

# **The Labor Market Effects of Globalization and Trade Adjustment Assistance**

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## Table of Contents

1.0	Introduction.....	1
1.1	Overview .....	1
1.2	Some Background Facts About the Labor Market in the U.S.....	3
1.3	Some Background Facts About Trade Flows in the U.S. ....	4
1.4	The Determination of Unemployment and Employment in the U.S. ....	6
2.0	Trade Theory and Empirical Evidence.....	9
2.1	Wage Determination in the Closed Economy.....	9
2.2	Wage Determination in the Open Economy .....	12
2.3	The Major Welfare Implications of the Open Economy Model .....	17
2.4	Estimation of the Effect of Changes in International Prices on Relative Wages.. .....	19
2.5	Departures From the “Pure” Open Model .....	21
2.6	Trade and Economic Growth .....	23
2.7	Outsourcing.....	25
2.8	Future Trends in the Sensitivity of the U.S. Labor Market to the Rest of the World .....	28
3.0	Short-Run Adjustment and Trade Adjustment Assistance .....	29
3.1	The Simple Adjustment Model .....	29
3.2	Trade Adjustment Assistance Programs .....	31
3.3	Individual Job Displacement Effects .....	32
3.4	Wage Insurance.....	34
4.0	Recommendations for Future Research and Information Gathering by DOL .....	35
	Endnotes .....	37
	Appendix A: A Simple Ricardian Model with Two Skills and Four Goods.....	42
	Appendix B: The Effects of the Outsourcing of Jobs on Employment, Average Real Wages, and the Distribution of Earnings in the Short, Medium, and Long Runs .....	50

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## 1.0 Introduction

### 1.1 Overview

This report deals with the effects of increasing globalization on the labor market in the United States. To many authors the term “globalization” is somewhat imprecise (Dore 2001), for it seems to apply as much to the homogenization of cultures (what is often called variants of “Americanization”). **For purposes of this report, however, globalization is taken to reflect the extent to which the U.S. economy is integrated into the world economy.** Within this definition, there is no question that globalization has increased over the past half century. Further, it seems likely—but is not a certainty—that economic integration will continue to increase over the next several decades. Such a prediction is conditional on further decreases in transportation and communication costs and a continuation of a relatively stable international political climate and favorable attitudes within the U.S. and other relevant countries toward trade.

Section 1.3 of the report reviews some of the key facts about the increase in the importance of traded goods—both imports and exports—in the U.S. economy over the past 40 years. The interesting analytical questions concern the implications of globalization on the operation of the labor market. How much of the increase in earnings inequality during the past 25 years (the facts about which are reviewed in section 1.2) is due to the factors that caused an increase in trade? Opinion of economists on the extent to which international forces have affected the U.S. labor market ranges from “a lot” (Wood 1994) to “surprisingly little” (Freeman 2003).

Section 2.0 of the report examines different approaches to various aspects of the labor market effects of globalization in the medium and long runs in which an economy like that of the U.S. has time to reach full employment. Most labor economists and macroeconomists in this country think of the determination of wages and employment in a closed economy; i.e., an economy in which trade and foreign prices are not important. This was a fine assumption in, say, 1950, but it is not very accurate for the current American economy. Nevertheless, because so many people think in these terms—and because there is still a great deal of relevance to the model—the closed economy labor market is sketched in section 2.1. At the other extreme is the standard textbook model in which trade is not only significant, but in which foreign economic conditions dominate in the determination of labor market variables within the U.S.—even if traded goods represent a relatively small fraction of total production. This model of the open economy labor market is discussed in section 2.2. It is interesting to note that the potential effects of many labor market policies (including many DOL programs) are very different in an open as compared to a closed economy setting.

One of the propositions of the normative economics of trade policy is that, under most specifications, the typical policy that promotes free trade between the U.S. and other countries has a negative effect on some group of workers, but a larger positive effect on the welfare of others such that, on average, U.S. citizens are better off. Section 2.3 discusses this conclusion with illustrative examples. An interesting conclusion of this section is that the aggregate gains of

the “winners” from a liberalized trade policy tend to be only slightly larger than the aggregate losses of the “losers” due to the policy. Thus, the redistributive effects of a particular trade policy may be much more noticeable than the gains in average income. Given these results, it is not surprising that the consensus of the empirical literature on the effects of international openness on the rate of economic growth, which is reviewed in section 2.6, is that this effect is small and statistically insignificant. Another presumption of the trade literature is that, since the U.S. is relatively abundant in high- rather than low-skilled labor compared to the rest of the world, increased openness will benefit the upper tier of the skill distribution and hurt the lower tier.

There is a large amount of literature on the effects of the international forces that cause increased trade on the wage structure in the U.S., and this literature is reviewed in section 2.4. Using both price equations and factor content analysis, various studies conclude that a relatively small fraction of the huge increase in earnings inequality, the high-/low-skilled average relative wage, since the late 1970s is directly attributable to international factors. It appears from these studies that more important causes of increases in inequality are skill-biased technological change and, to a smaller extent, increased immigration of low-skilled workers. Nevertheless, the fact that the increase in earnings inequality coincided with the increase in imports and exports in the U.S. gives the perception that there is a causal relation.

The conclusion that the major labor market developments were not caused by globalization leads economists to be somewhat skeptical about the applicability of the pure textbook version of the open economy model discussed in section 2.2. Among the assumptions necessary for this model to apply are that consumers within the U.S. treat foreign and domestic versions of most products as perfect substitutes and that the U.S. is active in a wide range of both low-skilled intensive industries as well as high-skilled intensive industries. Many recent papers in international economics disagree with one or both of these assumptions, and the resulting model yields a set of predictions about the behavior of labor markets that are between those of the closed and open models. This “intermediate” case is discussed at length in section 2.5. In this author’s view, there is no question that the correct model is indeed a weighted average of the two extreme models. The important question involves how close the true model of the labor market is to one extreme versus the other.

In section 2.7, the rather smaller literature on the outsourcing (or “offshoring”) of parts of production processes to foreign countries is discussed. This has—in part because the latest focus of outsourcing has been on white collar and high-tech jobs rather than, as was the case in the 1980s and 1990s, on blue collar jobs—become controversial in recent years. In principle, the effects of outsourcing are little different from the effects of trade in goods. If the outsourcing is concentrated on low-skilled intensive production processes, it has much the same effects on U.S. GDP (Gross Domestic Product) and wages as an increase in imports of low-skill intensive products (like textiles), but the lower prices on these goods have, in the aggregate, a beneficial effect on wages. Some economists have argued that because earlier outsourcing concentrated on low-skilled jobs, the conclusions about the impact of trade based on industry import and export data are seriously underestimated. In other words, international factors actually accounted for a much higher fraction of the increase in earnings inequality than was concluded by the studies discussed in section 2.4. This is a possibility, but the data on outsourcing and trade in services are simply not yet good enough to resolve this issue.

The more an economy is open to international trade, both in terms of import policy and institutional and technological arrangements, the closer the operation of the labor market is to the textbook open economy model rather than the closed economy model. Section 2.8 reviews what is known about this in the U.S. with a view toward determining how things will look at various points in the future. The answer to this is (as with the questions associated with section 1.3) partly conditional on political events that are essentially unforeseeable. However, barring certain catastrophic shocks, it is likely that the U.S. economy will become more integrated with those of other regions. Recent trends in the outsourcing of services underscore the prediction in this regard.

Section 3.0 of this report examines various aspects of the short-run adjustment of the economy to trade shocks. Section 3.1 sets out a simple model in which the effects over time of an adverse trade “shock” on three different groups of members of a labor type that are adversely affected by the development. These include: (a) those in the affected industry who lose their jobs due to the shock, (b) those in the affected industry who retain their jobs, and (c) all other workers in that labor type. In the medium run; i.e., after 2 or 3 years, a shock that affects this labor type negatively causes the wages of groups (a), (b), and (c) to fall. In the short run, however, the workers who lose their jobs directly due to the shock, group (a), incur the costs of adjustment, both in terms of lost earnings due to unemployment and the retraining and/or movement expenses associated with changing industries. In addition, group (a) workers, especially those with high levels of job tenure, tend to lose job specific human capital, thus causing further long-run losses upon reemployment. This literature is reviewed in section 3.3.

Trade adjustment assistance (TAA) programs, which attempt to provide income support and transition assistance to group (a) workers, are discussed in section 3.2. Since TAA does not provide any sort of compensation to the other losers from a particular trade development (workers from groups (b) and (c) in the preceding paragraph), the policy cannot by definition meet the requirement that the “winners” from a change in trade policy fully compensate the “losers”—the focus of attention in section 2.4. Resources allocated to TAA, however, can affect the speed of adjustment of the labor market after the change in trade policy or some other international development, and TAA can be usefully evaluated in terms of its contribution to economic efficiency.

An interesting variant of TAA is the concept of “wage insurance,” in which group (a) workers who are subsequently reemployed at lower wage rates receive a fraction of their lost earnings in the form of compensation from the government. This is discussed in section 3.4. Although restricted to group (a) workers over the age of 50, wage insurance was added to TAA in the U.S. in the 2002 legislated changes to the program.

Section 4.0 of the report discusses ongoing research and data needs with respect to globalization and the labor market in the U.S.

## **1.2 Some Background Facts About the Labor Market in the U.S.**

A great deal of the attention of labor market analysts during the past 15 years has focused on issues dealing with what has happened to the average level and the structure of real wages. Some of these developments are summarized in table 1. First, column (c) shows the ratio of the

average weekly wages for males of college graduates to those of high school graduates. The most notable feature of this number is that, like most other measures of returns to skill and income inequality,<sup>1</sup> it rose so rapidly during the 1980s. The growth in the educational earnings differential has continued since 1989, but at a slower rate.

**Table 1. U.S. Basic Labor Market Data  
Selected Years: 1960–2003**

<b>Year</b>	<b>Relative supply skill* (a)</b>	<b>Avg. growth rel. supply (b)</b>	<b>Relative wage skill** (c)</b>	<b>Avg. real wage*** (d)</b>	<b>Avg. growth real wage (e)</b>
<b>1960</b>	.120		1.35	1.00	
<b>1973</b>	.325	7.7	1.40	1.30	2.0
<b>1979</b>	.434	4.9	1.34	1.30	0.0
<b>1989</b>	.609	3.4	1.58	1.24	-0.5
<b>2000</b>	.718	1.5	1.69	1.35	0.7
<b>2003</b>	.745	1.2	---	1.39	1.1

\*From data in table 13, Borjas, Freeman, and Katz (1997), last two years updated by author.

\*\*From figure 5, Card and DiNardo (2002), first and last years calculated by author.

\*\*\*Average hourly earnings of production workers in private employment adjusted by the consumption deflator.

Second, column (d) reports an index of the average real hourly earnings of production workers in the private nonagricultural industries. This was rising at an average rate of 2.0 percent per year from 1960 to 1973 (a little above its average growth rate for roughly a century before 1960) when it stopped growing until the mid-1990s. Since 1995, the average real wage rate has started to increase as it used to before 1974, although it is too soon to tell whether or not real wage growth will reach and, more importantly, sustain its pre-1973 trend value.

The third interesting stylized fact in table 1 is the fact that the relative supply of skilled workers in the U.S. has been rising at a very rapid rate for many years. Column (a) reports estimates of the ratio of the employment of “college equivalents” to the employment of “high school equivalents.”<sup>2</sup> This has grown consistently since 1960 (and, of course, back to the 19<sup>th</sup> century), but its rate of growth, column (b), has diminished steadily over the past half century.<sup>3</sup> From the point of view of closed economy economic analysis, the fact that the relative wage of skilled workers rose for the 25 years after the early 1970s in the face of a large increase in the relative supply of skilled workers was considered by labor economists to be somewhat paradoxical—things tend to fall in price when they become more, not less, abundant.

### **1.3 Some Background Facts About Trade Flows in the U.S.**

By any relevant measure, traded goods have steadily become a larger part of the U.S. economy since World War II. Table 2 presents the most basic macroeconomic data involving the international sector—the percentage ratio of exports and imports to GDP and the difference between these two numbers, the net exports as a percentage of GDP. The sum of the exports/GDP and imports/GDP ratios is sometimes used as an indicator of the importance of trade to the economy, and this roughly tripled between 1960 and 2003.

**Table 2. U.S. Basic Macro Trade Data as a Fraction of GDP  
Selected Years: 1960–2003**

<b>Year</b>	<b>Net exports (a)</b>	<b>Exports (b)</b>	<b>Imports (c)</b>	<b>Openness (d)</b>
<b>1960</b>	0.5	4.8	4.3	9.1
<b>1973</b>	-1.5	5.1	6.6	11.7
<b>1979</b>	-0.9	6.2	7.1	13.3
<b>1989</b>	-1.2	8.0	9.2	17.2
<b>2000</b>	-3.5	11.3	14.8	26.1
<b>2003</b>	-3.8	10.9	14.8	25.7

One reaches similar qualitative conclusions about the data on trade confined to trade involving merchandise alone (Donnelly 2001), merchandise trade with low-wage countries (Borjas, Freeman, and Katz (1997)), and in terms of imports of intermediate inputs as a fraction of value added in manufacturing (Feenstra 1978). The U.S. has, over the past 50 years, simply become much more open to trade with other countries than it used to be.

Net exports have been consistently negative since the 1970s, and usually of a large magnitude relative to GDP since the 1980s. This foreign trade deficit is often interpreted by politicians and journalists to be caused by the increase in U.S. imports and/or rejection by foreign economies of exports from the U.S.<sup>4</sup> The position of orthodox economists, however, is that under conditions such as faced by the U.S. and other industrialized countries since the 1970s, net exports are determined by the difference between GDP and the sum of domestic demand for goods and services, consumption plus investment plus government spending. Given flexible real and nominal exchange rates, GDP is determined only by monetary policy and the exogenous variables of the domestic product market.<sup>5</sup> The role of a positive trade deficit (negative net exports) is to finance the difference between total domestic demand and total GDP. Net exports (along with the predetermined value of GDP and domestic and foreign tastes for imports) determine the values of exports and imports, not vice versa. Any attempt to cut the foreign trade deficit (raise net exports) by restricting imports would simply increase the real and nominal value of the dollar and lower both exports and imports by the same amount.

Since government spending and investment as fractions of GDP have not been particularly large during the last 20 years, it follows from the preceding that the large increase in the foreign trade deficit since the beginning of the 1980s is simply the result of consumption being too high. The reason that consumption was too high is a combination of taxes being set too low and perceived wealth effects from the dramatic rise in stock market prices (why save for the future when your 401k will triple in value as the Dow goes to 30,000?).<sup>6</sup>

That exports and imports have become increasingly important in the U.S. economy over the past half century is not subject to question, and obviously, the effects of international factors on the U.S. labor market have grown accordingly. The interesting questions in this regard concern what will happen to the relative importance of trade in the future. Will the U.S. continue

to experience increases in exports and imports over the next several decades? Will international factors become even more important to the U.S. labor market?

A forecast of a summary index of openness such as exports/GDP plus imports/GDP, which is given in column (d) of table 2, based on an extrapolation of the value of that variable since the end of World War II would clearly yield an affirmative answer to this question. However, there are several reasons to be somewhat skeptical of a naive forecast of this sort. The first reason for skepticism is that a forecast of increasing trade volume in the future is conditional on a continuation of both international political stability and of political attitudes within major national blocs that are favorable to relatively unrestricted trade. The steady increase during the 19<sup>th</sup> century in trade volume as a percent of GDP for the U.S. and other industrialized countries came to an abrupt end with the onset of World War I, at which point trade volumes fell drastically (Johnson and Slaughter 2001). Because of protectionist policies during the 1920s, the Great Depression of the 1930s, and World War II, trade volume as a percent of GDP did not reach its 1913 level until the mid-1950s. Based on data up to 1913, a forecast based on a simple extrapolation would have predicted a continuing increase in trade/GDP over the next 40 years. It is, accordingly, possible that 2004 is a point similar to 1913; i.e., that unforeseeable events will cancel out the forces that have historically caused trade volume to increase.

A second reason for being skeptical of predicting a continuing increase in the degree of openness of the U.S. economy is that we may be approaching the limit of the extent to which merchandise can be profitably traded. Rodrik (1997 and 2000) makes the case rather convincingly that, at least at some point in the relatively near future, further increases in international economic integration will require an expansion of political jurisdictions. This means that the U.S. and other countries would have to give up a large amount of control to some supra-national agency over policies that affect trade between nations—just as individual states in the U.S. have little control over inter-state commerce. Rodrik thinks that this is likely in the long run, but he indicates that he would not be surprised if there were several backward movements (like bouts of protectionist legislation) over the next 20 years.

Although, as will be pointed out in section 2.0, there is a fair amount of disagreement among economists about how the observed expansion of trade (or, more precisely, the factors that caused the expansion of trade) over the past 30 years has affected labor market outcomes in the U.S. An important element in the answer to questions concerning the future effects of international developments on the U.S. labor market is the extent to which international economic integration continues to grow. This author's estimate is that there will be an expansion of trade and globalization over the next several decades, but the forecast error of this prediction is, for the two reasons given above, rather large.<sup>7</sup>

#### **1.4 The Determination of Unemployment and Employment in the U.S.**

In all economic models of labor markets in an economy with trade, there is a common result that the various international “shocks” that can hit the economy shift the demand curves for different types of labor in different ways. These demand shifts can affect the real and relative price of labor types, the data underlying table 1, and they can, in principle, also affect employment and unemployment levels of the different types of labor.



This author's view is that—during the post World War II era, at least until 2000 and most likely beyond 2004—aggregate employment and unemployment in the U.S. tend to be unaffected by shocks after about 3 years. This applies to all sorts of shocks—energy price, technological, and aggregate demand as well as those dealing with foreign prices. The motivation for this is the results of a regression for the postwar period of quarterly unemployment rate in the U.S. related to lagged values of unemployment and a dummy variable for a cyclical turning point into (but not out of) a contraction and its value lagged twice,<sup>8</sup> as well as time trends to capture movements over time in the equilibrium aggregate unemployment rate. The occurrence of a turning point to a downturn—whatever the shock that caused it—is followed, on average, by a rise in the unemployment rate until between the fourth and sixth quarter after the shock. After this rise in the unemployment rate, there is a slow decline in the rate back to its equilibrium value such that after 3 years most of the initial rise in the unemployment rate is over.<sup>9</sup>

Within this framework there is no long-run effect of a shock on unemployment and, given that there is, at most, a very small effect on the long-run value of labor supply, there is very little long-run effect of the shock on employment. This conclusion applies to whatever were the shocks that caused the recession and this reasoning is applied to the long-run (i.e., after a couple of years) effect of international shocks on employment.

This is not to minimize the costs of adjustment to individuals due to international shocks which will be discussed in section 3.0 of this report. However, the major effects of increasing trade on the U.S. labor market would appear to be the average value and distribution of wages—the sorts of variables represented in table 1—rather than on employment levels.

At the same time, there is considerable attention paid in the popular press about the possibility that there have been major employment effects over the past couple of years due to an alleged increase in outsourcing of jobs in American firms. There has been much discussion of the “jobless recovery” from the recession that began in 2001,<sup>10</sup> and this is the major reason this author hesitates to apply the “rapid adjustment model” (described above) to a prediction of the current adjustment of the economy.

To see how things might be different in the current economy, a standard employment adjustment function on annual data for the period 1957 through 2001 was estimated.<sup>11</sup> The model was then used to predict the rates of growth of employment in 2002 and 2003, the figures for which are reported in table 3. Using the Bureau of Labor Statistics (BLS) establishment survey data on nonagricultural employment, one would have predicted no change in employment, but employment actually fell by 1.1 percent. For 2003, with a recovery—however weak—in output growth, one would have expected employment to rise by 1.3 percent, but it actually fell by 1.3 percent. Thus, employment growth was 1.1 percent lower (with a forecast error of 0.3 percent) than it “should” have been in 2002 and 1.6 percent (0.4) higher in 2003. This implies a shortfall of about 3.5 million nonagricultural jobs in 2002.

**Table 3. Actual and Predicted Employment Growth in 2002 and 2003 Using Alternative Data Sets**

Year	Establishment survey		
	Actual	Predicted	Residual
2002	-1.1	0.0	-1.1
2003	-0.3	1.3	-1.6
	Household survey		
	Actual	Predicted	Residual
2002	-0.4	0.1	-0.5
2003	1.0	1.0	0.0

The establishment data suggest the presence of a jobless recovery, and a common explanation of the phenomenon, is that the additional output is being produced in China, Mexico, and—to the chagrin of computer programmers—India. This would imply that “Okun’s law,” a historical relationship between changes in the unemployment rate and changes in GDP, has been repealed. Of greater relevance to this report, it might also suggest a greater impact than commonly believed for “trade” shocks on the U.S. labor market. However, the lower panels of table 3 report predicted values of a different employment variable, total civilian employment based on the Current Population Survey (CPS) household survey. Now, with the same employment function model, the difference between the predicted value of employment growth and its actual value is -0.5 percent, which is within two forecast errors in 2002 and essentially zero in 2003. This is a shortfall on only 700,000 jobs (and obviously not statistically different from zero). These results suggest a very different story about the potential problems being caused by the much publicized spate of outsourcing.<sup>12</sup>

This author has attempted to determine why these two employment series give such drastically different pictures of employment growth during the early stages of the recovery from the recession of 2001. Again, employment from the establishment survey fell by 1.4 percent over the 2002-2003 period, but employment from the household survey increased by 0.6 percent during this time. First, during the 1957-2001 period the percentage changes in the two employment levels were highly correlated ( $r = +.94$ ), so their divergence in the last 2 years is quite remarkable. Second, about 0.2 percentage points of the household survey employment number from 2001 to 2003 represents an increase in self-employment, which is not included in the establishment survey. Third, about 1.0 percentage points of the increase in employment from the household survey represents an increase in the fraction of workers who are employed on a part-time basis (0.8 for economic reasons and 0.2 voluntarily). To the extent that the establishment survey misses part timers, this may explain part of the reason why the two series tell such different stories. Another reason is that the establishment survey may be based on a sample that could have missed a lot of job creation in small businesses—if there was in the past 2 years a major structural change from large to smaller firms.

## 2.0 Trade Theory and Empirical Evidence

### 2.1 Wage Determination in the Closed Economy

We begin by examining the fairly long-run determination of employment and wages in an economy that is characterized by both full employment and the absence of any international trade. The second assumption—that the economy is closed—is obviously a temporary one, for the point of this report is to review the labor market effects of various international developments. This closed economy assumption leads to a set of conclusions in which wages by skill are determined by the relative supplies of different types of labor and the nature of consumer demand for different products. The open economy model that will be discussed in section 2.2 leads to very different conclusions about what affects the determination of wages.

It is convenient to think of the aggregate labor force as being composed of two types of workers, high-skilled (H workers) and low-skilled (L workers). This is a gross simplification of the labor market in the U.S. (or anywhere else), for different members of the labor force are in reality delineated by a plethora of characteristics such that there are many separable types of labor input, rather than just two kinds.<sup>13</sup>

For reasons that will become clear in subsequent discussion involving the possible effects of international developments, it is necessary to think of the economy as being composed of, at least, four industries. These four industries include two relatively high-skilled intensive industries (like finance or higher education) and two relatively low-skilled industries (like food retailing or textile manufacturing). In subsequent sections, one of each of the high-skilled intensive and the low-skilled intensive industries will be assumed to be competitive in world markets and products in those industries are imported and/or exported. The other two industries, again one high-skilled intensive and the other low-skilled intensive, produce goods that are nontradable. In this section, however, there are no exports or imports, so all the output of each of the four industries is consumed domestically.

It is customary to assume that workers of each type of labor are mobile across the four industries. It is also usually assumed that the wage rate of each type of labor is the same in each of the four industries.<sup>14</sup>

In addition to the two types of labor, output is assumed to depend on inputs of capital and other factors of production. The aggregate stock of capital is presumably allocated among the four industries such that the rate of return to capital is identical in each.

The outcome variables in which we are interested are:

- The real wage rates of high-skilled labor ( $W_H$ ) and low-skilled labor ( $W_L$ ).
- The distribution of wages, in this case the relative wage of high-skilled workers,  $rel = W_H/W_L$ .
- The average real wage rate ( $W_A = hW_H + (1-h)W_L$ , where  $h$  is the fraction of total employees who are high skilled).

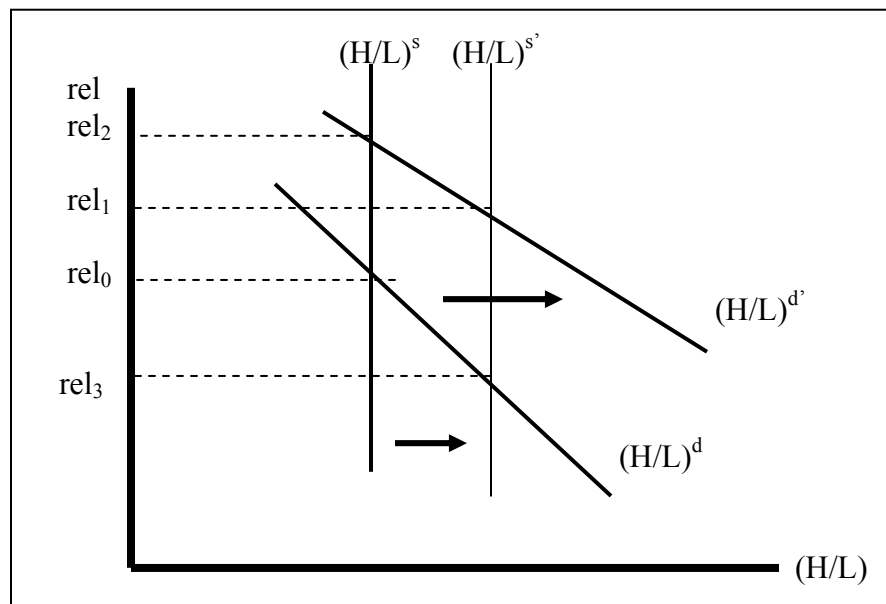
- The prices of the four goods in the economy.
- The employment distribution of each type of labor across the four industries.

The equilibrium of the economy and, of particular interest to us, of the labor market depends on the state of consumer demand for the four goods, the overall efficiency of the production process in each industry, the supplies of each type of labor, the aggregate supply of capital, and the technology parameters in each industry. What can, in the context of the closed economy model, happen that can cause the above outcome variables to change? The “comparative statics” of the models are as follows:<sup>15</sup>

- Shifts in consumer demand: If there is a shift in consumer preferences away from consumption of one of the low-skilled intensive goods toward one of the high-skilled intensive goods, the prices of the two high-skill intensive goods rise and those of the two low-skill intensive goods fall. This causes  $W_H$  to rise and  $W_L$  to fall, so the high-skilled/low-skilled relative wage ( $rel = W_H/W_L$ ) increases. The effect on the average real wage rate ( $W_A$ ) is ambiguous. The effects of an opposite shift in consumer demand—from a high-skilled consumption good to a low-skilled consumption good—are the opposite.

The effects of shifts in product demand on the equilibrium high-/low-skilled relative wage are demonstrated in figure 1. A change in product demand toward a high-skill intensive good shifts the relative demand curve for skilled labor to the right—from  $(H/L)^d$  to  $(H/L)^{d'}$ . This causes the high-/low-skilled relative wage,  $rel$ , to rise from its initial value  $rel_0$  to  $rel_2$ .

**Figure 1. Determination of the Equilibrium High-Skilled/Low-Skilled Relative Wage in the Closed Economy Case**



- Increases in the quantities of high- and low-skilled labor: If, ceteris paribus, the supply of high-skilled labor (H) rises proportionally more than the supply of skilled labor (L), the output of the two high-skill industries will tend to rise and the relative prices of the goods of those industries will fall. Accordingly,  $W_H$  will fall and  $W_L$  will (most likely) rise, thus causing a decline in  $rel = W_H/W_L$ . The average wage ( $W_A$ ) will fall in the short run, but, depending on the conditions dictating the aggregate supply of capital, the decline in  $W_A$  will be much smaller in the long run (when the capital stock adjusts to its new equilibrium). Geometrically, the increase in  $(H/L)^s$  is represented by the rightward shift in the (vertical) relative supply function in figure 1. This causes  $rel$  to fall from its initial value  $rel_0$  to  $rel_3$ .<sup>16</sup>
- Increases in industry efficiency: Now suppose that the production process in one of the high-skill intensive industries becomes more efficient.<sup>17</sup> This means that the price of the output of that industry falls, and resources are drawn from other industries, especially the other high-skill intensive industry, to that industry. The value of both the high- and low-skilled real wage rates and the average real wage rate rise, but one cannot tell in advance whether  $W_H$  rises proportionately more or less than  $W_L$  rises; the sign of this effect depends on the values of the various elasticities of product demand, intra-labor type substitution, and capital/labor substitution. The reason for this ambiguity is that the increase in efficiency in a particular industry raises the productivity of workers in that industry, which raises their relative wages, and, through the associated increase in output, lowers the relative price of output in that industry which depresses relative wages. Thus, the relative demand curve in figure 1 may shift to the right or to the left (or not at all) in response to a change in the relative productive efficiency of a particular industry.
- Skill-biased technical change: This is the labor economist's "conventional wisdom" about what happened to the U.S. labor market from the mid-1970s into the 1990s.<sup>18</sup> Because of the introduction of computer technology and a general increase in the relative productivity of educated workers, many jobs that used to be performed by low-skilled workers were shifted to high-skilled workers—in all industries.<sup>19</sup> This causes, holding relative supplies constant, a rise in  $W_H$  and a fall in  $W_L$ . In terms of figure 1, the relative demand curve shifts to the right, which, absent other changes, would make the skill differential rise to  $rel_2$ . During the 1980s and 1990s in the U.S., however, the relative supply of high-skilled labor increased significantly. The bottom line (of this conventional view) is that the combination of skill-biased technical change and large relative supply increase caused the value of the skill differential to increase from  $rel_0$  to  $rel_1$ —instead of increasing to  $rel_2$ , due solely to skill biased technical change, or decreasing to  $rel_3$ , due solely to the increase in relative supply. This framework was employed by several investigators, e.g., Bound and Johnson (1992) and Katz and Murphy (1992), to explain the apparent anomaly of observed rises in the value of both  $rel$  and  $H/L$  in the U.S. during the 1980s.

It should be pointed out that the closed economy labor market model has two implications that are not present in the extreme form of the open economy model that will be

examined subsequently. The first of these concerns is the potential effects of education and training on wage rates of the two types of labor. A training program, in principle, uses resources to transform some low-skilled workers into high-skill workers; i.e., H rises and L falls by the number of successful trainees.<sup>20</sup> The long-run economic effects of a training program (or of an expansionary educational policy, like an increase in tuition subsidies) are, in the context of the closed economy model, the results for an increase in H, which was discussed above, and a decrease in L. The prices of the goods produced in the high-skill intensive sectors would fall relative to the prices of goods in the low-skill intensive sector. In terms of figure 1, the  $(H/L)^s$  curve moves to the right so that  $W_H/W_L$  falls.

This leads to one of the very few policy implications from the closed economy model concerning the effects of skill-biased technological change. If society does not like the increased wage inequality that results from a prolonged spell of skill-biased technical change, it can pursue policies, like training programs, that lower  $W_H/W_L$  by increasing the supply of high-skilled labor. The second implication of the closed economy model that is not present in the open economy version concerns the labor market effects of immigration. Suppose that there is a large immigration of low-skilled workers into the country. This is represented by an increase in L such that the  $(H/L)^s$  curve in figure 1 shifts to the left. The effects of this immigration include an increase in  $W_H$  and a decrease in  $W_L$ , as well as declines in the prices of goods produced in the low-skilled intensive industries relative to those in the high-skilled intensive industries.

The principal conclusions of the closed economy model of labor market equilibrium in the medium and long run are:

- Wage rates for different labor market types are affected by demand changes and changes in relative supply.
- Generalized shifts in production functions, usually associated with skill-biased technological change, can also change wage differentials.

## 2.2 Wage Determination in the Open Economy

We now lift the assumption that the economy is characterized by autarky; i.e., that there is no significant foreign trade in the economy. This, the textbook model of the equilibrium of the labor market under international trade, yields very different assumptions about the forces that are influential in the determination of the wages of different types of labor in the economy.

Instead of assuming that the economy is closed, we assume that the products of two of the four industries in the economy, one high-skilled intensive and the other low-skilled intensive, can be purchased or sold abroad (that is, they are potentially tradable). The other two industries in the economy, again one high-skilled intensive and the other low-skilled intensive, produce goods that are nontradable. To keep the exposition as simple as possible, we will identify the industries as follows:

<b>Industry 1</b>	High-Skilled Intensive Tradable Goods
<b>Industry 2</b>	Low-Skilled Intensive Tradable Goods

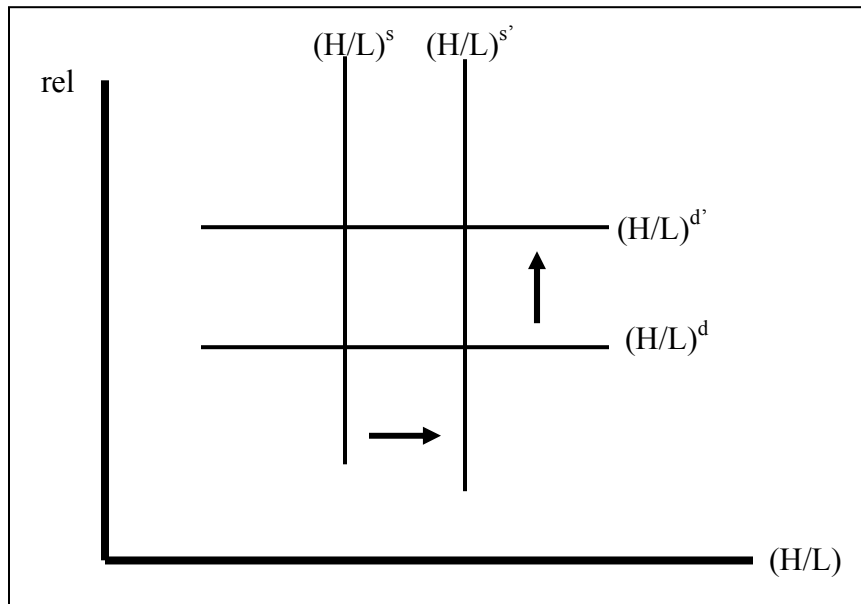
- Industry 3** High-Skilled Intensive Nontradable Goods  
**Industry 4** Low-Skilled Intensive Nontradable Goods

It is further assumed that: all production of each of the four goods takes place within the country;<sup>21</sup> foreign and domestic versions of tradable goods 1 and 2 are perfectly substitutable;<sup>22</sup> as in the discussion of the closed economy above, all factors within the country are, after the passage of the relevant amount of time, perfectly mobile between industries; and the economy is too small to have a significant effect on the values of world prices of tradable goods (“small country” assumption). We also continue to assume that wages for each labor type are more or less equal across industries—although this is not very important.<sup>23</sup>

There is a problem with applying the completely open economy to the United States because it accounts for about 23 percent of world GDP and a significant, although somewhat smaller, fraction of the consumption of tradable goods. The “small country” assumption is not strictly correct for policy discussions involving the U.S. The world is, after all, a closed economy, and the U.S. accounts for between a quarter and a fifth of that economy. Thus, any analytical results for the U.S. should be a weighted average of the results for the relevant open economy model and the closed economy model, with the weight for the open economy result being equal to one minus the proportion of tradable goods that directly involve the U.S. (perhaps  $0.80 = 1 - 1/5$ ).

The resultant model of labor market equilibrium and predicted effects of changes in certain exogenous variables are very different in the open economy model than in the closed economy model.<sup>24</sup> First, the determination of the wage rates for high- and low-skilled labor throughout the economy are determined entirely in the tradable goods sector. The reason for this is that, given the world prices (inclusive of transportation costs and tariffs) of the two tradable goods ( $P_1$  and  $P_2$ ), as well as the conditions of production in those industries,  $W_H$  and  $W_L$  must take unique values in order for the firms in those industries to remain sufficiently profitable and to stay in business.<sup>25</sup> This implies that the value of the high-/low-skilled labor relative wage rate,  $rel = W_H/W_L$ , is determined solely by the internationally determined relative prices of goods 1 and 2,  $P_1/P_2$ , and the relative productive efficiencies of those two industries. Other exogenous variables, such as relative supply of high-skilled labor,  $(H/L)^s$ , and composition of domestic product demand, have no effect on real and relative wages in the open economy model.<sup>26</sup>

**Figure 2. Determination of the Equilibrium High-Skilled/Low-Skilled Relative Wage in the Open Economy Case**



The relative labor demand function in the open economy case is therefore horizontal, as depicted by the  $(H/L)^d$  curve in figure 2. This demand curve is shifted up or down as, respectively, the internationally determined value of the relative price of the high-skilled intensive good ( $P_1/P_2$ ) rises or falls. It also shifts up when the average efficiency level of the high-skilled intensive industry increases relative to the low-skilled intensive industry. The horizontal relative demand curve is not shifted by changes in tastes or by generalized (i.e., across all industries) skill-biased technological change.

It is instructive to compare the effects of various exogenous changes in the contexts of the closed and the open economies:

- Shifts in consumer demand: If there is a shift in domestic consumption demand away from one of the low-skilled intensive goods, either the traded good (industry 2) or the nontraded good (industry 4), toward one of the high-skilled intensive goods (either industry 1 or 3), there is, in an open economy setting, no change in the relative demand for skilled labor and, therefore, no change in the high-/low-skilled relative wage,  $rel = W_H/W_L$ . In the closed economy model, we saw that such a change in tastes causes  $rel$  to rise. What happens due to product demand shifts in the open economy model is that labor and other factors of production flow toward the industries in which they are needed in order to keep relative prices consistent with their international values. This is sometimes rather subtle. For example, suppose that there is a shift in consumer demand from industry 4 (the low-skilled intensive nontraded good) toward industry 1 (the high-skilled intensive traded good). The



primary effect of this change in tastes is a shift of resources from industry 4 to industry 2 (the low-skilled intensive traded good). Domestic consumption of good 1 has increased, meaning that exports of that good have fallen (or imports of good 1 have risen), so exports of good 2 have to rise (or imports of good 2 have to fall) in order to keep the economy in balance.<sup>27</sup>

- Increases in the quantities of high- and low-skilled labor: In the closed economy, as we saw in the last section, an increase in  $H/L$  causes the value of  $rel$  to fall. In the open economy, on the other hand, if a certain number of  $L$ s were suddenly transformed into  $H$ s, resulting in an increase in  $H/L$ , there would be no change in relative price of labor. What would happen instead is that there would be a flow of resources out of industry 2 (the low-skilled intensive traded good) into industry 1 (the high-skilled intensive traded good) along with slight increases in the amount of resources in both nontraded goods industries.<sup>28</sup>
- Increases in industry efficiency: In the closed economy an  $x$  percent increase in the efficiency of any one of the industries, either high-skilled or low-skilled intensive, causes the average level of real wages to rise but has an ambiguous effect on the high-/low-skilled relative wage. In the open economy, however, because the prices of traded goods are determined internationally, an  $x$  percent increase in the overall efficiency of each industry has different effects depending on the industry in which the efficiency increase occurs. First, the average real wage in the economy,  $W_A$ , rises by approximately the share of the contribution of that industry to GDP times the  $x$  percent efficiency increase regardless of which industry the improvement occurred. Second, an  $x$  percent increase in the efficiency of the production of either of the nontraded goods, industry 3 or 4, causes an increase in both  $W_H$  and  $W_L$  by the consumption share of the relevant nontraded good times  $x$  percent. Third, an increase in the overall efficiency of the production of the high-skilled intensive traded good, industry 1, causes an increase in the high-/low-skilled relative wage, for the horizontal relative demand function in figure 2 shifts up by at least  $x$  percent. The price of the high-skilled intensive nontraded good, industry 3, rises and the price of the low-skilled intensive non-traded good, industry 4, falls.  $W_H$  rises as a result of the increase in efficiency, but the low-skilled real wage rate ( $W_L$ ) falls. The qualitative effects of an increase in the efficiency of industry 4 are, of course, analogous to the effects of the increase in the efficiency of industry 1;  $rel$  falls,  $W_H$  falls,  $W_L$  increases, and so forth.
- Skill-biased technical change: In the closed economy model, the effect of skill-biased technical change in any of the sectors of the economy on the relative demand function for high-skilled labor is an unambiguous rightward shift. In the open economy case, however, it is not the skill bias of technological change that causes an increase in the relative demand for high-skilled labor but the sector bias.<sup>29</sup> The standard labor economics explanation of the behavior of the U.S. labor market during the past 25+ years—that there was significant skill-biased technical change in most or all industries—would not necessarily yield an increase in  $rel$  in the context of an open economy.

- Changes in the relative prices of tradable goods: There are three reasons why  $P_2$  (the price of good 2 relative to the price of good 1) may decline. First, the cost of transporting foreign production of good 2 into the U.S. may fall due to technological or political improvements. Second, economies in other parts of the world may get better at producing good 2. The third reason, which has slightly different effects on the level and distribution of real income and will be discussed in the next section, is that tariffs imposed by the U.S. on imports of good 2 may be reduced. In terms of figure 2, the decline in  $P_2$  causes the vertical labor demand function to shift up such that  $rel = W_H/W_L$  rises. There is a transfer of resources out of industry 2 into industries 1 and 4. The real wage rate of high-skilled labor rises and that of low-skilled labor falls. The average real wage in the economy rises as a result of the decrease in  $P_2$  so long as the economy was initially a net importer of the low-skilled intensive good.

It should be clear that the two policy implications of the closed economy model discussed in the preceding section do not hold in the open economy version of the model. First, the attempt to reduce increasing earnings inequality with training and education policies designed to increase the relative supply of skilled labor ( $(H/L)^s$ ) will not have a long-run effect on  $rel$  because the relative demand function is horizontal. Instead, an increase in  $H/L$  supplied will, after a period of adjustment, only cause the product mix of production to change without changing any relative prices or wages in the economy.

The second implication of the open economy case that is different from the closed economy case concerns the effects of immigration on relative labor earnings. In the closed economy case, a large increase in low-skilled labor through immigration depresses the real wages of domestic low-skilled workers and, because of the necessary complementarity between low- and high-skilled workers, increases the real earnings of high-skilled workers. As with the potential policy response to skill-biased technical change in the closed case, the best (in the sense of cost efficiency as well as fairness) thing to do in this case is to train some of the domestic  $L$ s to be  $H$ s. In an open economy setting, the increase in low-skilled immigration causes a change in product mix in the economy without changing the value of  $rel$ . Further, the use of training programs in order to reduce relative wages is futile in an open economy setting, for the increase in the relative supply of skilled workers has, in an open economy framework, no effect on relative wages.

The principal conclusions of the open economy model of labor market equilibrium in the medium and long run are:

- Wage rates for different labor market types are principally determined by the internationally determined values of the prices of tradable goods and the general productivity of industries in the tradable goods sector.
- Unlike the closed economy case, wage rates for different labor market types are not affected by product demand changes and changes in relative labor supply.

- Generalized shifts in production functions, usually associated with skill-biased technological change, do not change wage differentials as they do in the closed economy case.

### 2.3 The Major Welfare Implications of the Open Economy Model

The principal policy implication of the standard economic approach to international trade is that tariff or nontariff barriers to trade lower average real wage rates. The “best” (average utility maximizing) policy for a country is free trade. There are some exceptions to this general rule,<sup>30</sup> but the consensus among international economists is that it is best not to interfere with the free flow of goods.

A strong interpretation of trade adjustment assistance policy is to assure that the “losers” due to a trade liberalization policy or some sort of globalization development are compensated by the “winners” such that the former are no worse off as a result of whatever happened.<sup>31</sup> It is interesting, therefore, to illustrate the quantitative magnitudes of the effects of changes in tariffs and of international economic conditions. Table 4 shows what happens to aggregate GDP, high-skilled labor real earnings, and low-skilled labor real earnings as a result of a perfectly targeted tariff on imports.<sup>32</sup>

**Table 4. Hypothetical Effects of Imposition of Tariff on Imports of Low-Skilled Intensive Goods on GDP, High-Skilled and Low-Skilled Labor Earnings, and the High-/Low-Skilled Relative Wage Rate**

<b>Tariff</b>	<b>GDP</b>	<b>High-skilled earnings</b>	<b>Low-skilled earnings</b>	<b>rel</b>
0.00	1.000	1.000	1.000	1.50
0.05	0.99997	0.975	1.024	1.43
0.10	0.9990	0.951	1.047	1.36
0.15	0.9978	0.928	1.067	1.30
0.20	0.9962	0.906	1.087	1.25
0.25	0.9942	0.884	1.105	1.20
0.30	0.9920	0.863	1.121	1.15

The numbers in the table show the hypothetical value of these variables relative to their values at a zero tariff. For example, at a tariff rate of  $t = 0.05$ , the aggregate earnings of high-skilled workers is 97.5 percent of its value at  $t = 0$ ; at  $t = 0.10$  high-skilled earnings are 95.1 percent of their value at a zero tariff.

The major implication of table 4 is that the major effects of tariffs are in terms of the distribution of economic welfare rather than its aggregate value. For example, imposing a 30 percent tariff on the imports of low-skilled goods lowers the net real earnings of high-skilled workers by about 14 percent and raises the earnings of low-skilled workers by about 12 percent, but it only lowers the average net real earnings of all workers by about one percent. Accordingly, reductions in tariffs on low-skilled goods, along the lines of the North American Free Trade

Agreement (NAFTA), would be expected to yield smaller efficiency gains than their effects on income distribution.<sup>33</sup>

A similar conclusion—that developments with respect to trade affect the distribution of real income more than its level—applies to the effect of a change in international relative prices. Table 5 reports the hypothetical effects on real GDP, its distribution among high- and low-skilled workers, and the high-/low-skilled relative wage (rel) of an exogenous decrease in the internationally determined relative price of the low-skilled intensive good.<sup>34</sup>

**Table 5. Hypothetical Effects of Decreases in the International Price of Low-Skilled Intensive Tradable Goods on GDP and Its Distribution With and Without Tariff Increases**

$P_2$	Without tariff increase				With tariff increase		
	GDP	High-skilled earnings	Low-skilled earnings	rel	$t^*$	GDP	rel
1.00	1.0000	1.000	1.000	1.50	0.000	1.0000	1.50
0.95	1.0081	1.034	0.982	1.58	0.036	1.0079	1.52
0.90	1.0173	1.071	0.964	1.67	0.075	1.0167	1.52
0.85	1.0281	1.111	0.945	1.77	0.117	1.0267	1.58
0.818	1.0357	1.139	0.932	1.83	0.145	1.0335	1.60

A 15 percent decrease in the international price of the low-skilled intensive good causes GDP to increase by about 3 percent, but this is the result of an 11 percent increase in the earnings of high-skilled workers and a decrease of 5.5 percent in the real earnings of low-skilled workers.<sup>35</sup> The last three columns of the table calculate what would happen to aggregate welfare if a tariff on the importation of good 2 were imposed such that the net real wage rate of low-skilled workers was the same given the new value of  $P_2$  as it was initially with  $P_2 = 1$ . This is an example in which policies are enacted such that the low-skilled population is “held harmless” of effects of globalization. This policy slightly lowers the increase in aggregate efficiency due to the fall in  $P_2$ , but the increase in income inequality is, of course, substantially reduced.

This is not meant to advocate policies associated with the last two columns, for there are some serious objections to the use of tariff increases as a way of protecting groups of workers within the U.S. from international competition. First, except for temporary “emergencies,” it is illegal under World Trade Organization (WTO) rules. Second, raising tariffs in the U.S. invites other countries to impose tariffs on U.S. exports. Third, it is generally in the foreign policy interests of the U.S. to promote prosperity in poorer countries. Fourth, there are, in principle, less inefficient ways of compensating losers than tariffs (and, more so, nontariff barriers to trade).

The principal conclusion of this section is:

- Increases in foreign productivity and liberalizations of trade policy will tend to increase average welfare, but they tend to have larger effects on relative wages.

## **2.4 Estimation of the Effect of Changes in International Prices on Relative Wages**

There are two major approaches in the literature on the estimation of the effect of changes in international prices on relative wages. The conclusion of both of these approaches is that—at least through the 1990s—a relatively small proportion of the increase in income inequality in the United States since 1979 is directly attributable to international developments.

The first—and most direct—of these approaches is to use a regression analysis to relate the percentage change in the price of tradable goods to the factor shares of each factor of each good over a time period of relevance. Although there are some serious econometric issues (like the potential correlation of the omitted variable industry technology change with both the right hand side and the dependent variable), the estimates of these coefficients can, in principle, be used to determine the effect of international price changes on relative wages.

The results of estimation of these cross-sectional price equations have not been very encouraging. The most extensive recent study of this sort, Baldwin and Cain (2000), concludes that the thrust of their results for the 1979-1991 period “supports the conclusion that trade, by itself, cannot explain the increased wage inequality in favor of groups with more education.” The major reason for the lack of success of this approach in explaining movements in rel is contained in Leamer (1998), an economist who is more likely than most to accept an open economy explanation of events. Leamer reports that the relative price of producer prices for low-skilled labor fell significantly during the 1970s and rose during the 1980s. Given that the qualitative movement in rel during these both of these periods was very much in the opposite direction, one would have to look elsewhere for an explanation.

One potential problem with the price equation approach is that it does not identify the source of price changes—in particular, those due to changes in tariffs and transportation costs versus those due to other factors like industry-specific productivity growth. Haskel and Slaughter (2003) attempt to sort this out for the U.S. by identifying the portion of imported good price changes between 1974 to 1979 and 1979 to 1988 that were due to reductions in tariffs and transportation costs. First, they find that these reductions were highest in the low-skilled intensive sectors of the economy. However, the estimated effect of these reductions on changes in relative wages in the U.S. was both small and statistically insignificant.

The second way of estimating the effect of trade developments on relative wages is factor content analysis (FCA). This approach (which seems to appeal slightly little more to labor economists than to trade economists) is based on the calculation of the amount of each type of labor that is used for exports and/or would be used in the production of goods that are now imported. The net additional demand across all tradable goods (positive for exports, negative for imports) for each type of labor is then subtracted from the aggregate supply of each type of labor,

and calculations can be made of the effects of changes in trade patterns on relative wages using the labor demand functions from a model based on the assumption of a closed economy.<sup>36</sup>

The approach is somewhat paradoxical in the following sense. Suppose that in a closed economy the supply of low-skilled workers rose by 10 percent because of immigration. After a period of adjustment, the prices of the low-skilled intensive goods and the wages of low-skilled workers would fall relative to the wages of high-skilled workers. In the open economy model, however, relative wages would not be changed after the period of adjustment; instead, the composition of product demand would change in response to changes in endowments such that there were more jobs in low-skilled intensive industries.

Now consider the effects of an increase in the efficiency in foreign countries of production of what are in the U.S. low-skilled intensive tradable goods. This causes the relative international price of these goods (e.g., toys) to fall and causes a shift of resources in the U.S. out of these industries and an expansion of the exports of high-skilled intensive goods. To determine the effect of this global “shock” on the U.S. wage structure, we could use FCA to calculate the implied change due to the event on the relative supply of high- versus low-skilled labor and then, with the closed economy relative demand elasticity, how much rel changes as a result of the change in international prices. If the synthetic relative supply change due to the increase in imports was a reduction in relative supply of 10 percent, the wage effect would be the same as a 10 percent increase in real low-skilled supply due to immigration in the closed economy case.

The use of FCA is an approximation, for it requires satisfaction of several assumptions,<sup>37</sup> but it provides at least an approximation of the effects of trade. Borjas, Freeman, and Katz (1997) make calculations of the effects of increased U.S. trade with less developed countries (LDCs) on the change in the relative wage structure from 1980 to 1995. Of the increase in the college/high school relative wage of 21.0 percent during that interval, they estimate that increased trade with LDCs accounted for only about 0.7 to 1.3 percentage points (depending on the assumed wage elasticity of labor demand). A somewhat larger—but still relatively small—fraction of the 11.5 percent increase in the wage differential between high school graduates and dropouts can be attributed to increased trade, between 0.6 and 1.2 percentage points. They interpreted the data as suggesting that increased immigration had a larger impact than increased trade. Baldwin and Cain (2000) used FCA to explain the 12.3 percent increase in the wage of workers with 13 plus years of schooling relative to those with lower levels of schooling over the interval 1977 to 1987. Their estimated attribution to trade developments was about 1/6<sup>th</sup> of the change in the differential—larger than Borjas, Freeman, and Katz, but still fairly small.

The principal conclusion of the recent literature on the effects of trade-related changes on relative wages since the 1970s in the U.S. is:

- Trade developments have had an effect on wage differentials by skill in the U.S. since the 1970s, but this effect has been fairly small (1/10 to 1/5 of the observed changes).

## 2.5 Departures From the “Pure” Open Model

The failure of the traditional open economy model to explain very much (hardly any) of the observed changes in relative wages raises questions about the degree to which the standard, textbook open economy model is relevant to the U.S. economy. In addition, there is abundant evidence that the relative demand function for skilled labor is downward-sloping rather than horizontal (that is, it looks, at least qualitatively, like figure 1 instead of figure 2). Contrary to the implications of the pure trade theory model, there is considerable evidence for the U.S. that domestic factor supplies have the negative *ceteris paribus* effect on domestic wage rates that is predicted by the closed economy model.<sup>38</sup>

A key assumption of the open economy model is that the United States is active in both of the tradable goods industries, the high-skilled intensive industry, and the low-skilled intensive industry. We have seen that there is a reduction in resources devoted to industry 2 in response to an increase in  $H/L$  and a decrease in the world price of  $P_2$ . As pointed out below, as transportation costs have fallen and a number of formerly relative primitive economies have organized industries producing good 2, the price of imported versions of good 2 is bound to fall. In addition, if there is an increased demand for low-skilled workers in nontradable services, an expansion of the relative importance in consumption of industry 4, there will be a further contraction of resources devoted to industry 2.

At a certain point, it is accordingly possible for industry 2 to disappear from the U.S. and that all consumption of good 2 is, like sisal or (ignoring Hawaii) coffee, imported from other countries. When industry 2 disappears so that good 1 is the only product produced in the economy that is subject to international competition, the economy is said to have left the cone of diversification, in which domestic relative factor prices are determined internationally. In this case, labor market equilibrium in the economy looks very much the way it does in the closed economy model<sup>39</sup>—the relative demand function looks very much like figure 1 rather than figure 2.

A great deal of recent empirical work by international economists has attempted to reconcile certain apparent inconsistencies between observed behavior and the traditional open economy model by allowing for diversity between countries in technology and qualitative endowments rather than just quantitative endowments (capital per worker and the skill distribution of the workforce).<sup>40</sup> The model emerging from this line of research is that of a multiple-cone equilibrium in which each economy specializes in the subset of goods that is most appropriate given both the qualitative and quantitative nature of that country’s endowments and technology.

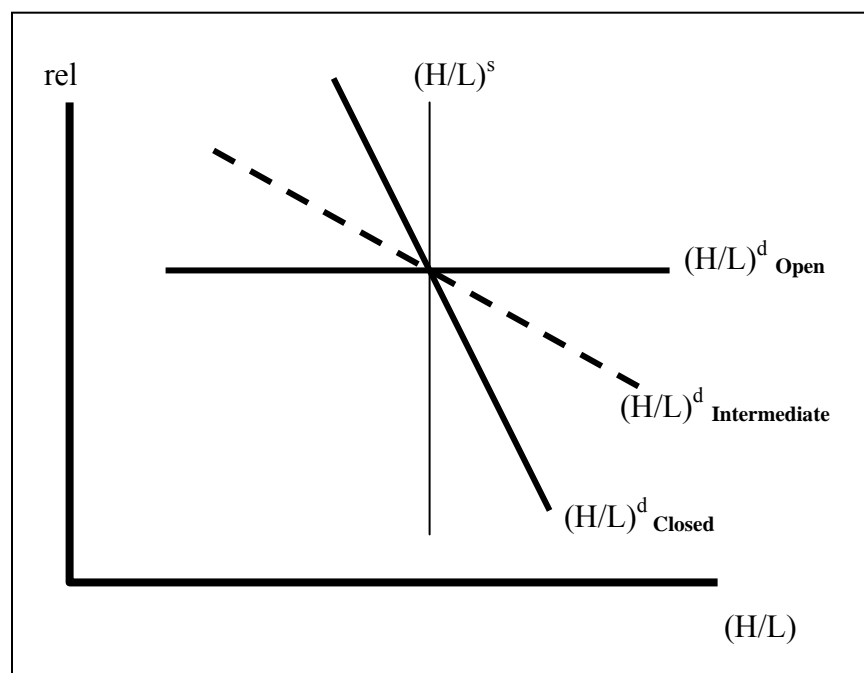
A second departure from the standard open economy model arises from the possibility that many goods are sufficiently heterogeneous that versions produced in different countries are less than perfectly substitutable for each other. An alternative approach, first suggested by Armington (1969), is to specify that for each relevant good there is an elasticity of substitution in consumption between the domestic and foreign version of the good, the Armington elasticity.<sup>41</sup> For example, with a finite value of this elasticity with respect to vehicular equipment, the U.S. relative demand for domestic versus foreign-produced automobiles would depend negatively on

their relative price. As the price of foreign relative domestic cars increases, consumers shift away from Volvos toward Hummers. But because of differences in tastes of consumers for different aspects of motor vehicles, one would expect that this substitution would be partial; i.e., the Armington elasticity would be finite. Other products, such as petroleum and sugar, are not differentiated by source, and there is no reason to suspect any home bias in consumption demand. In these cases, there is no reason to suppose that the Armington elasticities are less than infinity.

This suggests that—at least for many products—import demand functions will have a finite relative price elasticity (in terms of the U.S. price of the foreign good, including tariffs and transportation costs, divided by the price of the foreign alternative). Each import demand function will also depend on a taste parameter, reflecting among other things, the popularity of the foreign versus the domestic version of the good. If Armington elasticities are finite in the U.S., they should be finite elsewhere, which means that the demand for exports of the typical good will have a finite absolute elasticity equal to (approximately) the Armington elasticity. Each export demand function will also depend on a taste parameter that is shifted by changes in the popularity, prices held constant, of American versus other versions of the good.<sup>42</sup>

The resultant relative labor demand function with an Armington elasticity that is finite (but greater than one) is illustrated in the figure 3 case as  $(H/L)^d_{\text{Intermediate}}$ , the dashed line that is in between the downward-sloping demand function of the closed economy and the horizontal demand function for the open economy. In the intermediate case, the demand function is the more horizontal—the closer to the open economy case—the larger is the value of the Armington elasticity. The implications of the intermediate case are, needless to say, strictly between those of the two extremes that were discussed in sections 2.1 and 2.2.

**Figure 3. The Relative Demand for High- and Low-Skilled Labor in Three Cases**





Empirical evidence on Armington elasticities varies a great deal. A recent survey by McDaniel and Balistieri (2002) concluded that estimates tend to be higher if they: refer the long run than for the short run; are based on very disaggregated product data; and focus on cross-sectional data with adjustment for supply conditions than single equation time series regressions. It is interesting to note that there is some evidence, due to Slaughter (2001), that labor demand elasticities in the U.S. became more elastic from the 1960s to the early 1990s, and this could be interpreted as reflecting increases over this period in the average value of the relevant Armington elasticities.

A generalization of this approach to changes in preferences is the model of Rauch and Trindade (2003) that focuses on the dynamics of information exchanges across national borders. They note that in the 1990s, there were tremendous increases in the number of periodicals devoted to international trade and commerce and the development of the Internet that greatly facilitated entry of entrepreneurs in one country into other countries.<sup>43</sup> These sorts of technological changes yield what Rauch and Trindade call “familiarity,” and this, in turn, causes labor market integration among different countries. A key result of their paper is that complete familiarity makes the absolute relative wage elasticity of the labor demand function to go to infinity (in terms of the framework in this report, to move from figure 1 to figure 2 over time).<sup>44</sup>

The principal conclusions of the various more realistic models of the long-run and medium effect of trade on the labor market are:

- The correct specification of the effect of international developments on the U.S. labor market is, for several reasons, a blend of the closed and the open economy models.
- This means that in the long run relative wages are affected by both international factors (foreign prices and trade policies) and domestic factors (relative supplies, domestic consumer demand, and skill-biased technological change).

## 2.6 Trade and Economic Growth

One of the more interesting empirical topics in the international economics literature concerns the *ceteris paribus* effects of policies toward trade on the equilibrium rate of economic growth in the economy. In particular, we can posit that over some time interval (like from 2005 to 2020) the average annual rate of growth ( $g_Y$ ) depends on a set of internal factors that affect growth ( $X$ ) and a representation of the set of policies relating to openness to international interdependence, say  $\Theta$  (theta for “trade”), that is:

$$(1) \quad g_Y = f(X, \Theta).$$

The  $X$  variables would include the average rate of growth of the labor force, changes in the skill distribution of the economy, changes in the social infrastructure (roads, public safety, etc.), and various types of technical change. The  $\Theta$  variables include the absence of tariffs, nontariff barriers, currency exchange controls, and laws restricting capital mobility. In other words, a set of policies that encourages, rather than discourages, the openness of the economy is represented by a high value of  $\Theta$ .

What would we expect to be the effect of an increase in  $\Theta$  on the rate of economic growth? First, we have already seen in section 2.3 that a reduction in tariffs tends, at least under most conditions, to cause aggregate GDP to rise. The same qualitative conclusions apply to reductions in nontariff barriers and other restrictions on international commerce. Since an increase in aggregate GDP in the long run requires that  $Y$  must for some time grow faster than it would have without the policy change, we would thus expect the value of  $g_Y$  to be higher during the relevant adjustment period after an increase in  $\Theta$ . Depending on the form of the policy change, this adjustment period could last for 10 or more years. After the adjustment period, however, one would expect no further positive effect of trade liberalization on  $Y$ , and hence its rate of growth due to the increase in economic efficiency.

Most of the literature on the effect of trade policy on economic growth deals with the permanent effect of  $\Theta$  on  $g_Y$  rather than its temporary effect. Table 6 reports average rates of growth since 1929 of GDP and employment between various points at which the economy was at full employment.

**Table 6. Average Annual U.S. Percentage Rates of Growth In Real GDP and Employment Selected Sub-Periods: 1929-2000**

<b>Subperiod</b>	<b>GDP (<math>g_Y</math>)</b>	<b>Employment (<math>g_N</math>)</b>
<b>1929-1948</b>	3.4	1.0
<b>1948-1973</b>	3.9	1.5
<b>1973-1989</b>	3.1	2.0
<b>1989-2000</b>	2.9	1.3

The idea is that the average rate of growth over a specific interval of time may be affected by international economic policy. For example, between 1973 and 1989, would  $g_Y$  have been higher or lower than 3.1 percent if the United States had had less restrictive policies toward imports of goods and capital from the rest of the world? If the ceteris paribus relation between  $g_Y$  and  $\Theta$  were positive, less restrictive policies might have made the actual average rate of growth of GDP equal to, say, 3.4 percent rather than the actual 3.1 percent. Since the average real wage in the economy tends to be proportional to average productivity,<sup>45</sup> the ratio of GDP to employment would (in the likely absence of labor supply effects) have grown at 0.3 percentage points per year over the 16 years from 1973 to 1989, which would have made the average real wage rate in 1989 approximately 5 percent higher than it actually was. Similarly, the trade liberalization component of the NAFTA agreement of 1994 would, under the assumption of a positive effect of  $\Theta$  on  $g_Y$ , have increased the observed rate of growth of U.S. GDP during the second half of the 1989-2000 period, and it would be expected to do so for all years after 2000.

There are many theoretical reasons for suspecting that trade liberalization has a positive effect on growth. In recent years there have been attempts to link the effects of increased specialization brought about by increased trade on the rate of technical change in the context of endogenous growth models.<sup>46</sup> On a more common sense level, exposure to and competition with

production systems from other countries can obviously cause an increase in the rate of Hicks-neutral technological change through technology transfers.<sup>47</sup> On the other hand, there is an alternative argument that the protection of “infant industries” and policies, followed by Japan in the 1970s and 1980s and more recently by Korea, that promote exports through explicit subsidies, which are represented by a reduction in the value of  $\Theta$ , cause economic growth to increase.<sup>48</sup>

Estimation of the effects of trade policy on economic growth must necessarily involve comparisons across countries, so the conclusions of the various studies of this sort do not apply exclusively to the United States. The consensus of the early papers on this (for example, Dollar (1992) and Sachs and Warner (1995)), which tended to focus on developing economies, was that trade liberalization caused increases in economic growth; i.e., there is a positive *ceteris paribus* relation between  $g_Y$  and  $\Theta$ . There were, as pointed out by Rodriguez and Rodrik (2001), severe econometric problems with each of these studies<sup>49</sup>—to the point that the consensus of a positive relationship has been replaced with agnosticism about its sign and magnitude.

Indeed, some trade economists (Hallak and Levinsohn 2004) now maintain that the question of the extent to which trade policy affects growth has to be studied in a microeconomic context—with attention paid to the modeling of the specific mechanisms by which trade policy affects the economy—rather than a macroeconomic context.

At this stage, therefore, when someone claims that liberal trade policies will definitely make GDP and real wages grow faster in the long run (or says that they will have the opposite effect), the honest, up-to-date answer is “perhaps.” The principal conclusion with respect to the question of the effect of a liberal trade policy on the long-run rate of economic growth is:

- The evidence that liberalized trade policy increases economic growth is somewhat inconclusive.

## 2.7 Outsourcing

Perhaps the most contentious “trade” issue of the last several years is the growing practice of many U.S. firms to have parts of their production performed abroad. This is most often referred to as “outsourcing”—although the term “offshoring” may be more popular in the press.<sup>50</sup> Although the outsourcing of jobs to another country is, in principle, no different from the purchase of imported goods with a given skill content,<sup>51</sup> shifting a production line in Gary, IN to suburban Shanghai seems to have a more disturbing effect on workers than the purchase of finished goods from China that used to be produced in the United States.

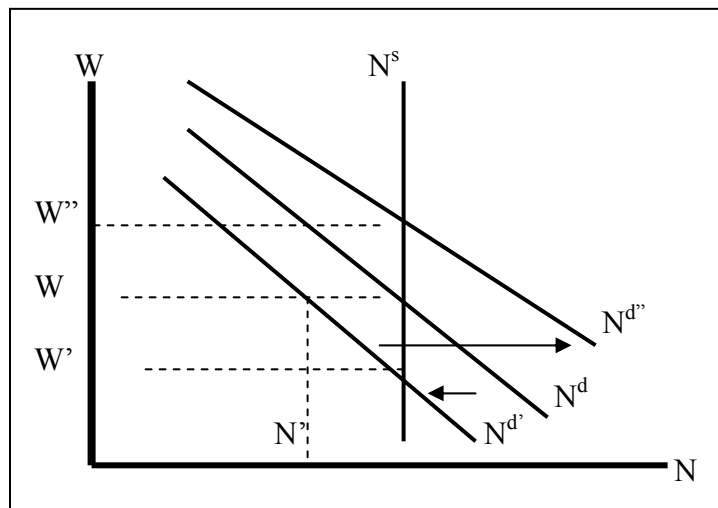
U.S. data on the quantity and form of outsourcing are considered, by those who try to work with them (Feenstra and Hanson 1999, 2001), to be quite poor, and estimation of the effects of the practice—even in its magnitude and the products for which it is used—is often fairly indirect and anecdotal.<sup>52</sup> It seems to be a safe prediction that the volume of outsourcing will grow rapidly over the next several years, and, to the extent that we want to mesh labor market policies dealing with trade dislocations with what is effective and necessary, it would be a very good thing for efforts to improve data on outsourcing be undertaken as soon as possible.<sup>53</sup>

Most of the work on outsourcing has focused on the case in which firms profitably shift their assembly and related functions (which are relatively low-skilled intensive), to low-wage countries, leaving the planning and management functions (which are high-skilled intensive) in the U.S. The result of this adjustment in any sort of model with less than horizontal demand function (like models with the qualifications discussed in section 2.5)<sup>54</sup> is a rightward shift in the downward-sloping relative demand function given in figure 3. In this case, the effects of outsourcing on relative employment demand and on equilibrium relative wages are just like the effects of skill-biased technical change. If, on the other hand, the outsourcing of jobs is balanced in the sense that the relative demand for labor by skill is not changed (i.e., there is proportionally as much outsourcing of high- as of low-skilled positions), the relative demand function does not shift, and the equilibrium value of *rel* is unaffected.

Given the recent focus on the incidence of the outsourcing of high-skilled jobs, the effects of an increase in outsourcing that is (more or less) balanced across skill groups are interesting to explore.<sup>55</sup> The first three items of appendix A of this report discuss this in the context of a straightforward one-sector macroeconomic model. Part of the flow of labor services can be purchased abroad, although almost all jobs are more efficiently performed within the U.S. and would not be outsourced unless wages were sufficiently lower in the source country or countries (this author will focus on just one country). A decrease in transportation or communication costs and/or a general increase in productivity—either private or through improvements in public infrastructure—make outsourcing more likely.<sup>56</sup>

The demand curve for domestic employment (*N*) as a function of the average real wage rate (*W*) is illustrated in figure 4. Once the practice had begun, further improvements in the efficiency of outsourced labor (represented in appendix A by the parameter *b*) have an ambiguous effect on the demand for domestic labor.

**Figure 4. Effects of an Increase in the Efficiency of Outsourcing in the Short, Medium, and Long Runs**



If domestic and outsourced labor are sufficiently substitutable for each other in the relevant range, the aggregate labor demand function shifts to the left from  $N^d$  to  $N^{d'}$  as in figure 4. In the short run, if the real wage rate does not adjust from its original value, employment falls to  $N'$ . The increased outsourcing “destroys jobs” in a net sense in the way some in the popular press interpret the “jobless recovery” in the present time (see section 1.3). In the medium run, the real wage is bid down to  $W'$ , and the employment level goes back to where it would have been without the increase in the efficiency of outsourcing.

The effect of the increased outsourcing on the labor demand function and the equilibrium real wage rate in the long run depends on the nature of the supply of capital. If the supply of capital is perfectly elastic with respect to its return, the labor demand function shifts back beyond its original value to  $N_d$ , thus causing the real wage rate in the U.S. to be higher as a result of outsourcing. If the supply of capital is less than perfectly elastic with respect to the return on capital, the shift back to the right may exceed or fall short of the original demand function, so real wages may rise or fall as a result of the increased efficiency of outsourcing. If the outsourcing requires foreign direct investment by U.S. firms, the likelihood that an increase in the efficiency of output causes a long-run increase in the real wage rate in the U.S. is lessened.

Another way that outsourcing, as well as direct trade in goods, can affect wages is by lowering the ability of workers to extract “rents” from employers.<sup>57</sup> As labor demand functions become more elastic, unions will be increasingly less able to negotiate higher than market wages for their members. This, alas, may be one reason why private sector unionism, which represented about 35 percent of employment in 1955, has fallen to a representation level of a little less than 9 percent at the present time. To the extent that the employment effects of unionism are subject to an absolute wage elasticity of less than one (which might require some explicit bargaining over employment), the lowering of the rents for a portion of the labor force would lower the average wage of workers who used to be well represented by private sector unionism—the relatively low-skilled. Of course, there is not much room for private sector unionism to fall further, so this effect clearly refers to the past rather than the future.

The conclusions of this section on outsourcing are:

- The outsourcing of parts of individual production processes is, in principle, just like the importation of goods with similar skill content.
- To the extent that intermediate trade of the 1980s and 1990s was more low-skilled intensive than the products involved, estimates of the contribution of international developments to increased earnings inequality must be revised upward.
- The long-run effect of outsourcing on the average real wage is positive.
- The shorter-run effects of outsourcing on employment demand is ambiguous.

## 2.8 Future Trends in the Sensitivity of the U.S. Labor Market to the Rest of the World

There are very large differences in the way labor markets are expected to work between situations in which international factors are fairly unimportant (the closed economy model discussed in section 2.1) and situations in which trade is quite important (the open economy model of section 2.2) and its subsequent modifications. Just how far the U.S. labor market has moved from quite closed, as it was around 1950, to very open is subject to some disagreement, but there has obviously been a great deal of movement. It is natural to ask whether there will be further movement toward a “fully open” economy labor market during the next few decades. Can we expect that the U.S. labor market will be more integrated into the world economy in, say, 2025 than it is today?

First, part of the answer to this question depends on the answer to the questions posed in section 1.3 concerning future trends in exports and imports as a fraction of U.S. GDP. Given continued international political stability and further decreases in transportation and communication costs, as well as an endogenous “globalization dynamic” (Americans getting used to consuming foreign goods), the indications of further integration with the world economy are fairly clear. But it is possible that some unforeseeable catastrophic event or events (terrorism comes to mind) or political change (a populist move toward extreme protectionism) could turn this trend around such that the economy becomes less open in 2025 than it is in 2004.

In the absence of a political disruption, however, there are two reasons why one would expect the U.S. labor market to become more integrated with the rest of the world. First, with the passage of time and the secular increase in international communication, we would expect Armington elasticities to get larger (the degree of home bias to get smaller), which would imply secular increase in labor demand elasticities within the U.S. Similar results would be expected on the basis of the Rauch-Trindade informational dispersion model.

The second reason for suspecting that the U.S. labor market will continue during the next few decades to become more open and more inter-dependent with foreign labor markets is the potential for the growth of outsourcing. Mann (2003) and Bardhan and Kroll (2003) both document the recent growth in the outsourcing of white collar positions, and an implication of their findings is that there is probably a great deal of potential for further migration of these types of functions.

Interestingly, one brake on the rate at which U.S. jobs are outsourced is the effect of U.S. fiscal policy on future values of the exchange rate. Given that the U.S. has opted for relatively permanent, large structural government and foreign trade deficits, the fraction of net assets in the U.S. held by foreigners will continue to grow for some time. As long as this happens, there will be constant downward pressure on the real value of the U.S. dollar relative to other major currencies. This will cause the price of labor in the U.S. to fall relative to its price in countries that are potentials for outsourcing (see Swenson (2000) for evidence concerning this effect) and thus lower incentives to U.S. firms to outsource.

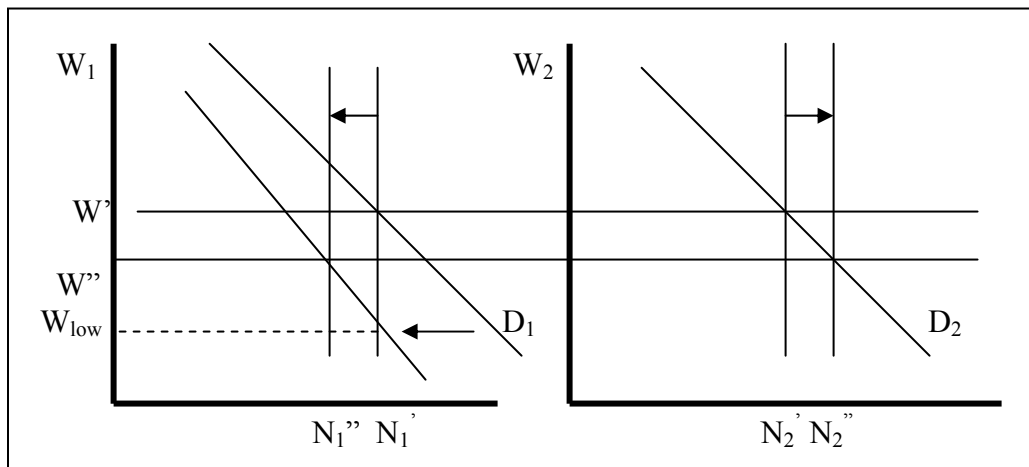
### 3.0 Short-Run Adjustment and Trade Adjustment Assistance

#### 3.1 The Simple Adjustment Model

Section 2.0 of this report highlighted many ways in which international shocks of various kinds can influence the demand for various types of labor. These shocks include reductions in world prices of certain goods caused by an increase in the productive efficiency of the production of those goods elsewhere in the world, reductions in transportation costs or tariffs, which have the same effect on the prices of relevant goods as reductions in prices, and, more recently, an increase in the outsourcing of certain types of labor in some industries.

It is instructive to consider a simple model, represented in figure 5, in which a particular type of labor is employed in either sector 1 (the diagram on the left) or sector 2 (the diagram on the right). Initially, total employment of this type of labor in the economy,  $N = N_1 + N_2$  is equal to the aggregate effective supply of labor, and the prevailing wage in both sectors is equal to  $W'$ ,<sup>58</sup> which is defined in annual full-time units.

**Figure 5. Labor Market Adjustment Between Sectors Following a Negative International Shock**



Now assume that there is some sort of international shock that lowers the demand for labor in sector 1 without affecting demand in sector 2.<sup>59</sup> This is represented by a leftward shift in the  $D_1$  curve. What happens eventually (in what was referred to in section 2.3 as the medium run) is that  $N_1' - N_1''$  workers in sector 1 migrate to industry 2 such that the wage for this type of labor falls from  $W'$  to  $W''$ . Thus, after the adjustment period, each worker of this type—regardless of the initial industry of employment—loses  $(W' - W'')$  per year.

To keep matters as straightforward as possible, assume that: the wage in both sectors adjusts immediately to the new equilibrium level  $W''$  from its pre-shock value  $W'$ ; there is an out-of-pocket transfer cost of  $T$  (some combination of the total costs of training, migration, and job search) for each person who moves from sector 1 to sector 2; all adjustment of the labor force

to sector 2 is complete after (arbitrarily) 2 years; the average fraction of 2 years that it takes a displaced worker to obtain a job in sector 2 is  $2S$  years; and (e) the (appropriately discounted) worklife expectancy of  $\Omega$  years.<sup>60</sup> There are three different categories of workers within this labor type: the  $N_1' - N_1''$  job losers in sector 1 who have to move to sector 2; the  $N_1''$  members of the original workforce in sector 1 who are lucky (or have enough seniority) to be retainers of their jobs in that sector; and the  $N_2'$  original employees in sector 2.

The breakdown of the effects of the trade shock on net earnings per person of the three categories is given in table 7. Both the sector 1 job retainers and the original workers in sector 2 incur lifetime losses of  $(W' - W'') \bullet \Omega$ , the annual earnings reduction due to the trade shock times average years remaining in the labor force. The average lifetime loss of the  $N_1' - N_1''$  job losers is  $(W' - W'') \bullet \Omega + T + 2 \bullet (1 - S)W''$ . This is obviously the higher, the larger is the resource cost of adjustment,  $T$ , and the lower is the speed of adjustment,  $S$ . If  $S$  were equal to one; i.e., displaced workers found jobs in the other sector immediately, the loss per displaced worker would be equal to those of all other similar workers plus the resource cost of changing sectors,  $T$ . If, for example,  $S = 0.5$ , it takes an average of 1 year for a displaced worker to find a new job, and the additional cost to a displaced worker is  $T$  plus 1 year's earnings,  $W''$ .

**Table 7. Hypothetical Effects of Trade Shock on Various Members of the Affected Labor Group**

Category	Number in category	Two-year adjustment period	Remainder of worklife
Sector 1 job losers	$N_1' - N_1''$	$- T + 2 \bullet (W' - S \bullet W'')$	$- (\Omega - 2) \bullet (W' - W'')$
Sector 1 job retainers	$N_1''$	$- 2 \bullet (W' - W'')$	$- (\Omega - 2) \bullet (W' - W'')$
Original sector 2	$N_2'$	$- 2 \bullet (W' - W'')$	$- (\Omega - 2) \bullet (W' - W'')$

The aggregate losses as a fraction of the original wage bill due to the trade shock of this labor type as a fraction of the original wage bill are given by:

$$(3-1) \quad \frac{LOSS}{W' N \Omega} = \left[ \frac{W' - W''}{W'} + \left( \frac{2(1 - S)W'' + T}{\Omega W'} \right) \left( \frac{N_1' - N_1''}{N_1'} \right) \right]$$

This is equal to the proportionate change in the wage of the labor type due to the trade development plus the ratio of total adjustment costs per displaced worker to the original wage, all times the fraction of workers who are displaced by the shock. Total displacement costs are resource costs plus the lost output due to unemployment. In the aggregate, the trade development creates a benefit to all other factors of production in terms of increased real incomes that, presumably, is greater than the loss in (3-1).

The major conclusions of this section are:



- In the short run, the principal effect on a negative trade shock on a group of affected workers is the unemployment of those workers in the industry directly affected by the shock.
- In the long run, the trade shock results in lower wages for all workers in that skill class—whether or not they were initially employed in the affected industry and whether or not they were initially unemployed as a result of the trade shock.
- Losses incurred by those who lose their jobs as a result of the trade shock are the greater, the lower is the rate of labor market adjustment and the higher are the out-of-pocket costs of adjustment.

### **3.2 Trade Adjustment Assistance Programs**

The purpose of the Trade Adjustment Assistance (TAA) is to compensate groups of workers who can be identified as having received trade-related losses.<sup>61</sup> In practice, however, groups of individuals must be clearly identified as having lost their jobs as a result of a particular trade development in order to be eligible for TAA. Thus, TAA is limited to helping compensate negatively affected workers for the second term in (3-1). It does not attempt to do anything about the long-run losses of groups—like the low-skilled workers in the various discussions in section 2.0—who may be negatively influenced by international economic developments, but who do not lose their jobs directly as a result of shocks that are directly (i.e., administratively) attributable to trade shocks.

Table 8 reports the budget (actual, estimated, and proposed) for TAA for the 3 fiscal years (FY) 2003, 2004, and 2005. About 70 percent of the TAA budget goes for adjustment assistance (primarily unemployment compensation) and a little over 20 percent goes to job retraining.

Given that adverse trade developments for some groups may affect relative wages and the real wage, the adequacy of existing TAA programs in terms of distributional equity is, almost by definition, in question. The primary evaluation questions that one would ask about TAA from the point of view of economic efficiency concern the effects of payments to displaced workers on  $S$ —the average time to reemployment in alternative sectors. To the extent that the program provides useful information and, in some cases, training to displaced workers about alternative job openings and the like,  $S$  would fall, and aggregate output would rise. On the other hand, income subsidies tied to nonwork can have disincentive effects that lower  $S$  and thus lower aggregate output.

**Table 8. Budget for Trade Adjustment Assistance 2003–2005  
(\$ millions)**

<b>Activity</b>	<b>FY 2003 (actual)</b>	<b>FY 2004 (est)</b>	<b>FY 2005 (est)</b>
<b>Adjustment assistance</b>	399	523	750
<b>Training</b>	259	259	259
<b>Wage insurance Demo.</b>	---	14	48
<b>Reimbursable programs</b>	17	40	40
<b>Total</b>	675	836	1097

Source: appendix to FY 2005 Budget, pp. 707-08

It is interesting to speculate about the adequacy of the TAA budget in the face of the sorts of trade shocks that the U.S. has experienced over the past 25 years. In particular, we can compare the size of the TAA budget with the aggregate losses incurred by the groups that are made worse and those made better off due to trade developments. For example, assume that 0.013 of the increase in the high-/low-skill relative wage from 1979 to 2003 can be attributed to changing trade conditions (0.013 is on the high end of the Borjas, Freeman, and Katz (1997) estimates and below those of Baldwin and Cain (2000)). The nominal value of the aggregate wage bill, including employer supplements, in the third quarter of 2003 was \$5.1041 trillion. In terms of the hypothetical effects of a reduction in the price of the low-skilled intensive good discussed in table 5 in section 2.3, the effects of a change in the relative price of the low-skilled intensive good,  $P_2$ , such that  $rel = W_H/W_L$  increases by 1.3 percent means that the wage bill of high-skilled workers increases by \$21.7 billion and the wage bill of low-skilled workers decreases by \$11.4 billion.<sup>62</sup> The 2005 proposed expenditure on TAA is about 10 percent of the total.

The major conclusions of this section are:

- Trade adjustment assistance provides partial compensation only to those in the affected group who lose their jobs directly due to the trade shock.
- Trade adjustment assistance does not provide any compensation to the two other groups in the affected labor class—those who retain their jobs in the affected industry and those in other industries, both of whose wages fall in the long run.
- Trade adjustment assistance can be evaluated with respect to its contribution to economic efficiency.

### **3.3 Individual Job Displacement Effects**

The implicit assumption in figure 5 and the associated algebra of a single wage for all members of a particular labor group as well as the focus on the average speed of adjustment  $S$  provide some insights into the adjustment process, but they miss a great deal of the story. We know that workers identified by any set of observable characteristics are very heterogeneous in

the sense that there is an enormous amount of unexplained variation across samples of individuals. The same is true for the effect of job displacement on individuals' subsequent employment and earnings.<sup>63</sup>

The thrust of the empirical work on the effects on this topic reveals some regularities. First, reemployment rates at a given time after displacement are higher for those with more education and are lower for older, female, and minority workers. Second, the average negative effects of displacement on the probabilities of employment in subsequent years tends to diminish to zero the longer the period of time since displacement. Third, the amount of earnings loss as a proportion of predisplacement earnings is smaller for workers with high levels of education, for younger, and—not surprisingly—those with low values of tenure on the job. Fourth, the large negative effect of displacement on subsequent earnings per unit of time worked diminishes somewhat with time since displacement, but it does not seem to disappear.<sup>64</sup>

One interesting finding that calls into question the simplistic “changing sectors” approach is that individuals who are subject to job displacement in manufacturing, including trade sensitive industries, do significantly better in terms of subsequent earnings when they are reemployed in manufacturing industries than when they move in trade, services, or any other industry (Kletzer 2000, 2004). The reason for this is probably that displaced manufacturing workers have certain skills that are specific to that sort of work so that they do better remaining in jobs that are close in terms of skills to what they have been doing for most of their working lives. With normal labor turnover, these displaced workers will have a reasonable chance of obtaining relatively high-paying manufacturing employment even if there is, as a result of past layoffs in the area, a socially suboptimal oversupply of people looking for those jobs.

It is interesting to reflect on the implication of this empirical stylized fact for the evaluation of part of the TAA program. Suppose that there is a training program component of TAA and that a fraction of displaced workers enter a training program that attempts to get participants prepared for careers in other industries like health services. Some proportion of participants complete the program successfully and take jobs in the sector for which they were prepared.

Now spurred by pressure from the various budget authorities, DOL decides that it wants to evaluate the training component of TAA and commissions the collection and analysis of data on the postprogram experience of TAA recipients, some of whom were trainees and others nontrainees. As part of the evaluation of the training component of TAA, researchers run a multiple regression of earnings 12 quarters after leaving the program on a dummy variable indicating whether the person had received training as part of his/her TAA experience in addition to the usual adjustment variables.

What would one conclude if the estimated coefficient on TAA training program participation was not significantly different from zero?<sup>65</sup> One would, of course, conclude nothing. The expenditure of public resources to get some of the redundant manufacturing labor supply into other occupations that were likely to have been characterized by tight, if low-paying, labor markets may well have been a very good investment from a social point of view. The over

simple evaluation framework that has been posited, however, would never pick up the positive contribution of the training program to net aggregate welfare.

There are many reasons for job displacement to occur. These include cyclical downturns, changes in technology, mismanagement, and shifts in consumer demand as well as the sort of trade-related shocks that motivate TAA. Kletzer (2004) summarizes an attempt to figure out the fraction of total job displacement in the U.S. between 1979 and 1999 that came from trade sources. She identifies a set of high-import competing manufacturing industries,<sup>66</sup> which composed 5.2 percent of nonagricultural employment during this period, but had 14.2 percent of nonagricultural displacement. At first blush, this suggests the potential for a lot of trade-induced displacement. Looking more deeply at these numbers, as she did with a slightly earlier data set in Kletzer (2000), she concludes that trade-related job displacement over this period was probably a fairly small part of total displacement.<sup>67</sup>

The major conclusion with respect to the literature on job displacement is that:

- Trade-related job displacement incurs greater costs, in terms of longer periods of unemployment and larger decreases in reemployment.

### **3.4 Wage Insurance**

An implication of various approaches to the welfare economics of international trade is that an equitable and (relatively) efficient way to compensate losers due to some development is by establishing a system of “wage insurance” for displaced workers (Dixit and Norman 1986; Kletzer and Litan 2001). A feature of the changes in TAA in the U.S. contained in the Trade Act of 2002 is the introduction of a limited version of wage insurance to workers who are displaced by trade. Wage insurance is currently confined to displaced workers over the age of 50 who obtain a different job within 26 weeks at a wage of less than \$50,000 per year. This is called the Alternative Trade Adjustment Assistance (ATAA) program. ATAA pays participants half of the difference between their previous earnings level and the earnings in their new job for up to 2 years, and the insurance payment is capped at \$5,000 per year. The wage insurance component of ATAA is still quite small (see table 8), but it could, in the future, be expanded to cover the entire population of displaced workers (i.e., the age restriction on eligibility could be eliminated).

In terms of equation (3-1), wage insurance gives a payment of the subsidy rate times ( $W^2 - W$ ) for up to 2 years so long as  $S$  is less than a certain value. For the current ATAA, the subsidy rate is 0.5 and the critical value of  $S$  is 0.25. Thus, some of the additional losses of those who lose their jobs directly through trade-related shocks can be compensated with a wage insurance scheme. Wage insurance has the advantage over transfers based solely on unemployment compensation of increasing incentives to gain reemployment swiftly as well as to lower incentives to wait for the possibility of recall to the old jobs. By confining participation to those who directly lose their jobs in an affected industry, however, wage insurance does nothing for other workers in the relevant skill group who are not directly affected through job displacement. This feature, however, is common to all TAA programs.

The focus of ATAA on older displaced workers is understandable in the light of the empirical facts mentioned in section 3.3 about the effects of age on the average reemployment rates and income losses of older workers. However, this restriction makes evaluation of wage insurance programs difficult, for whatever one observes that is different about ATAA participants is as likely to be attributable to age as to the parameters of the wage insurance system. It would be useful to set up an experimental design study in which some younger (under age 50) displaced workers were randomly chosen for eligibility for wage insurance. The resultant effects on reemployment rates and subsequent earnings between the experimental group and control group of noneligibles would provide the information necessary to evaluate the efficacy of wage insurance.

#### **4.0 Recommendations for Future Research and Information Gathering by DOL**

What DOL should be doing now to prepare for the future with respect to the labor market effects of trade-related developments depends rather crucially on the answer to one question: Will the scope and size of Trade Adjustment Assistance programs be expanded in the future? Whether the U.S. should or should not do this is a political value judgment. It is common, especially when new trade liberalization pacts are discussed, for politicians over almost the whole range of the U.S. political spectrum to call for an expansion of TAA.

For example, among the recommendations in the November 2000 “Issues Report” of the bipartisan U.S. Trade Deficit Review Commission were the following:

- Increasing private and public efforts to provide more effective adjustment assistance with such efforts extending to all workers bearing the costs of adjustment to economic change irrespective of why they have lost their jobs or whether they are eligible for specific trade adjustment aid.
- Expanding the educational and training opportunities available to all Americans because a more productive workforce is the key to our long-term international competitiveness.
- Promoting labor mobility by removing barriers to retraining and to taking new jobs. Serious consideration should be given to providing wage insurance to temporarily fill some of the gap between a displaced worker's old wage and a lower wage in a new job. Depending on the adequacy of funding, the program might also include providing for health insurance coverage during periods of sustained unemployment.

It is interesting to note that the first and third of these recommendations were, to some extent, followed in the 2002 amendments to the TAA program. Its budget was expanded significantly (to \$1.1 billion for FY 2005 from \$0.4 billion in 2002), and a health insurance subsidy (in the form of a tax credit equal to 65 percent of total health care insurance premiums) was added. In addition, a wage insurance scheme, along the lines of that proposed by Kletzer and Litan (2002), was introduced for affected workers over the age of 50.

At the same time, these programmatic remedies do not touch the secondary effects of trade-related developments on the general level of wages of certain affected groups (the first term in the right hand side of equation (3-1)). If economic policy were to attempt to try to fulfill the goal of Corden’s “conservative social welfare function”—that no one would be worse off as a result of any trade liberalization—government policy would have to attempt to raise the net incomes of those groups that lose as a result of the policy. Such a policy, for the reasons discussed throughout this report, goes beyond those who are temporarily dislocated as a result of a trade shock and eligible for TAA. The policy would have to involve other branches of government, principally the Treasury Department, for it would most likely have to involve a serious revision of the tax code.

At the same time, trade-related developments are likely to become increasingly important to the future determination of labor market outcomes in the United States, and informed policy decisions will require an understanding of these effects and the constraints the international economic environment may impose. Consequently:

- It would be very useful for policymakers within the DOL (and elsewhere in the Government) to have access to the results of a general parameterized model that would provide an indication of the effects of international economic developments on wage and employment levels in the U.S. This would require the attention of a group of specialists within the DOL to build the model, with consultation by trade and labor economists.
- The group of specialists within DOL assigned to work on the model should monitor on a continuous basis empirical studies of the effects of trade-related developments on labor market variables and adjust the model accordingly.
- Much more information on outsourcing of functions and the imports and exports of services generally than what we currently get from the national accounts dealing with data. It would probably be useful to be able to identify outsourcing in a large sample at the firm level. The data from “free trade zones,” which were discussed in section 2.7, are an example of the sort of data that would be very useful in this regard.

The preceding three suggestions refer to issues that are relevant to general government policy toward the effects of international development on the labor market. Policies toward these issues are not uniquely the province of DOL—although the economics of the trade/labor market relation have major implications for other DOL programs. DOL’s current programmatic responsibilities with respect to the international economy are much more related to short-run adjustment. Two suggestions along these lines are:

- Work should be undertaken to attempt to improve information from the Displaced Worker Survey of the Current Population Survey on those job losses that are trade related and, with respect to the previous point, due to outsourcing.

- With the data from the preceding suggestion, work could then be done to determine if the patterns and time path of adjustment to new employment tend to be significantly different for those displaced by trade and outsourcing than for those displaced for other reasons.

The wage insurance variant of TAA that is a small part of the current program (although restricted to older workers) seems especially promising—and seems to have gained support from virtually the whole range of the political spectrum. We are probably not going to learn much by observing the older workers in the program—although the analysis of the distribution of payments will be of some interest to analysts. Therefore, it is recommended:

- A sample of younger TAA participants should be selected to participate in a wage insurance experiment. How does the presence of the wage insurance option affect job search, length of time to a new job, earnings on new job, and so forth?

## Endnotes

<sup>1</sup> An important exception to this is the fact that women's earnings relative to men's rose significantly over this period which, since women earn less on average than men, lowered inequality. The primary reason that this happened, however, is that women's average labor market skill rose considerably faster than men's over this period.

<sup>2</sup> College equivalents are assumed equal to full time equivalent employment of college graduates plus 0.8 times one-half of the employment level of workers with some college; high school equivalents are equal to the employment of workers with exactly 12 years of schooling plus 0.8 times the employment of dropouts plus 1.2 times one-half of the employment level of workers with some college. The ratio in table 1 is mildly sensitive to the somewhat arbitrary 50/50 assumed allocation of the some college group.

<sup>3</sup> There is some concern that the U.S. is close to reaching the end of the rapid growth in the average level of completed schooling. This is primarily because rates of school attendance of young persons have not increased very much since the 1960s, so entering cohorts of the labor force will soon have a very similar educational composition than cohorts of retirees. Day and Bauman (2000), for example, forecast a range of distributions of educational attainment in 2028 that would imply an annual rate of growth in relative supply of between 0.6 and 1.0 percent. The evolution of enrollment trends in the U.S. is examined extensively in Card and Lemieux (2000).

<sup>4</sup> For an expression of similar sentiments by a practicing economist, see Blecker (1999).

<sup>5</sup> If the successfully executed goal of monetary policy were to maintain exchange rates between the dollar and other major currencies at fixed target values, trade policy would have an effect on domestic demand. But anybody who has been to Europe over the past 2 years knows that the \$/€ is not fixed.

<sup>6</sup> A regression of the annual value of net exports per unit of GDP for the U.S. on the value of the government deficit/GDP and the household saving rate suggests that (a) and (b) are approximately equally responsible for the chronic trade deficit.

<sup>7</sup> Discussing the question of what is likely to happen to the extent of openness of the U.S. economy, Rodrik (2000) admits that "economists rank second only to astrologists in their predictive abilities."

<sup>8</sup> For the period in tables 1 and 2, there were seven such NBER turning points, occurring in 1960-II, 1969-IV, 1973-IV, 1980-I, 1981-III, 1990-III, and the last in 2000-I.

<sup>9</sup> When the model is estimated separately for the 1948-1973 and 1974-2000 subperiods, there is a statistically significant difference between the subperiods in both the length and amplitude of recession-related increases in unemployment. Recessions in the more recent period are less severe (in the sense that the proportional rise in the unemployment rate following a cyclical turning point is lower), but the adjustment of the aggregate unemployment rate to its noncyclical low was significantly slower in the 1974-2000 subperiod than during the 1948-1973 subperiod.

<sup>10</sup> This has also received the attention of applied economists. See, for example, Groshen and Potter (2003).

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<sup>11</sup> The model is as follows:  $gN = b_1gY + b_2gY(-1) + b_0(t)$ , where  $gY$  is the value of the percentage change in GDP and  $gY(-1)$  is its lagged value and the constant term is assumed to be different (in fact, significantly higher) for the 1974-1994 interval because of the very low productivity growth during that time. In addition, the path of the unemployment rate during the recession that began in the first quarter 2001 has been much different from that implied by the model of the adjustment of the unemployment rate described earlier in this section. Based on estimated parameters for the 1974-2000 period, the unemployment rate in 2004-I should have fallen to a value of 4.9 percent from its quarterly high of 5.9 percent during the downturn. However, the actual 2004-I value was 5.6 percent, which suggests a much lower rate of adjustment during the current recession than during for other recessions since 1973.

<sup>12</sup> The latter set of results would probably not be picked up by [www.saveamericanjobs.com](http://www.saveamericanjobs.com).

<sup>13</sup> One example in which the heterogeneous labor force is aggregated into two types is the use of “high school equivalents” for  $L$  and “college equivalents” for  $H$  as in Katz and Murphy (1992) and Johnson (1997). The flow of college equivalent labor is equal to the employment of BAs plus the employment of workers with graduate degrees adjusted for their higher relative earnings plus one-half the number of workers with some college adjusted for their lower earnings relative to BAs. The flow of high school equivalent labor is similarly constructed, weighting the employment of workers with less than high school by their average earnings relative to high school graduates and of half the employment of employees with some college with an appropriately higher weight. Although this approach has the benefits of computational feasibility and is obviously suggestive, it does not confront many interesting complications—some of which will be discussed in other contexts below.

<sup>14</sup> The model could easily be modified to reflect inter-industry wage differentials due either to nonpecuniary factors or trade union wage policy. For example, wages in industry 1 (autos) may tend to be 25 percent greater than wages in industry 2 (fast food retailing) either because jobs in industry 1 are onerous relative to those in industry 2 and require a 25 percent compensating differential or because a trade union in industry 1 successfully keeps the wages of its members 25 percent higher than the nonunion wages in industry 2. Given constant relative wages across industries, such a modification does not alter the conclusions of the analysis with respect to the variables of interest.

<sup>15</sup> In appendix A of this report, the properties of a simple (but illuminating) model are set out, in which two of the industries are completely high-skilled intensive and the other two are completely low-skilled intensive. Item 1 of this appendix sets up the model, and item 2 examines the comparative statics of the closed model.

<sup>16</sup> The absolute value of the proportional change in  $rel$  in response to a proportional increase in  $(H/L)$  is the reciprocal of a weighted average of the elasticity of substitution between high- and low-skilled labor and the elasticity of substitution between goods in consumption.

<sup>17</sup> In terms of an aggregate production function for that industry, take the simplest case:

$$Q_i = A_i H_i^{\alpha_1} L_i^{\alpha_2} K_i^{1-\alpha_1-\alpha_2},$$

where  $Q_i$  is output of industry  $i$ , and  $H_i$ ,  $L_i$ , and  $K_i$  inputs of the two types of labor and of capital,  $A_i$  is the Hicks-neutral technical change parameter, an increase in which represents an increase in overall productive efficiency.

<sup>18</sup> Most labor economists sign on to this view, but not all. See, for example, Card and DiNardo (2002) for a skeptical view.

<sup>19</sup> Skill-biased technological change is best thought of, in terms of the Cobb-Douglas production function in the previous endnote, as a reduction in the value of  $\alpha_2$  and an increase in the value of  $\alpha_1$ , a transfer in the relative importance in the production process from low- to high-skilled workers.

<sup>20</sup> In a more realistic specification of the labor market there would be several (versus two) types of labor, which might be arrayed in terms of skill equivalents. A typical training program would attempt to move its participants one or more rungs up the skill ladder.

<sup>21</sup> This means that there is no “outsourcing” of parts of the production function. This assumption is relaxed in section 4.2.

<sup>22</sup> This means that there is no “home bias” at home or abroad in consumption. The implications of lifting this assumption are explored in section 4.2.

<sup>23</sup> For a discussion of the analysis of union effects in the open economy model see Johnson and Stafford (1999).

<sup>24</sup> Item 3 of appendix A derives the major implications of the open economy model in the context of a simple Ricardian model of the economy.

<sup>25</sup> The demonstration of this result, following Jones (1965), is as follows: The zero profit condition in industries 1 and 2 is, ignoring, for the sake of expositional convenience, capital input, given by:



$$P_i A_i H_i^{\alpha_i} L_i^{1-\alpha_i} - M_H H_i - M_L L_i = 0, \quad i = 1, 2$$

where  $M_H$  and  $M_L$  are the nominal wages of high and low-skilled labor and the assumption that industry 1 is more skill intensive than industry 2 means that  $\alpha_1 > \alpha_2$ . Differentiating these conditions totally yields two equations in the proportional changes of the two wage rates:

$$\begin{aligned} -d(\log P_a) + d(\log P_1) + d(\log A_1) &= \alpha_1 d(\log W_H) + (1 - \alpha_1) d(\log W_L) \\ -d(\log P_a) + d(\log P_2) + d(\log A_2) &= \alpha_2 d(\log W_H) + (1 - \alpha_2) d(\log W_L), \end{aligned}$$

where  $P_a$  is the average price level in the economy (so that  $W_H = M_H/P_a$ ). The solution change in the high-/low-skilled relative wage rate is then:

$$d(\log rel) = d(\log W_H) - d(\log W_L) = \left( \frac{1}{\alpha_1 - \alpha_2} \right) d \left( \log \left( \frac{P_1 A_1}{P_2 A_2} \right) \right).$$

Then, given that the wages of the two types of labor have been determined in industries 1 and 2, the prices of the nontraded goods,  $P_3$  and  $P_4$ , are determined as functions of these wages and the productivity parameters in those industries.

<sup>26</sup> This led Freeman (1995) to characterize the open economy model by the question: “Are Your Wages Set in Beijing?” His answer, unlike the model set out in this section, was “no.”

<sup>27</sup> Total net exports of the economy are equal to  $P_1(Q_1 - C_1) + P_2(Q_2 - C_2)$  and are predetermined in a macroeconomic setting (equal to zero for the average country in the world), where  $Q_i$  is domestic output and  $C_i$  is domestic consumption. Since  $P_1$  and  $P_2$  are set in international markets, the rise in  $C_1$  due to a change in tastes with no changes in  $Q_1$  or  $C_2$  means that  $Q_2$  must rise.

<sup>28</sup> This property of open economy models—that changes in factor supplies cause adjustments in the mix of goods produced rather than adjustments in wages and prices—is referred to in international trade theory as the Rybczynski theorem. An interesting test of the theory across states in the U.S. is reported in Hanson and Slaughter (2002). Leamer and Levinsohn (1995) refer to the property of the model that factor supplies do not affect relative factor prices the Factor Supply Irrelevance theorem.

<sup>29</sup> See Haskel and Slaughter (2002) for a detailed analysis of this proposition.

<sup>30</sup> These include lifting the “small country” assumption and, from the “new trade theory,” some degree of monopolistic competition and/or increasing returns to scale in certain industries of the economy. For a very readable and perceptive discussion of the political economy of trade policy, see Rodrik (1995).

<sup>31</sup> This is an example of what Corden (1974) called the “conservative social welfare function,” which implies that no one should be worse off as a result of a change in trade policy or any other international event. This would be a very strong interpretation of the intent of TAA policy—much stronger than what actual policies in the United States have tried to do.

<sup>32</sup> This example uses the Ricardian model with unitary price elasticities that is set out in item 3 of appendix A. It is assumed that 40 percent of the labor force is high skilled, i.e.,  $H/(L+H) = 0.4$  and that the domestic consumption share of the high-skilled imported good ( $\beta_1$ ) is 0.1, the share of the low-skilled imported good ( $\beta_2$ ) is 0.2, and that the share of the nontraded goods that are high-skilled and low-skilled intensive ( $\beta_3$  and  $\beta_4$ ) are equal to, respectively, 0.25 and 0.45. Initial international prices without the tariff and the productivity parameters are such that the initial value of the relative wage of skilled workers is  $rel = 1.5$ . Initially, exports and imports (all of the former being of the high-skilled intensive good and all of the latter of the low-skilled intensive good) are each equal to 15 percent of GDP.

<sup>33</sup> This is a common conclusion of more detailed computable general equilibrium models of trade effects (see, for example, Brown, Deardorff, and Stern (1992)) and of any sort of standard welfare analysis of the effects of “distortions.” The overall efficiency loss due to the imposition of tariffs of given magnitude may, of course, be larger than those implied by table 1 under certain alternative parametric and other assumptions.

<sup>34</sup> The procedure and parametric assumptions underlying this computation are the same as in the example associated with figure 1.

<sup>35</sup> The example stops with a relative price of good 2 of 0.818 because at this point industry 2 “disappears;” i.e., all low-skilled workers are employed in the production of nontradables.

<sup>36</sup> The equation for FCA in the context of the Ricardian trade model is set out in item 3 of appendix A.

<sup>37</sup> The introduction of FCA was by Deardorff and Staiger (1988). Its use is only strictly correct if all production and utility functions have unitary elasticities of substitution; although a variant of the approach can be used if these

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functions all have the same constant elasticity of substitution (see Deardorff 2000). The magnitudes of the biases involved in departures from these assumptions are discussed in Johnson and Stafford (1999). Further skepticism about FCA is expressed by Panagariya (2000) and, more strongly, by Leamer (2000). Krugman (2000) addresses some of the arguments against FCA and thinks that they are over wrought. He concludes that the results from a simple FCA calculation “at least suggests that it is unlikely that trade has played a dominant role” in the observed increase in the relative demand for high-skilled labor in Organization for Economic Cooperation and Development (OECD) countries.

<sup>38</sup> A recent and compelling example of this is the results in Borjas (2003) with respect to the negative effects of immigration on wages in the U.S. Recall from section 4.2 that an unambiguous prediction of the open economy model is that immigration—after an adjustment period—causes product mix rather than relative prices to change.

<sup>39</sup> See item 5 of appendix A for the explicit derivation of the demand function for the case in which the equilibrium of the economy is “outside the cone.” In terms of the endnote below, there is only one equation in  $d(\log P_1)$  so that the changes in  $W_H$  and  $W_L$  are no longer uniquely determined by the exogenous values  $d(\log P_1)$  and  $d(\log P_2)$ . To determine changes in domestic wages, one has to make reference to the nontraded sector—just as one must do in the analysis of the closed economy labor market.

<sup>40</sup> These papers include, among many others, Harrigan (1997), Trefler (1995), Davis and Weinstein (2001), and Schott (2003).

<sup>41</sup> The associated utility function with the Armington elasticities given by the  $\omega_i$ 's is discussed in item 6 of appendix A.

<sup>42</sup> During the past year there have been well publicized examples of taste shifts associated with a foreign policy disagreement—Americans boycotting French wine and cheese and Europeans doing the same with certain visible United States exports.

<sup>43</sup> In this regard, another related factor that has had a large impact on economic integration is the worldwide adoption of English as a second language and the principal language of international commerce. This, of course, makes the U.S. especially open to the rest of the world.

<sup>44</sup> It is, however, useful to remember the point by Rodrik (1997)—that globalization is limited by the cultural and legal frameworks of different countries. Full information would probably increase demand elasticities but leave them short of infinity.

<sup>45</sup> Given a unit elasticity of substitution between the labor aggregate and capital, the average real wage is given by  $W = \alpha Y/N$  and the annual rate of growth of the real wage is  $g_w = g_Y - g_N$ .

<sup>46</sup> See, for example, Grossman and Helpman (1991). A very accessible survey of the various approaches to the relation between  $g_Y$  and  $\Theta$  is Baldwin (2003).

<sup>47</sup> An example of this is the use by United States manufacturers of the Japanese “just-in-time” inventory management system. Thoenig and Verdier (2003) propose the hypothesis that the source of much observed skill-biased technological change is an endogenous reaction to foreign competition.

<sup>48</sup> The conventional wisdom among economic historians is that  $\partial g_Y / \partial \Theta$  has been positive in the 20<sup>th</sup> century but was negative in the 19<sup>th</sup> century (Henry Clay’s “American Plan” for the U.S. being a case in point). Clemens and Williamson (2001) refer to this as the “tariff-growth paradox” (but resolve it by an argument that the “true” empirical growth-tariff relationship involves some complicated interaction terms).

<sup>49</sup> These problems include simultaneous equations bias (countries that are growing tend to open up, those that are not growing tend to introduce trade restrictions), omitted variables (not controlling adequately for  $X$  in equation (1)), and errors in variables (an imprecise specification of  $\Theta$ ).

<sup>50</sup> Feenstra (1998) cites several other terms for outsourcing used by prominent international economists. These include “kaleidoscope comparative advantage,” “slicing the value chain,” “delocalization,” and “intra-mediate trade.” One could also mention the “disintegration of production,” which he uses in the paper, and “global production sharing,” which he uses in another paper. Jones (2000) titles his report 7 on this topic “Fragmentation of the Production Process.”

<sup>51</sup> See Bhagwati (2004) for a very accessible exposition of the proposition that outsourcing and trade have similar effects. Bernanke (2004) makes similar points but more in a short-run than a longer-run context.

<sup>52</sup> Looking at much the same data, for example, Feenstra and Hanson (2001) come to a much different conclusion about the potential effects of outsourcing than do Berman, Bound, and Grilliches (1994).

<sup>53</sup> One problem here is similar to that identified with testing trade theories featured in many of the recent papers cited in section 4.2.5, the high level of heterogeneity of products produced in even the most detailed industry breakdowns. There is now a preference for the use of plant level data. The same sorts of concerns with making

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wrong inferences would apply to work involving outsourcing. Doing it right, however, would be both very difficult and very expensive.

<sup>54</sup> Item 4 of appendix B derives the effects on relative wages of an increase in the efficiency of outsourcing of low-skilled functions on relative wages and compares them to the effects of skill-biased technical change.

<sup>55</sup> However, according to Scheve and Slaughter (2001), the perception of the public is that trade and direct foreign investment leading to outsourcing are focused on products and production processes on the low-skilled side of the spectrum, for the potential skill level of respondents is positively associated with favorable attitudes toward trade. It will be interesting to see if this holds up in the future.

<sup>56</sup> An interesting paper by Swenson (2000) found that there was a statistically significant (but “economically small”) effect in the expected direction of changes in exchange rates on the extent of outsourcing. Illustrating how poor are current data on outsourcing, this paper used data from firms in foreign trade zones in the U.S. Firms in these areas are legally required to keep and report data that are simply not available in the general economy.

<sup>57</sup> The theme in this paragraph is consistent with Borjas and Ramey (1995), who applied it to trade in goods in general rather than to outsourcing in particular.

<sup>58</sup> One could easily allow for different wage rates in the two sectors, either because of the effect of unions or nonpecuniary differences in the jobs in the two sectors. This modification, however, does not alter the basic point of the model and will be ignored.

<sup>59</sup> In general, as we saw in section 4.2.2 and item 3 of appendix A, a shock such as a fall in the relative world price of low-skilled intensive tradable goods may have (at least eventually) small, positive effects on the demand for low-skilled intensive nontradable goods. We ignore this in the present discussion because of its complexity, and it does not affect the qualitative point being made.

<sup>60</sup> One could also assume that it takes time for both wage rates to adjust to the new equilibrium through some sort of sectoral Phillips adjustment mechanism. This is fairly easily done, but it would simply complicate the analysis and shift attention away from the main point without adding anything important.

<sup>61</sup> TAA is usually identified in the economics literature as a “bribe” to groups of workers who are likely to lose as a result of trade liberalization (Fung and Staiger 1996). It is an attempt to follow Corden’s “conservative social welfare function”—trade policy should not make anyone worse off; i.e., it should be “Pareto Optimal”—discussed in section 4.2.3.

<sup>62</sup> These losses of low-skilled workers are, of course, contingent on the true quantitative effect of trade developments over the past quarter on the structure of wages. Feenstra and Hanson (2001), for example, believe that, because of outsourcing, the quantitative effect is much higher than the conventional wisdom.

<sup>63</sup> Two excellent surveys of the (rather large) job displacement literature are Fallick (1996) and Kletzer (1998).

<sup>64</sup> A much-cited large estimate of the effect of displacement for a sample in Pennsylvania on earnings 4-6 years later is 25 percent. See Jacobsen, Lalonde, and Sullivan (1993).

<sup>65</sup> This is a fairly accurate description of table VI.2 of the last program evaluation of TAA, Corson et al. (1993). To be fair to the authors of that study, they did not seem to be very surprised at the results with respect to TAA training programs.

<sup>66</sup> The largest industries in this set are electrical machinery, radio-TV, apparel, motor vehicles, computing equipment, blast furnaces, footwear, textiles, and rubber products.

<sup>67</sup> Kletzer’s conclusions are endorsed very strongly by Bernanke (2004), and he extends this to the more recent phenomenon of large-scale outsourcing.

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## Appendix A: A Simple Ricardian Model with Two Skills and Four Goods

Many of the propositions in trade theory discussed in section 2.0 are very neatly derived from a very simple (and quite extreme) version of the open economy model. The two relatively high-skilled intensive industries, industry 1, which produces goods that are potentially tradable, and industry 3, which produces goods that are non-tradable, are assumed to hire only high-skilled labor. Similarly, the two low-skilled intensive industries, 2 and 4, are assumed to hire only low-skilled labor. This means, in terms of the two-labor-type model set out in section 2.0, that  $\alpha_1 = \alpha_2 = 1$  and  $\alpha_3 = \alpha_4 = 0$ .

### 1. The Basic Model

The production functions for the four industries are given:

$$\begin{aligned}(A-1) \quad Q_1 &= A_1 H_1, \text{ high skilled potentially tradable good} \\ Q_2 &= A_2 U_2, \text{ low skilled potentially tradable good} \\ Q_3 &= A_3 H_3, \text{ high skilled non-traded good} \\ Q_4 &= A_4 U_4, \text{ low skilled non-traded good}\end{aligned}$$

where  $Q_i$  ( $i = 1, 2, 3, 4$ ) is the rate of production of each of the four goods,  $A_i$  is the industry productivity parameter, and the  $H_i$ 's and  $U_i$ 's are the inputs of the relevant types of labor into the four industries. The economy is at full employment, so the fixed supply of each type of labor is allocated among the four industries:

$$\begin{aligned}(A-2) \quad H &= H_1 + H_3 \\ U &= U_2 + U_4\end{aligned}$$

The nominal wage rates (in terms, arbitrarily, of the price of good 1) of each type of labor,  $M_H$  and  $M_L$ , are assumed to be equal in each of the two sets of industries and are equal to the relevant marginal revenue product of labor. This implies that:

$$\begin{aligned}(A-3) \quad M_H &= A_1 = P_3 A_3 \\ M_L &= P_2 A_2 = P_4 A_4\end{aligned}$$

where the  $P_i$ 's are the price levels in industries 2, 3, and 4 relative to the price in industry 1.

Aggregate nominal expenditure (again, in terms of the price of good 1) on the four goods in the economy is equal to nominal income,  $I$ , minus net exports, or:

$$(A-4) \quad C_1 + P_2 C_2 + P_3 C_3 + P_4 C_4 = I - NX$$

where:

$$(A-5) \quad I = Q_1 + P_2 Q_2 + P_3 Q_3 + P_4 Q_4$$

Since goods 3 and 4 are non-traded,  $C_3 = Q_3$  and  $C_4 = Q_4$ . It then follows that nominal net exports in the economy are equal to:

$$(A-6) \quad NX = (Q_1 - C_1) + P_2(Q_2 - C_2)$$

For the average country in the world  $NX$  is equal to zero, so if good 2 is imported,  $C_2 > Q_2$ , good 1 must be exported,  $Q_1 > C_1$ . For countries with high net exports (like Japan), both goods could be exported; for countries with large trade deficits (like the United States since the mid-1980s), both goods could be imported.

The utility function for the economy is assumed to take the simplest possible form:

$$(A-7) \quad U = C_1^{\beta_1} C_2^{\beta_2} C_3^{\beta_3} C_4^{\beta_4}$$

where the sum of the exponents is one. One could use a more general utility function; for example, one that assumed that the elasticity of substitution between different goods was different from one, but the major result of this would be to increase the algebraic complexity of the presentation.

Maximization of utility subject to (A-4) implies that the nominal expenditure on each good is:

$$(A-8) \quad P_i C_i = \beta_i (I - NX)$$

The aggregate price level for the economy is given by:

$$(A-9) \quad P_A = P_1^{\beta_1} P_2^{\beta_2} P_3^{\beta_3} P_4^{\beta_4}$$

$P_1$  has been set equal to one, and, by (A-3),  $P_3 = (A_1/A_3)$  and  $P_4 = (A_2/A_3)P_2$ . Thus:

$$(A-10) \quad P_A = P_2^{\beta_2 + \beta_4} A_1^{\beta_3} A_2^{\beta_4} A_3^{-\beta_3} A_4^{-\beta_4}$$

## 2. The Closed Economy

In this case, there are no imports or exports of goods 1 and 2, which means that the output of each industry is consumed domestically,  $NX = 0$  and  $Q_i = C_i$  for all four industries. The equilibrium of the labor market for the closed economy case, which was discussed in section 2.1 of the text, is easily derived in the Ricardian model. By summing up the demand across industries for each type of labor, the relative demand for skilled labor is easily shown to be

$$(A-11) \quad \left(\frac{H}{L}\right)^d = \left(\frac{\beta_1 + \beta_3}{\beta_2 + \beta_4}\right) \left(\frac{W_H}{W_L}\right)^{-1}$$

This is consistent with figure 1 in the text, in which the relative demand for skilled labor depends on the relative wage,  $rel = W_H/W_L$ , and the distribution of product demand across the four goods. If the elasticity of substitution between consumption goods mentioned after formula A – 7 has been assumed to be greater (less) than one, an increase in the value of  $A_1$  or  $A_3$  would shift the relative demand function to the right (left). With the Cobb-Douglas assumption (a unitary elasticity), changes in the values of the  $A_i$ 's have no effect on relative demand.

The solution real wage rates for each type of labor in the closed economy model are given by:

$$(A-12) \quad W_H = \frac{M_H}{P_A} = A_1^{\beta_1} A_2^{\beta_2} A_3^{\beta_3} A_4^{\beta_4} \left(\frac{\beta_2 + \beta_4}{\beta_1 + \beta_3} \frac{H}{L}\right)^{-(\beta_2 + \beta_4)}$$

$$W_L = \frac{M_L}{P_A} = A_1^{\beta_1} A_2^{\beta_2} A_3^{\beta_3} A_4^{\beta_4} \left(\frac{\beta_2 + \beta_4}{\beta_1 + \beta_3} \frac{H}{L}\right)^{(\beta_1 + \beta_3)}$$

Each wage rate is affected in proportionally the same way by each of the four industry productivity parameters.

### 3. The Open Economy

Under the assumptions about the economy underlying section 2.2, the solution of the model of labor market equilibrium is much different than in the closed economy. Now the prices of the traded goods are determined internationally. The price of good 1 is assumed to equal one, so the key exogenously determined price that is relevant for the solution of the model is the price of good 2 relative to that of good 1,  $P_2$ .

From (A-3) it then follows that the high-skilled nominal wage rate is  $M_H = A_1$  and the low-skilled nominal wage is  $M_L = P_2 A_2$ . This means that the high-/low-skilled relative wage is given by:

$$(A-13) \quad rel = \frac{M_H}{M_L} = \frac{M_H}{M_L} = \frac{A_1}{P_2 A_2}$$

This is the relative demand for skilled labor function depicted in figure 2 in the text. Since  $rel$  must take a certain value given the values of  $P_2$ ,  $A_1$ , and  $A_2$ , the relative demand for skilled labor,  $(H/S)^d$ , is infinitely elastic with respect to its relative price.

The solution real wage rates of the two types of labor are given by:

$$(A-14) \quad W_H = \frac{M_H}{P_A} = P_2^{-(\beta_2+\beta_4)} A_1^{1-\beta_3} A_2^{-\beta_4} A_3^{\beta_3} A_4^{\beta_4}$$

$$W_L = \frac{M_H}{P_A} = P_2^{1-(\beta_2+\beta_4)} A_1^{-\beta_3} A_2^{1-\beta_4} A_3^{\beta_3} A_4^{\beta_4}$$

Since the average real wage in the economy is  $W_A = [W_H H + W_L L]/(H+L)$ , the proportional change in the average real wage rate,  $\hat{W}_A = d(\log W_A)$ , etc., is:

$$(A-15) \quad \hat{W}_A = \hat{W}_H s_H + \hat{W}_L s_L$$

$$= [s_L - \beta_2 - \beta_4] \hat{P}_2 + [s_H - \beta_3] \hat{A}_1 + [s_L - \beta_4] \hat{A}_2 + \beta_3 \hat{A}_3 + \beta_4 \hat{A}_4$$

where  $s_L = W_L L/Y$  is the share of GDP going to low-skilled labor and  $s_H = 1 - s_L$  is the share for high-skilled labor. Assuming that the ratio of net exports to GDP is approximately equal to zero, the coefficient on  $\hat{A}_1$  in (A-14) is equal to the share of GDP arising from the production of good 1, and the coefficient on  $\hat{A}_2$  the same for good 2. Thus, the effects of changes in the efficiency parameters on the average real wage is the same in the open and the closed model, but the effects of changes in  $A_1$  and  $A_2$  on the distribution of wages is very different in the two specifications.

The coefficient on  $\hat{P}_2$ ,  $s_L - \beta_2 - \beta_4$ , is positive if the country is a net exporter of good 2 and negative if it is a net importer. Thus, an exogenous decrease in the international price of good 2 relative to the price of good 1 causes the high-skilled real wage to rise and the low-skilled real wage to decline, and the average real wage in the economy increases if, initially, the country was a net importer of that good.

A key assumption of the open model is that firms in the economy find it profitable to operate in both industries 1 and 2. If this is not so, the resultant model has very different implications, which will be pointed out in item 5 of this appendix. It is, however, possible that all low-skilled workers will be employed in the nontraded sector, industry 4, and that the entire amount of good 2 that is consumed is imported. Alternatively, it is possible that industry 1 could disappear so that all high-skilled workers are employed in the nontraded sector—although this is a less likely possibility for the United States. International trade theorists refer to an equilibrium in which both tradable goods are produced as occurring within the cone of diversification. The condition for this to be true (i.e., for both  $H_1$  and  $L_2$  to be positive) is:

$$(A-16) \quad \frac{1-\beta_4}{\beta_4} + \frac{NX}{P_2 A_2 L} > \frac{A_1 H}{P_2 A_2 L} > \frac{\beta_3}{1-\beta_3} \left[ 1 - \frac{NX}{P_2 A_2 L} \right]$$

The left hand inequality is necessary for industry 2 to be profitable, and the right hand inequality is necessary for industry 1 to be profitable.

In the context of the United States, the question of whether the low-skilled intensive industry continues to exist is obviously the more interesting of the two. This is the more likely the lower is  $\beta_4$  (i.e., the less demand there is for low-skilled workers in the non-traded sector), the higher is NX (i.e., the lower are foreign trade deficits, the higher is the international price of the tradable low-skilled intensive good relative to the tradable high-skilled intensive good ( $P_2$ )), the more productive is industry 2 relative to industry 1 ( $A_2/A_1$ ), and the larger the supply of less skilled relative to high-skilled workers ( $L/H$ ).

#### 4. Factor Content Analysis

An interesting implication of the open economy model is that, under certain very strong assumptions about technology and product demand parameters, one can derive the effects of changes in the relative international prices of traded goods by looking at the amounts of different types of labor necessary to produce the resultant changes in net exports. Note that the technology and product demand parameters are, due to Deardorff and Staiger (1988), that the underlying production and utility functions both have unit elasticities of substitution; i.e., they are of the Cobb-Douglas form. Deardorff (2000) generalized this approach to the case in which both the production technology and utility functions are characterized by the constant elasticity of substitution function with the same substitution parameter in each case. The Ricardian system with a Cobb-Douglas utility function used in this appendix satisfy the Deardorff-Staiger requirement.

Factor content analysis (FCA) has been widely used to estimate the contribution of globalization to changes in relative factor prices. What is done in FCA in the context of our simple Ricardian system is to set up a synthetic demand system in the context of a closed economy model:

$$(A-17) \quad rel = \left( \frac{\beta_1 + \beta_3}{\beta_2 + \beta_4} \right) \left( \frac{H^*}{L^*} \right)^{-1} = \left( \frac{\beta_1 + \beta_3}{\beta_2 + \beta_4} \right) \left( \frac{H - \frac{1}{A_1}[Q_1 - C_1]}{L - \frac{1}{A_2}[Q_2 - C_2]} \right)^{-1}$$

$H^*$  is equal to the supply of high-skilled labor plus  $(1/A_1)[Q_1 - C_1]$ , which is the amount of skilled labor needed to produce the exports of good 1 if it is exported or the negative of the amount of skilled labor that would have produced imports of good 1 if it had not been imported.  $L^*$  is interpreted analogously.

A little algebra quickly confirms that  $rel = (A_1/A_2P_2)$ . Thus, if the relative price of low-skilled intensive goods falls, we will see imports of good 2 rise and exports of good 1 rise such that the proportional decrease in  $H^*/L^*$  is equal to the proportional decrease in  $P_2$ .

#### 5. The Welfare Economics of Trade Policy

The preceding model of the equilibrium of the labor market was based on the implicit assumption that there are no tariffs on the importation of goods 1 or 2 into the economy. The



reasons that the relative price of good 2 relative to good 1,  $P_2$ , may fall exogenously include a fall in the world price of good 2 because of large productivity advances abroad and a decrease in the cost of transporting good 2 into the U.S. The effect of a decrease in the tariff rate on the domestic level and distribution of net real income is through a reduction in  $P_2$ , but it has to be modeled slightly differently.

It is now assumed that the relative price of good 2 is equal to the exogenous world relative price,  $P_{2w}$ , plus one plus the tariff rate,  $t$ . Thus, the domestic relative price of good 2 is  $P_2 = (1+t)P_{2w}$ , and the nominal (i.e., in terms of the price of good 1) revenue from the tariff on good 2 is  $tP_{2w}(C_2 - Q_2)$ , the tariff rate times the nominal value of imports. It then follows that aggregate nominal income in the economy is:

$$(A-18) \quad I = Q_1 + P_2Q_2 + P_3Q_3 + P_4Q_4 + tP_{2w}(C_2 - Q_2)$$

$$= A_1H + P_{2w}A_2L + t[P_{2w}C_2 + P_{4w}C_4]$$

where  $P_{4w} = (A_2/A_4)P_{2w}$  is what the price of the low-skilled intensive nontraded good would be if there were no tariff on good 2. Since (for  $NX = 0$ ) each consumption level is  $C_i = \beta_i I/P_i$ , the nominal value of aggregate income in the economy is equal to  $I = (1+t)I_w/(1+(\beta_1+\beta_3)t)$ , where  $I_w = A_1H + P_{2w}A_2L$  is nominal national income in world prices. Division of this value by the price level, (A-10), yields aggregate real national income:

$$(A-19) \quad Y = \frac{(1+t)^{\beta_1+\beta_3}}{(1+(\beta_1+\beta_3)t)} I_w P_{2w}^{-(\beta_2+\beta_4)} A_1^{-\beta_3} A_2^{-\beta_4} A_3^{\beta_3} A_4^{\beta_4}$$

The familiar proposition that “free trade yields maximum aggregate welfare” is easily verified from (A-19) by showing that  $Y$  is highest, *ceteris paribus*, when  $t = 0$ .

Given that  $W_H/W_L = A_1/P_{2w}(1+t)A_2$  and  $W_HH + W_LL = I/P_A$ , we can also solve the net real wages of the two types of labor:

$$(A-20) \quad W_H = \frac{(1+t)^{\beta_1+\beta_3}}{(I_w + tP_{2w}A_2L)(1+(\beta_1+\beta_3)t)} I_w P_{2w}^{-(\beta_1+\beta_3)} A_1^{1-\beta_3} A_2^{-\beta_4} A_3^{\beta_3} A_4^{\beta_4}$$

$$W_L = \frac{(1+t)^{1+\beta_1+\beta_3}}{(I_w + tP_{2w}A_2L)(1+(\beta_1+\beta_3)t)} I_w P_{2w}^{1-(\beta_1+\beta_3)} A_1^{-\beta_3} A_2^{1-\beta_4} A_3^{\beta_3} A_4^{\beta_4}$$

It is straightforward to show that an increase in the tariff rate always lowers  $W_H$  and, so long as  $t$  is not too large, raises  $W_L$ . Of course, since  $Y$  falls as  $t$  is raised, the increase in low-skilled labor’s net income in response to an increase in the tariff rate is smaller than the decrease in the net income of high-skilled labor.

## 6. Equilibrium Outside the Cone of Diversification

An important assumption of the open economy model is that production is profitable in both of the traded goods industries, 1 and 2. This requires that both of the inequalities given by (A-16) be satisfied. Of particular relevance to the U.S., the unskilled intensive tradable good, industry 2, will, in the absence of tariffs, not be produced if it cannot be produced profitably domestically. Industry 2 is the more likely to disappear the lower are the values of  $P_2$ ,  $A_2$ ,  $L$ , and  $NX$ .

If domestic production of industry 2 is zero and all consumption of that good is in the form of imports, the resultant model of the labor market is more like the closed model in item 2 of this appendix rather than the open economy model of item 3. This is so even though the economy is in fact fully open to trade rather than closed.

To see this, note that, with industry 2 absent, all low-skilled labor is employed in the nontraded goods sector, industry 4, and all consumption of good 2 is imported. The nominal wage rate for high-skilled labor is still determined in the tradable goods sector, industry 1, for  $M_H = A_1 = P_3 A_3$ . The price of low-skill intensive nontraded good is determined domestically, for  $I = A_1 H / (1 - \beta_4)$  and  $P_4 = \beta_4 I / Q_4 = (\beta_4 / (1 - \beta_4)) A_1 H / A_4 L$ . This means that  $M_L = P_4 A_4 = (\beta_4 / (1 - \beta_4)) A_1 H / L$  so that the relative demand for labor function is given by:

$$(A-21) \quad \left( \frac{H}{L} \right)^d = \left( \frac{1 - \beta_4}{\beta_4} \right) \left( \frac{W_H}{W_L} \right)^{-1}$$

and the real wage rates for the two types of labor are given by:

$$(A-22) \quad W_H = \frac{M_H}{P_A} = A_1^{\beta_1 + \beta_2} A_3^{\beta_3} A_4^{\beta_4} P_2^{-\beta_2} \left( \frac{\beta_4}{1 - \beta_4} \frac{H}{L} \right)^{-\beta_4}$$

$$W_L = \frac{M_L}{P_A} = A_1^{\beta_1 + \beta_2} A_3^{\beta_3} A_4^{\beta_4} P_2^{-\beta_2} \left( \frac{\beta_4}{1 - \beta_4} \frac{H}{L} \right)^{1 - \beta_4}$$

Even though this economy is very much open to international trade, (A-21) and (A-22) are very similar to (A-11) and (A-21) for the closed model. The only difference is that  $A_2$  does not determine real wage levels because that industry no longer exists in the country. The relative demand for labor function has the same sort of finite elasticity that one obtains in the closed economy and, this, is represented by figure 1 rather than figure 2.

## 7. Product Differentiation

An important assumption of the open economy model is that consumption of foreign and domestic versions of the two tradable goods,  $C_{if}$  and  $C_{id}$  for  $i = 1, 2$ , are perfect substitutes for each other. Thus, we don't distinguish between the consumption of foreign and domestic versions of the same thing; instead,  $C_i = C_{if} + C_{id}$ .

An alternative to this is to recognize that there may be a difference between the domestic and foreign versions of each of the potentially tradable goods so that there is simultaneous consumption within the U.S. of both versions of both tradable goods. Now instead of (A-7) the utility function for the economy becomes:

$$(A-23) \quad U = \left[ \lambda_1 C_{1d}^{\frac{\omega_1-1}{\omega_1}} + (1-\lambda_1) C_{1f}^{\frac{\omega_1-1}{\omega_1}} \right]^{\frac{\omega_1}{\omega_1-1} \beta_1} \left[ \lambda_2 C_{2d}^{\frac{\omega_2-1}{\omega_2}} + (1-\lambda_2) C_{2f}^{\frac{\omega_2-1}{\omega_2}} \right]^{\frac{\omega_2}{\omega_2-1} \beta_2} C_3^{\beta_3} C_4^{\beta_4}$$

where  $\omega_i$  is the elasticity of substitution between the domestic and foreign versions of good  $i$  (which is usually referred to as the Armington elasticity) and  $\lambda_i$  is a shift parameter indicating the relative tastes for the domestic version of good  $i$ . If both  $\omega_i$ 's are infinite, (A-23) reverts to (A-9). If both  $\omega_i$ 's were equal to one, the utility function would be Cobb-Douglas in the six different goods (two versions each of goods 1 and 2) and the resultant product demand functions would each have absolute price elasticities of unity.

It is reasonable to suppose that for most potentially importable consumption goods there is some degree of home bias; i.e., the value of  $\omega$  is less than infinity (although greater than one). When one incorporates the  $1 < \omega < \infty$  assumption into the complete model of labor market equilibrium (Johnson and Stafford 1999), the resultant relative labor demand elasticity is between one (its value in the closed economy model with Cobb-Douglas preferences) and infinity (its value in the open economy model).

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## Appendix B: The Effects of the Outsourcing of Jobs on Employment, Average Real Wages, and the Distribution of Earnings in the Short, Medium, and Long Runs

This appendix sketches a relatively simple model in which there is the potential for firms in the economy to purchase some of their labor functions from outside the country. They can “outsource” or “offshore” some of their high- and/or low-skilled jobs.

What are the implications of increased outsourcing? The effects depend very much on which variables are assumed to be variable and which are fixed. Three cases will be distinguished: (1) the short run, in which real and/or relative wage rates may be fixed so that outsourcing may affect domestic employment levels, (2) the medium run, in which relative wages adjust so that the economy returns to full employment, and (3) the long run, in which the capital stock adjusts in response to changes in profitability.

### 1. The Model

This approach to the analysis of the effects of “offshoring” uses a one sector framework in order to focus on the major issues. Feenstra and Hanson (1999, 2001) set out an N sector model that is, as one would suspect, easily integrated into the standard trade model. This author makes similar assumptions—inspired by their model—about the nature of outsourcing, but the focus is more macroeconomic in nature. Aggregate real output in world prices ( $Y$ ) depends on the effective inputs of labor services ( $G$ ) and the capital stock ( $K$ ). The aggregate production function is assumed to take the form:

$$(B-1) \quad Y = AG^\alpha K^{1-\alpha}$$

Firms in the aggregate are assumed to hire  $N$  workers in the domestic market, but they may outsource some the work to foreign countries, hiring  $N_o$  foreign workers. The relevant production functions for the flow of labor services are assumed to be Constant Elasticity of Substitution (CES) and are given by:

$$(B-2) \quad G = \left[ \nu N^{\frac{\tau-1}{\tau}} + (1-\nu)(bN_o)^{\frac{\tau-1}{\tau}} \right]^{\frac{\tau}{\tau-1}}$$

where  $b$  is an efficiency parameter indicating how effectively jobs can be performed outside of the country. The elasticity of substitution between domestic and outsourced workers is assumed to be equal to  $\tau$ , which is assumed to be finite but greater than one. Diminishing returns to both types of outsourced labor is implicitly assumed in this formulation (the result of the assumption that  $\tau < \infty$ ). For example, a United States company may (as a result of the development of the Internet, represented by an increase in  $b$ ) find it profitable to shift programming jobs to India, but it still needs some computer aces around the home office to keep the local system running.

Similarly, because of low transport costs and political stability (an increase in the value of  $b$ ), assembly functions may be moved to Mexico or China, but truck drivers and sweepers must operate in the United States. The proportional change in the flow of labor flow services is then:

$$(B-3) \quad \hat{G} = \gamma \hat{N} + (1-\gamma)(\hat{N}_o + \hat{b})$$

$\gamma$  is the share of the total wage bill of each type of labor that goes to domestic workers. If  $b$  is so small that there is no outsourcing of labor,  $G$  would equal  $N$ .

Given competitive product markets and at least some outsourcing of the marginal conditions for the two varieties of labor input (domestic and outsourced labor) are:

$$(B-4) \quad W = \frac{\partial Y}{\partial N} = \alpha \nu \frac{Y}{G} \left( \frac{G}{N} \right)^{\frac{1}{\tau}}$$

$$W_o = \frac{\partial Y}{\partial N_o} = \alpha (1-\nu) b^{\frac{1-\nu}{\tau}} \frac{Y}{G} \left( \frac{G}{N_o} \right)^{\frac{1}{\tau}}$$

where the  $W$ 's are the relevant real wage rates domestic and outsourced labor. If, instead of just the first, both levels of the production function were Cobb-Douglas (so that  $\tau = 1$ ),  $\nu$  would equal  $\gamma$ , and it is easily seen in this case that domestic labor's share of aggregate GDP would be  $\alpha\gamma$ , which would be independent of any parameters of the model.

## 2. Effects of Increased Outsourcing of Labor in the Short and Medium Runs

The two equations in (B-4) determine the values of  $N$  and  $N_o$  as functions of  $W$ ,  $W_o$ , and  $b$  (in addition to the values of  $A$  and  $K$ ). Taking proportional changes and solving, the solution changes in the employment levels are seen to be:

$$(B-5) \quad \hat{N} = -\frac{\tau}{1-\alpha} \left[ \left( 1-\alpha - \frac{1}{\tau} \right) (1-\gamma) + \frac{1}{\tau} \right] \hat{W} + \frac{\left( 1-\alpha - \frac{1}{\tau} \right) \tau (1-\gamma)}{1-\alpha} (\hat{W}_o - \hat{b})$$

$$\hat{N}_o = -\frac{\tau\gamma}{1-\alpha} \left( 1-\alpha - \frac{1}{\tau} \right) \hat{W} - \frac{\tau}{1-\alpha} \left[ (1-\alpha)\gamma + \frac{1-\gamma}{\tau} \right] \hat{W}_o + \frac{\tau}{1-\alpha} \left[ \frac{\alpha-\gamma}{\tau} + \gamma(1-\alpha) \right] \hat{b}$$

The own real wage elasticities of the demand domestic and outsourced labor,  $\partial(\log N)/\partial(\log W)$  and  $\partial(\log N_o)/\partial(\log W_o)$ , are both negative. The effect of an increase in  $W_o$  on domestic demand is positive if:

$$(B-6) \quad \tau > \frac{1}{1-\alpha}$$

Given the assumed Cobb-Douglas aggregate production function, this requires that the elasticity of substitution between domestic and outsourced labor must be greater than between 2.5 and 3 in order for  $\partial(\log N)/\partial(\log W_o)$  to be positive. Interestingly, an increase in the efficiency of outsourcing (that has no effect on the real wage in the countries in which the potential outsourcing takes place), represented by an increase in  $b$ , decreases domestic labor demand if (B-6) is satisfied. If it is not satisfied—if domestic labor and outsourced labor are not highly substitutable—labor demand is increased by an increase in the profitability of outsourcing.

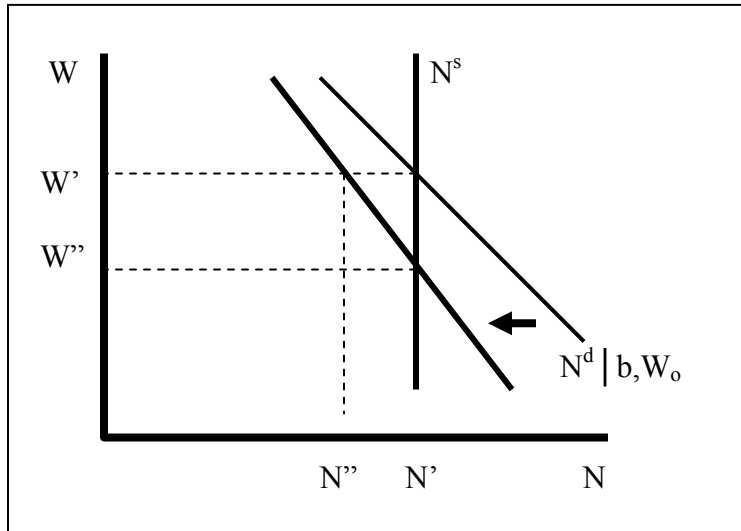
One can easily calculate the net value of “lost jobs” due to outsourcing within this framework. The short-run change in expenditure on outsourced labor due to an exogenous increase in  $b$  is given by  $W_o N_o \partial(\log N_o)/\partial(\log b)$ , and the change in expenditure on domestic labor is  $WN \partial(\log N)/\partial(\log b)$ . Substituting in the appropriate derivatives from (B-5) and dividing the latter by the former, this displacement ratio, evaluated at a low rate of outsourcing (i.e.,  $\gamma \approx 1$ ) is seen to be:

$$(B-7) \quad \text{displace} = \frac{1 - \alpha - \frac{1}{\tau}}{(1 - \alpha) \left(1 - \frac{1}{\tau}\right)}$$

There is a dollar for dollar displacement of  $WN$  by  $W_o N_o$  if domestic and outsourced labor are infinitely substitutable. The value of  $\alpha$  for the U.S. is approximately 2/3. For a value of  $\tau$  equal to 4.0, the value of *displace* is 0.33 (each dollar spent abroad reduces the domestic real wage bill by 33 cents). On the other hand, for  $\tau$  equal to 2.5, the value of *displace* is -0.33. (The improved efficiency raises employment in the U.S.)

The aggregate demand function for domestic labor in the economy is illustrated geometrically in figure B-1. The figure assumes (without evidence one way or the other) that (B-6) is satisfied.

**Figure B-1. Equilibrium of the Domestic Labor Market  
With an Increase in Outsourcing in the Short and Medium Runs**



In the short run, the real wage rate of domestic labor is assumed to be fixed (at  $W'$  in the figure). An increase in the value of  $b$  shifts the demand for labor function to the left. With  $W$  fixed, the employment level falls  $N'$ , the value at which employment is equal to the effective labor force  $N^s$ , to  $N''$ .

In the medium, run the real wage rate changes such that unemployment returns to its “natural” state. The real wage rate falls to  $W''$  (again assuming that (B-6) is satisfied; otherwise  $W$  rises). The effect of an increase on  $b$  on  $W$  is found from (B-5) to equal:

$$(B-8) \quad \frac{\partial(\log W)}{\partial(\log b)} = - \frac{\left(1 - \alpha - \frac{1}{\tau}\right)(1 - \gamma)}{\left(1 - \alpha - \frac{1}{\tau}\right)(1 - \gamma) + \frac{1}{\tau}}$$

This is, of course, negative or positive as (B-6) is or is not satisfied.

### 3. The Long-Run Effects of Outsourcing on Wages

An increase in the efficiency of outsourcing raises the marginal productivity of capital, and it is reasonable to suppose that this increases investment and, thus, the stock of capital in the long run. If we make the extreme assumption that capital stock adjusts in the long run such that the marginal product is unchanged by any external events, the conclusion concerning the effects of outsourcing on wages is quite different.

We will now assume that the capital supply equilibrium condition is:

$$(B-9) \quad r = \frac{\partial Y}{\partial K} = \alpha \frac{Y}{K}$$

where  $r$  is the world rental price of capital. From (B-1) this implies that  $K$  will adjust such that it is proportional to  $G$ , which, in turn, means that the long-run value of  $Y/G$  depends only on  $r$  and  $A$ , but is not influenced by any labor parameters such as  $b$ .

In the long run  $W$  can vary, but domestic employment is equal to effective aggregate domestic supply. An increase in  $b$  thus affects the amount of outsourcing ( $N_o$ ), but not the value of  $N$ . Differentiating the second equation of (B-4) totally with respect to  $N_o$  and  $b$ , under the restriction that in the long run  $Y/G$  is unchanged by  $b$ , the proportionate change in outsourced labor is seen to be:

$$(B-10) \quad \hat{N}_o = \frac{1-\gamma}{\frac{\tau}{\gamma}} \hat{b}$$

The proportional change in the domestic real wage rate is found by letting  $b$  and  $N_o$  change in the first part of (B-4), or:

$$(B-11) \quad \hat{W} = \frac{1-\gamma}{\tau} [\hat{N}_o + \hat{b}] = \frac{1-\gamma}{\gamma} \hat{b}$$

The long-run effect of an increase in the efficiency of outsourcing on the domestic real wage rate is, given the assumption of an infinitely elastic supply of physical capital, unambiguously positive. Further, the long-run value of  $\partial(\log W)/\partial(\log b)$  is always greater than its medium run value, (B-8), so long as  $\alpha < 1$ .

If one assumes that the supply of capital is less than infinitely elastic (because, for example, resources for investment have to be raised domestically), the effect of an increase in  $b$  on the real wage rate is a blend of (B-8), the medium-run case, and (B-11), the long-run case with an infinite supply elasticity for capital. An increase in the efficiency of outsourcing in this case would raise or lower  $W$  in the long run, but  $W$  will be higher (possibly less negative) in the long than in the medium run.

An interesting variant of the model, which will not be discussed at length here, is based on the assumption that the U.S. must engage in foreign direct investment in order to take advantage of outsourcing. In this case, the aggregate production functions (B-1) and (B-2) above are replaced by:

$$(B-1') \quad Y = A \left[ \nu \left( N^\alpha K_d^{1-\alpha} \right)^{\frac{\tau-1}{\tau}} + (1-\nu) \left( b N_o^\alpha K_o^{1-\alpha} \right)^{\frac{\tau-1}{\tau}} \right]^{\frac{\tau}{\tau-1}}$$



where  $K_d$  is capital supplied for domestic production and  $K_o$  is capital supplied for foreign production (the result of past foreign direct investment by U.S. firms).

This modification leads to similar qualitative conclusions to the model based on the assumption that all capital is based in the U.S. about the short- and medium-run effects of  $b$  and employment and the real wage in the U.S. In the long run, however, the fact that  $K_d$  and  $K_o$  compete with each other lessens the potential beneficial effects of increases in the efficiency of outsourcing.

#### 4. Effect of Outsourcing on the Distribution of Earnings

Just one type of labor has been focused on to this point in the appendix. This approach is of some current interest; the recent spate of “offshoring” has been alleged to be somewhat balanced with respect to skills. Much of the literature on outsourcing focuses on an imbalanced incidence, and this requires that more than one type of labor be introduced into the model.

The aggregate production function is now assumed to be a 3-level CES of the following form:

$$(B-12) \quad Q = AG^\alpha K^{1-\alpha}$$

$$G = \left[ \delta (b_S G_H)^{\frac{\sigma-1}{\sigma}} + (1-\delta) G_L^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

$$G_H = \left[ \tau_H H^{\frac{\tau-1}{\tau}} + (1-\tau_H) (b_H H_o)^{\frac{\tau-1}{\tau}} \right]^{\frac{\tau}{\tau-1}}$$

$$G_L = \left[ \tau_L L^{\frac{\tau-1}{\tau}} + (1-\tau_L) (b_L L_o)^{\frac{\tau-1}{\tau}} \right]^{\frac{\tau}{\tau-1}}$$

$G_H$  and  $G_L$  are the flows of high- and low-skilled labor services,  $H$  and  $H_o$  are inputs of domestic and outsourced high-skilled labor services, and  $L$  and  $L_o$  are inputs of domestic and outsourced low-skilled labor services.  $\sigma$  is the elasticity of substitution between high- and low-skilled labor services, and an increase in  $b_S$  represents skill-biased technical change.  $b_H$  and  $b_L$  play the same role as  $b$  in earlier sections of this appendix; they are just specific to each labor type.

The real wage rates of the two types of domestic labor equal their marginal products, that is:

$$(B-13) \quad W_H = \frac{\partial Y}{\partial H} = \alpha \delta \tau_H b_s^{1-\frac{1}{\sigma}} \frac{Y}{G} \left( \frac{G}{G_H} \right)^{\frac{1}{\sigma}} \left( \frac{G_H}{H} \right)^{\frac{1}{\tau}}$$

$$W_L = \frac{\partial Y}{\partial L} = \alpha (1-\delta) \tau_L \frac{Y}{G} \left( \frac{G}{G_L} \right)^{\frac{1}{\sigma}} \left( \frac{G_L}{L} \right)^{\frac{1}{\tau}}$$

The high-/low-skilled relative wage is then:

$$(B-14) \quad rel = \frac{W_H}{W_L} = \frac{\delta}{1-\delta} \frac{\tau_H}{\tau_L} b_s^{1-\frac{1}{\sigma}} \left( \frac{G_H}{G_L} \right)^{\frac{1}{\tau} - \frac{1}{\sigma}} \left( \frac{H}{L} \right)^{-\frac{1}{\tau}}$$

assuming there is no outsourcing of either labor type,  $G_H = H$  and  $G_L = L$  and  $\tau_H = \tau_L = 1$ . The relative labor demand function then reduces to a somewhat simpler and more familiar relation with  $(H/L)^{-1/\sigma}$ , replacing the  $(G_H/G_L)^{1/\tau-1/\sigma} (H/L)^{-1/\tau}$  in (B-14). A more general production, say  $Y = F(G_H, G_L, K, \dots)$ , would allow for the possibility of different degrees of complementarity between capital and the two types of labor (versus the assumption of the 3-level CES that the two elasticities of complementarity are identical).

The elasticity of substitution between domestic and outsourced labor ( $\tau$ ) is presumably greater than the elasticity of substitution between high- and low-skilled labor aggregates. That means that the exponent on  $(G_H/G_L)$  in (B-14) is negative, so an increase in  $G_H/G_L$ ,  $H/L$  held constant, should lower the relative demand for high-skilled labor.

If, as seems to be true at least until fairly recently, outsourcing of jobs was concentrated at the low- rather than the high-skilled end of the distribution (the result of an increase in  $b_L$  rather than  $b_H$ ). This would make  $G_L$  rise relative to  $G_H$  and (with  $\tau > \sigma$ ) cause the relative demand for low-skilled labor to fall, resulting in a fall in the employment of  $L$ 's with relative wages fixed and a reduction in  $rel$  after labor market adjustment. This is, as pointed out by Feenstra and Hanson (2001), exactly what one would observe with skill-biased technical change (an increase in  $b_s$  with the inter-labor substitution elasticity,  $\sigma$ , greater than one).

There has recently been a great deal of publicity given to outsourcing of high-skilled jobs (programming functions to India, etc.), a result of an increase in  $b_H$ . This would shift the relative demand function in the opposite direction as would an increase in  $b_L$ , resulting in a fall in  $H/L$  in the short run and in  $rel$  in the medium and long runs. If changes in opportunities for outsourcing were balanced (i.e., changes in  $b_H$  and  $b_L$  over a time interval had roughly the same proportional effect on  $G_H$  and  $G_L$ ), the resultant effects on wages would be the approximately the same for both groups. The resultant outcomes in this case would be like those for the one labor type model discussed in items 1-3 of this appendix.