis to determine the effects that this price increase may have had, including on the level and structure of wages. It is reasonable to ask how wages would have behaved differently had the oil price not risen.

In contrast, however, consider the more general nominal price increases of the 1970s, which were driven not by decisions about prices but by the overheated economies of the Western world. Recalling the largely fruitless debates about "demand pull" versus "cost push" inflation, it would surely be inappropriate to view these price increases as in any sense coming from outside the system or as being causes of changes in wages. Surely an interactive system was operating, in which prices and wages were both responding to other forces, and the forces too were inside the system. A regression of wages on prices might have worked well in that situation, but it would not have told us anything useful about the policies that might have been used to slow that movement. It would not have told us, in particular, how wages would have changed in the absence of the price changes, since the latter could not have been removed without also removing the more primary causes that were acting on both. A better approach would have been to identify these primary causes and study their effects on both prices and wages simultaneously.

With those caveats, let us look at the studies that have used international prices to explain domestic wages.

The first study we will consider is by Gene Grossman (1987). This is actually an expansion of a 1986 study by Grossman that considers only the steel industry. Grossman estimates reduced form equations for both employment and wages in a number of industries, with import prices included among the explanatory variables. He finds strong evidence of import prices mattering for employment in only one out of eight industries, and for wages in only two out of eight industries.

Revenega (1992) performs a similar analysis, using improved data on import prices and employing an instrumental variables estimation strategy. She is able to find

¹⁷ A geographically large country like the United States, for example, would have a lower trade to GDP ratio than a smaller country just because of its size, even if its trade barriers were nonexistent.

statistically significant effects of import prices on both employment and wages, but for all industries together, not separately, since she pools them under the surprising assumption that all industries would share the same coefficients. She too finds the effects on wages to be much smaller in magnitude than the effects on employment.

The reason for these results, as their authors are well aware, could be that labor is more mobile among sectors of the economy than their models allowed for. In order to obtain manageable estimating equations, both Grossman and Revenga assume that there are separate supply curves for labor to each sector, a minor variation on the specific factors model. This is not implausible, perhaps, but it is contrary to the assumptions of the H-O model of trade. Most of us would regard the assumptions of the H-O model as too extreme in this regard, but the results of Grossman and Revenga suggest that the general-equilibrium, mobile-labor H-O model may have more to recommend it than we thought.

Only a few studies have taken the H-O model seriously as the basis for empirical analysis. Bhagwati (1991a,b) does this, arguing that what matters for factor prices are goods prices, *à la* the Stolper-Samuelson theorem, and producing empirical evidence that the U.S. terms of trade seem to have behaved in a manner opposite to what is required. A later study by Lawrence and Slaughter (1993) also analyzes this question in much greater depth. They provide a variety of empirical arguments why the changes in goods prices that have been observed cannot account for the observed changes in factor prices. These include: (1) the observation that real wages did not in fact fall in terms of producer prices – as they would have done if the Stolper-Samuelson mechanism had been driving them – but only in terms of consumer prices; (2) several arguments as to what caused consumer prices to differ as they did from producer prices, and why this was not due to trade; and (3) several additional observations that are inconsistent with a Stolper-Samuelson shift in favor of skilled-labor-intensive goods. One such observation is that the ratio of skilled to unskilled workers in manufacturing increased during the 1980s, instead of decreasing, as would have been expected from such a Stolper-Samuelson shift.¹⁸ Second, they note, as did Bhagwati (1991), that relative prices of skill-intensive goods did not rise during that period, but seem rather to have fallen slightly. They argue therefore that observed changes in wages have been consistent with technological improvements that have favored skilled-labor-intensive sectors, and indeed that have been biased in favor of skilled-labor employment.¹⁹

We find these arguments ingenious and compelling. They rest so heavily on the general-equilibrium model of trade theory that they do not lend themselves to the sorts of econometric analysis that have been used in most of the other studies we have looked at. For that reason they may be slow to gain acceptance among the contributors to that literature. And even for trade economists, this much reliance on the strong implications of the two-sector, H-O model leaves us somewhat uncomfortable. Nonetheless, we admire the efforts made by these authors to examine the data so carefully in accordance with what that economic theory implies.

¹⁸ See figure 3-1.

¹⁹ Example 3 above illustrates such a technical change favoring skill-intensive goods, but does not include this bias. The bias is needed in order to account for the observation that ratios of skilled to unskilled labor increased.

Notice again the question Lawrence and Slaughter have addressed. Has the behavior of wages and prices been consistent with the implications, and thus the assumptions, of the Stolper-Samuelson theorem? Their answer is no, thus implying that one or more of those assumptions is invalid. Their choice for that assumption is the constancy of technology, and they pose an additional question that they answer in the affirmative: has the behavior of wages and prices been consistent with technical progress favoring skilled labor? These questions may not appear to be directed precisely at the issue of how trade has affected wages, but in fact the study seems to have come closer to resolving that issue than most other approaches.

Studies of Protection and Wages

The most straightforward question we asked at the start was how changes in protection would affect wages. As we have seen, most of the literature on trade and wages has not asked this question. Two recent studies, however, do ask it.

The first is by Noel Gaston and Daniel Trefler (1992). Looking across industries, they regress wages on levels of protection, both tariffs and non tariff barriers (NTBs), and ask whether wages are higher or lower in more protected sectors. The key to their technique is that they control for worker characteristics, so that their results provide comparisons of identical workers. They find that wages are negatively correlated with levels of tariffs, but positively correlated with NTBs. That is, wages are highest where tariffs are lowest but where NTBs are highest.²⁰ Unfortunately, since these are cross-industry regressions, they do not tell us how protection would cause wages to change.

The other study is that of Edward Leamer (1992). We mention it in this section because it deals ostensibly with what effects the NAFTA would have on wages. Thus the question again is clear-how will the removal of tariffs between the United States and Mexico (Leamer did not consider Canada) change wages in the two countries? Leamer's approach to this question is characteristically original, but it actually has little to do with this question. In a long paper with a number of other useful elements as well, he argues that the NAFTA will open up the U.S. market to labor-intensive competition, and that the effects of this competition can be understood by analogy with the increased competition that has already occurred in recent decades. Like Lawrence and Slaughter, he insists that wage effects can only be inferred from price changes. He then sets out first to predict the price changes that a NAFTA would entail, then to transform the price changes into wage changes by estimating Stolper-Samuelson effects.

To predict price changes, he first regresses actual price changes over recent decades on factor shares.²¹ Using the coefficient from the capital-labor ratio in this regression to extract the effects of labor-intensive competition, he then calculates the price changes that such competition entails. Finally he multiplies these price changes

²⁰ The latter finding, that NTBs are highest in sectors where wages are highest, accords well with the observation by Deardorff and Haveman (1993) that administered protection, such as antidumping duties and countervailing duties, are used in sectors with higher than average wages.

²¹ Actually, he used data from only 1972-1985 for this regression, a period during which labor's share fell by a few percentage points. Over a longer period, 1950-1990, labor's share has remained essentially unchanged. We do not know how Leamer's choice of period may have affected his results.

(possibly scaled up or down to reflect the presumed degree of competition) by Stolper-Samuelson elasticities that he has inferred from a regression of outputs on factor endowments, and this gives him his estimates of factor price changes. The results indicate a substantial decline in the unskilled wage due to the NAFTA.

This is a clever method of answering a very difficult question. As in the case of the Lawrence and Slaughter analysis, we are concerned that it relies heavily on the strong mathematical properties of the H-O model. In particular, it seems to require equal numbers of goods and factors in order for the Stolper-Samuelson elasticities to be well defined. It also does not allow for the kinds of economies of scale and competition effects that are often thought to be important in determining the effects of free trade in small countries.²² And perhaps more seriously, we find it hard to accept the assumption that competition with Mexico will be qualitatively the same as the increased competition of the past few decades. Leamer's own discussion of Mexico as a "platform" for exports to the United States—which plays no role in his empirical analysis—seems to suggest that Mexico's role in a free trade agreement (FTA) will be different from the competition that we have experienced before.

Conclusion

We set out to provide a selective survey of the empirical literature on trade and wages, and we chose to structure our discussion around the questions that this literature was asking. We found a good deal of interesting and important work, with some useful and informative results. To facilitate comparison, we have summarized the results of some of the studies that look at the effects of international trade on *relative* wages in table 3-1.²³ From this table it is clear that the studies do not reach a unified conclusion. Moreover, the studies do not even address many of the questions we initially set out.

Does protection affect wages? Only Gaston and Trefler (1992) and Leamer (1992) even try to answer that question, and their answers are hardly conclusive. Yet the question is in the consciousness of the public at large, which seems to have little doubt as to the answer. Trade theorists may think they know the answer, based on the Stolper-Samuelson theorem, but we still have little empirical evidence to back it up.

Does variation in trade permit events abroad to change wages at home? That question is also high in the minds of the public, concerning as it does the vulnerability of the U.S. labor force to "international competition." Yet none of the studies we looked at attempt empirically to isolate foreign from domestic reasons for quantities or prices of trade to change, and therefore they do not address this question.²⁴ The question most

²² See Brown, Deardorff, and Stern (1993), which discusses how these considerations can alter the relationship between prices and wages in an otherwise Stolper-Samuelson framework. Brown, Deardorff, and Stern (1992) reports increases in real wages for all three NAFTA countries, largely because of scale economies.

²³ Our interpretation of the questions that are being addressed in all of the studies mentioned in table 3-1 is that they are of the more general "but for" form: But for any changes in trade volumes/prices, and regardless of the reasons for these changes, how would wages have behaved differently than they in fact did?

²⁴ Johnson and Stafford (1992, 1993) have elaborated a theoretical argument that technical progress abroad, particularly in the newly industrializing countries, may have been a source of decline in wages in the

commonly addressed is the more general one, of whether variations in trade make a country's labor force more or less vulnerable to shocks of all sorts, whether foreign or domestic. And there the evidence is mixed.

For the first half of the 1980s, changes in trade were associated with disruption in U.S. labor markets. The U.S. trade deficit expanded dramatically and unevenly across sectors, indicative of strains on the associated labor markets that in turn may have depressed unskilled wages, especially as compared with skilled wages. It may also be true that some of these changes could have been avoided if policies had prevented the changes in trade from taking place. There is no indication, however, that the causes of these changes came from abroad, or that restraining trade would have been desirable. Most likely, the source of the changes was the stance of the U.S. macroeconomic policy of the period, which led to a substantial expansion of expenditure relative to income. Had trade deficits not been possible, this expansion might also not have been possible, but the role of trade in this accident of history was more that of bystander than of instigator.

Similarly, over the longer period that includes the 1970s, changes in trade were again accompanied by changes in real and relative wages. Because the studies do not always do a good job of distinguishing induced changes in trade from other underlying causes of changes in both trade and wages, it is not easy to identify with confidence the causes of these changes. Evidence suggests, though, that they resulted from changes in technology that have occurred at home and abroad. Several studies, approaching the problem from quite different directions – from Bound and Johnson (1992) to Lawrence and Slaughter (1993) – have reached this conclusion, and we are inclined to agree.

In the end, the literature on trade and wages has told us something interesting and important about technology and wages. In our view, however, it has not answered convincingly the question that may be most on the minds of the public: whether U.S. workers have suffered from increased competition, through trade, with workers abroad.

United States and other industrialized countries. The reasoning is that, as these countries have acquired the technologies that were previously exclusive to the industrialized countries, the latter have suffered a worsening of their terms of trade. If this argument were verified empirically, it would suggest a loss to the industrialized countries due to a change abroad (technical progress) that was transmitted internationally through trade. That would not mean there had been a loss from trade per se however, since what was lost would only be a portion of the earlier, larger gains from trade. The decline over time could have been avoided by not trading, but only by pushing welfare to the much lower autarky level early on and leaving it there.

We have not included the Johnson-Stafford work in our survey here because it is not empirical.

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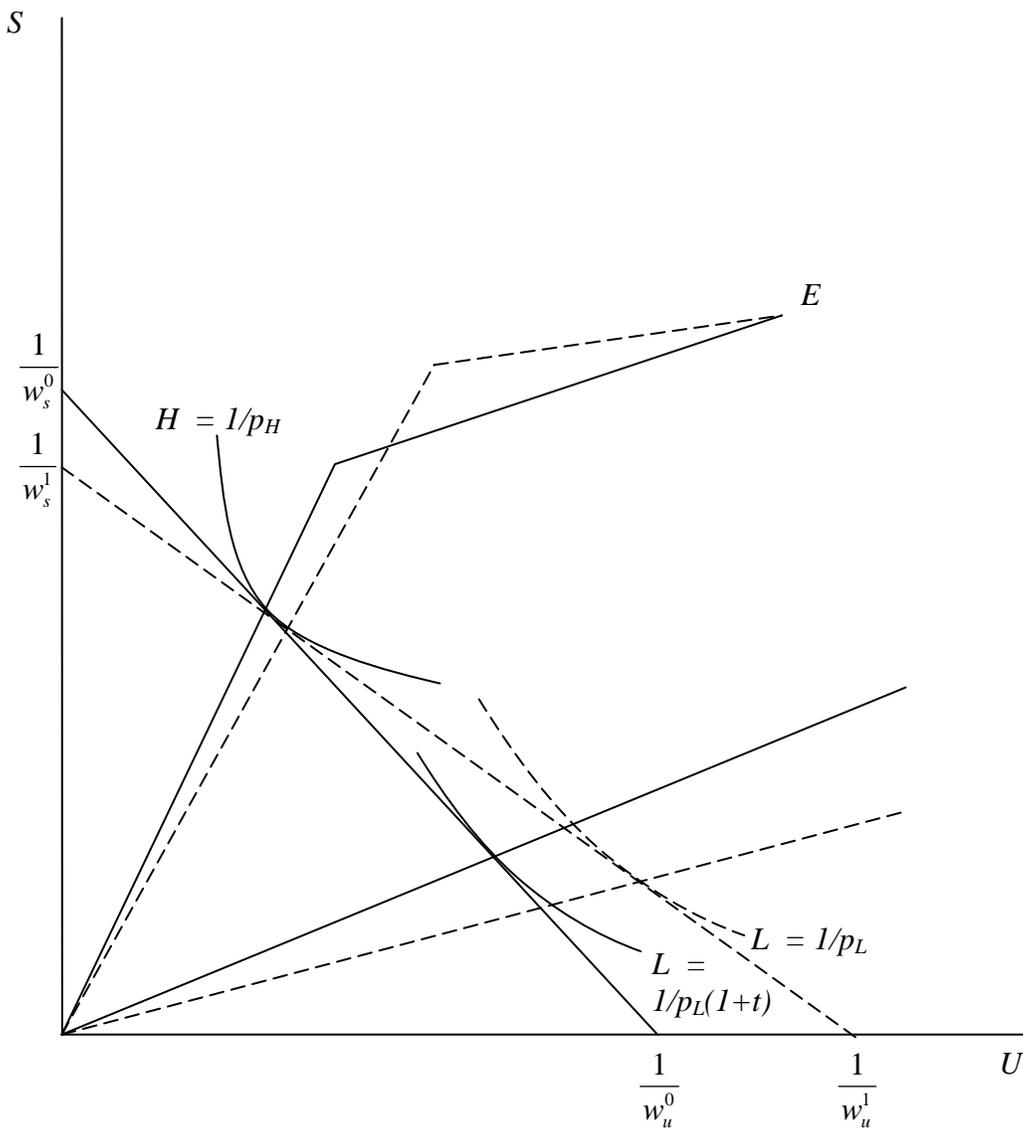
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TABLE 3-1
 EXTENT TO WHICH CHANGES IN RELATIVE WAGES CAN BE ACCOUNTED FOR
 BY INTERNATIONAL TRADE, ACCORDING TO THE STUDIES SURVEYED,
 1991-1993

<i>Study</i>	<i>Effect of Trade</i>	<i>Detailed Explanation</i>
Borjas, Freeman, and Katz (1991)	Substantial	Trade and immigration flows caused between 30-50% of the 10% decline in the relative weekly wage of high school dropouts, 1980-1988 Trade deficit caused between 15-25% of the 11% rise in the earnings of college graduates relative to high school graduates, 1980-1985
Murphy and Welch (1991)	Substantial	Exact match exists between the signs of relative labor demand changes predicted by changes in international trade with both the observed changes in the distribution of employment between industries and relative wages
Katz and Murphy (1992)	Some effect	Trade-induced changes in relative demand move in the correct direction to explain wage differentials, but are quite small in magnitude
Bound and Johnson (1992)	Little or none	Effects of trade a negligible, because estimates of total relative demand shifts are small
Leamer (1992)	Substantial	Estimates changes in real earnings induced by low-wage foreign competition to range from a \$3,038-\$30,384 increase for professional or technical workers, an increase of \$7-\$67 for every \$1,000 of capital, and a decline of \$931-\$9,312 for the earnings of other workers (calculated including petroleum refining)
Lawrence and Slaughter (1993)	None	Dismiss trade as an explanation for relative wage changes, since international prices move in the wrong direction from those expected by the Stolper-Samuelson theorem for the observed changes in relative wages

SOURCE: Authors.

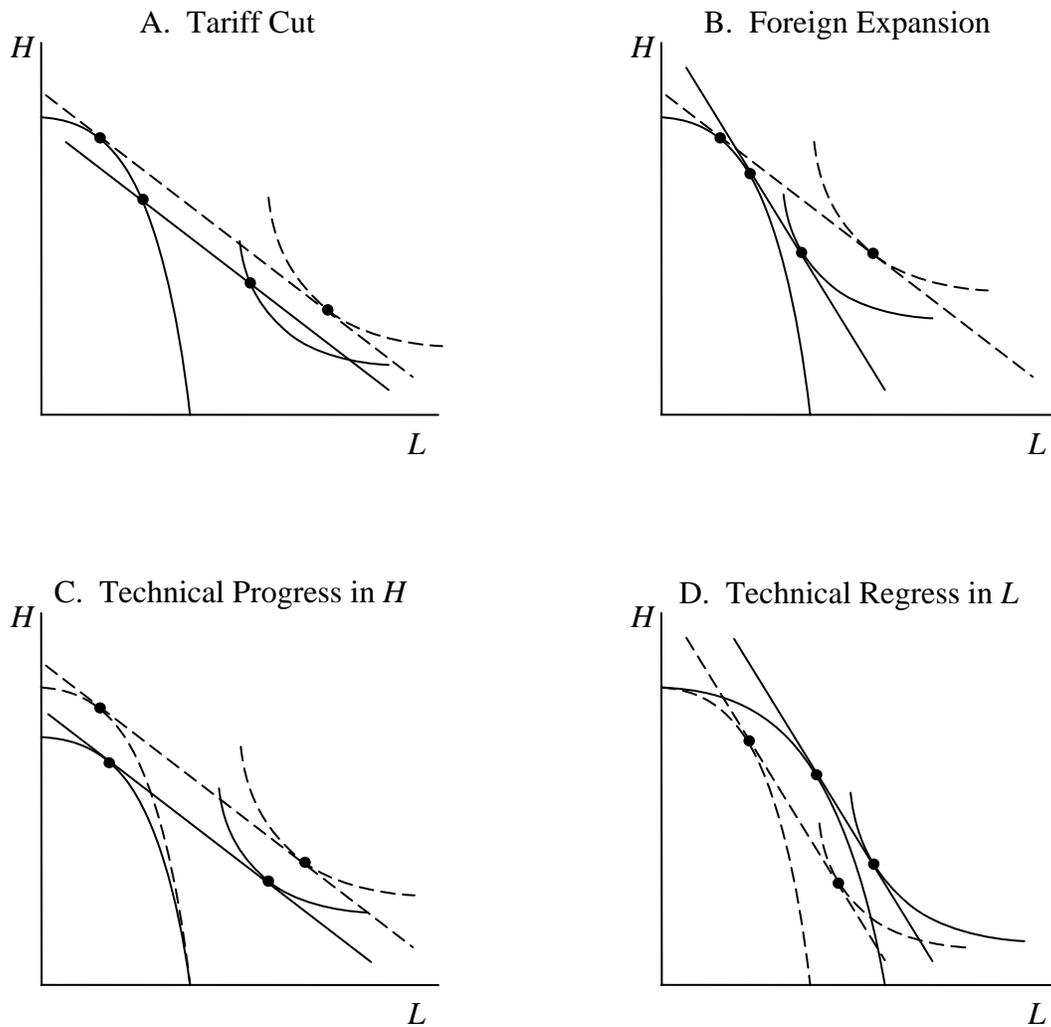
FIGURE 3-1
FACTOR-MARKET EFFECTS OF A TARIFF CUT



NOTE: Solid lines show unit-value isoquants, unit isocost line, and allocation of factor endowment E for skilled (S) and unskilled (U) labor in the presence of a tariff on the low-tech good L . Broken lines show the same in the absence of the tariff. This indicates that the tariff cut causes the skilled wage to rise, the unskilled wage to fall, and resources to shift into the high-tech sector H .

SOURCE: Authors.

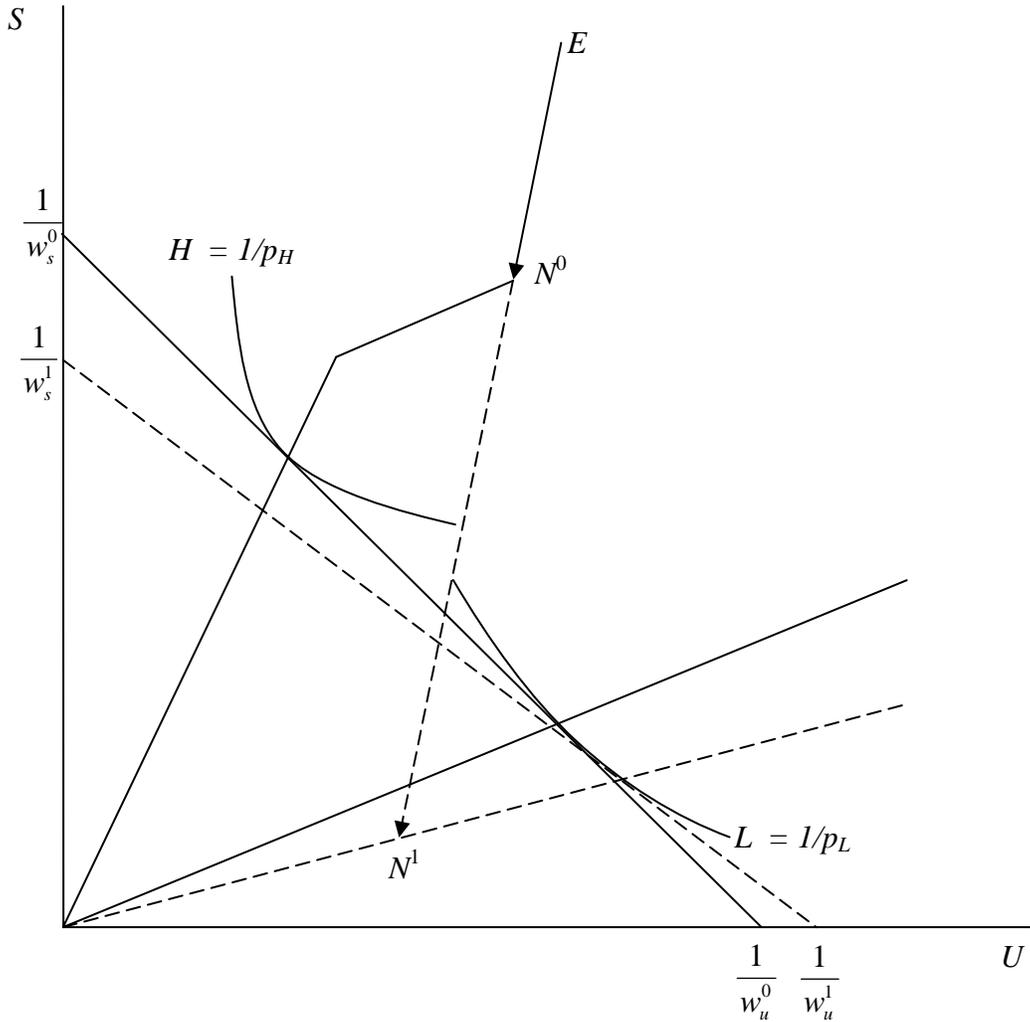
FIGURE 3-2
EXAMPLES OF OUTPUT AND TRADE EFFECTS



NOTE: Panels show production possibility frontiers for a high-tech good H and a low-tech good L , together with price lines and community indifference curves that indicate production and consumption. Solid lines denote the initial situation, broken lines the situation after the indicated change. In all four cases, for very different reasons, production of H expands and L contracts while imports of L increase.

SOURCE: Authors.

FIGURE 3-3
 FACTOR-MARKET EFFECTS OF A RISE IN EXPENDITURE



NOTE: Solid lines show initial positions of unit-value isoquants for two traded goods, L and H ; a unit isocost line; and an allocation of factor endowment E to those two industries plus a nontraded industry N . Broken lines show the effects of an increase in expenditure that requires greater production of the nontraded good, leading to complete specialization in traded good L , a rise in the skilled wage, and a fall in the unskilled wage. SOURCE: Authors.