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The Impact of International Trade on Wages: Trade Flows and Wage Premiums: Does Who or What Matter?

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Trade Flows and Wage Premiums
Does Who or What Matter?

Mary E. Lovely and J. David Richardson

9.1 Introduction

In this paper we investigate relationships between trade, wages, and the rewards to skill for U.S. workers during the period 1981–92. We isolate correlations between several types and measures of international trade and several types and measures of wage premiums, controlling for other important correlates. We find very different empirical patterns for trade with newly industrialized countries than for trade with traditional industrial partners. We also find very different empirical patterns for premiums paid to low-skilled workers than for those paid to high-skilled workers.

The broadest summary of our results is as follows. Greater U.S. trade with newly industrialized countries is associated with increased rewards to skill and reduced rewards to pure labor, consistent with heightened wage inequality and distributional conflict. The opposite association appears for trade with traditional industrial countries. It is associated with lower rewards to skill, higher rewards to pure labor, and lessened distributional conflict.

Our interpretation of these results rests on two models. The first model distinguishes intraindustry trade between two fully integrated northern countries from the intraindustry trade between them and a southern region whose factor prices vary from those in the north. North-north intra-

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industry trade is entirely in differentiated, skill-intensive producer inputs. North-south intraindustry trade is the vertical exchange of labor-intensive intermediates for skill-intensive producer inputs or finished manufactures. The second model is a partial equilibrium model of industry wage premiums that are rewards for loyalty, firm-specific knowledge, or (dis)amenities. We posit different premiums for skilled and less-skilled workers, as we assume that these labor markets are segmented from each other. We use this conceptualization to predict the movement of wage and skill premiums in response to industry-specific trade surges from industrial and newly industrialized partners.

Our paper relates to several recent contributions to the literature. One group studies how wages may be affected distinctively by trade with poorer countries and by trade in inputs (international outsourcing).[1] Another group conceives and estimates industry wage premiums and the way such premiums correlate with measures of international trade.[2] Because the literature on trade and wages has been surveyed extensively elsewhere, and because our empirical approach focuses on industry wage premiums, we review here only previous research investigating the relationship between trade and these premiums.

Dickens and Katz (1987), Krueger and Summers (1988), and Helwege (1992) find that industry premiums persist over time. Dickens and Lang (1988) and Katz and Summers (1989a) find that despite the stability of the ranking of these premiums across industries, they are correlated with trade flows: Wage premiums are negatively correlated with imports and positively correlated with exports. Using more detailed data on trade protection and allowing for endogenous protection, Gaston and Trefler (1994) confirm the positive wage effect of exports and the negative effect of imports.

Recent contributions to the literature ask whether all trade flows have similar effects. For example, Fung and Huizinga (1997) find evidence from Canada that freer intraindustry, as opposed to interindustry, trade raises workers wages. Anderton and Brenton (1998) take a different approach, distinguishing trade flows by characteristics of the source country. They find that increased imports from low-wage countries explain some of the rise in inequality among low-skill-intensive industries.

We make several contributions to this literature in models, measurement, and methods. Our theoretical models reveal that there are no obvious correlations between wages and global outsourcing and price trends, once one allows for inter- and intraindustry trade between and within a

1. Lawrence (1996), Sachs and Shatz (1998), Feenstra and Hanson (1996a, 1996b, 1997), Campa and Goldberg (1997), and Feenstra (1997).

2. Topel (1994), Borjas and Ramey (1995), Krueger and Summers (1988), Gibbons and Katz (1992), Kahn (1997), and Richardson and Khripounova (1998).

primary-producing "southern" tier of countries that also can assemble final manufactures and a "northern" tier of countries that assemble final manufactures and produce the intermediate components from which they are assembled. By measuring trade with three groups of trading partners—industrial countries, newly industrialized countries, and primary-product producers—we are able to estimate the correlation of trade flows from each partner group with wage premiums. Moreover, using econometric methods that separate pure wage premiums from the return to an individual worker's education, we are able to estimate the relationship between different types of trade flows and the skill differential. Thus, the paper broadens the existing literature by looking simultaneously at the distributional effects of trade with both developing- and developed-country partners.[3] In the sections that follow, we discuss measurement, and then move on to models, specification, results, and conclusions.

9.2 U.S. Trade Patterns by Trading-Partner Aggregates

Much of the concern expressed in the trade and wages debate (e.g., Lawrence 1996; Sachs and Shatz 1998) has focused on increased trade with newly industrialized countries and the ability of imports to displace U.S. production in industries that pay wage premiums, especially to blue-collar employees. These imports may take the form of finished goods that displace domestic production directly. Alternatively, the imports may take the form of outsourcing, defined as the import of components or assembly by firms who previously may have produced these inputs internally. As noted by Feenstra and Hanson (1996b), certain industries have a high propensity to outsource because their production processes can be separated into self-contained stages that vary considerably in the relative intensity with which they use labor of different skill types. These features of production and the search for low-cost workers are widely believed to be the impetus behind the outsourcing of activities, such as product assembly, to newly industrialized countries.

We investigate differences in industrial and newly industrialized countries' trade patterns with the United States by dividing countries into three broad groups on the basis of level of industrialization. These groupings are the industrialized countries (I countries), newly industrialized countries (N countries), and a group of primary producers (P countries). The appendix contains a list of countries in each grouping. The trade data

3. Rodrik (1998) notes that virtually all of the empirical studies in the literature looking at the labor market consequences of trade have focused on trade with developing countries, but argues that trade with developed countries matters for U.S. wages. Our findings support the view that attention to trade with traditional partners is clearly warranted. However, the nature of this trade, and its wage effects, may be quite different from those found for trade with developing countries.

come from the Statistics Canada compilation of United Nations bilateral trade by commodity, classified according to the Standard International Trade Classification (SITC), revision 3. Trade values are expressed in millions of (current) U.S. dollars. We aggregate data on U.S. exports and imports, annually from 1980 through 1994, across products and trading partners in ways described later and in the appendix. Virtually all U.S. merchandise trade is covered, although it is "allocated" among manufacturing subindustries in the United States.

For each group of trading partners, we also divide industries into three categories—producer nondurables, producer durables, and consumer goods—as described in detail in the appendix.[4] The producer-goods breakdown into nondurables and durables conforms very roughly to a distinction between industries producing intermediates and those producing capital goods. Raw materials, agricultural, and mineral products are associated with manufacturing sectors that use them as intermediate inputs; for example, raw crops are associated with manufactured foods. Capital goods, which are all manufactures, are assigned to the manufacturing sector in which they are produced.[5]

Several aspects of the trade data are noteworthy.

- The United States typically trades inputs, not outputs. In 1994, U.S. exports of producer goods swamped U.S. exports of consumer goods; they are typically three to four times as large.[6] More surprisingly, the same is true of U.S. imports, although the corresponding ratio is smaller, roughly two to one.
- By 1994, the cross-sector pattern of input trade with newly industrialized countries was very similar to the patterns with traditional industrial trading partners, and roughly one-half the size in the typical manufacturing sector. In electrical equipment (SIC 36), however, newly industrialized and industrial countries had become equally important.[7]

4. In our empirical research, however, category trade rarely correlated in any significant way with wages or returns to skill, suggesting perhaps that our category disaggregation was simply too crude. These results are not reported here.

5. As if the "own-sector" were the major purchaser of these capital goods. The same is done for intermediate manufactures, such as leather. Thus, imports of passenger railway cars are assigned to transport equipment (SIC 37), even if they are purchased and used by mass-transit service providers, and purchases of leather are assigned to leather products (SIC 31), even if they are purchased and used by apparel makers. That this assignment is closer to the typical case than one might imagine is demonstrated in Feenstra and Hanson (1997, 18).

6. The producer-goods breakdown into intermediates and capital conforms roughly to manufacturing distinctions between nondurables and durables. Fabricated metal products (SIC 24) was the only two-digit SIC sector where SITC trade in producer goods was subdivided into nondurables (SITC 69) and durables (SITC 81). Computers and office machines (SITC 75) were divided in half between capital equipment and consumer goods.

7. The exceptions are food (SIC 20), where U.S. trade in final and intermediate goods is about the same size, and apparel, footwear, and transport equipment (SIC 23, 31, and 37), where U.S. imports of consumer goods bulk somewhat larger than the norm in other sectors.

• Trade growth was strong with all types of countries, but transactions with industrial and newly industrialized countries swamped those with primary producers; they were five to eight times as large (except in imports of oil, apparel, and footwear, where transactions with primary producers either swamped or rivaled those with others in size).

• Two-way trade was, in 1994, a very prominent feature of U.S. trade in producer goods with industrial and newly industrialized countries. That was also true in 1980 for nondurables. But for capital goods in 1980, two-way trade characterized U.S. transactions only with its traditional industrial partners. Large net exports (one-way trade) characterized transactions with the N countries—that were only partway to becoming newly industrialized in that year, of course.

• One-way (interindustry) trade characterizes the relatively small amount of U.S. trade in producer goods with primary producers; oil flows one way and intermediates and capital goods flow the other. They also finance modest net U.S. imports in two final goods, apparel and footwear. With primary producers, two-way U.S. trade characterizes only food, both input trade and output trade.[8]

We use these data, scaled by industry shipments, as one measure of trade, "trade intensity," and examine its correlations with wage and skill premiums. We also use these data to create a variety of Grubel-Lloyd indices (GLIs) of intraindustry trade.[9]

Figure 9.1 presents the GLI breakdown by industry type and by goods type. In panel *A*, one can see that intraindustry trade is a large share of trade with all three groups of countries.[10] Panel *B* shows a breakdown by goods type, with intraindustry trade in producer goods of both types, durables and nondurables, being very high. Two-way trade in consumer goods is much less important than it is for producer goods.

Figure 9.2 shows Grubel-Lloyd indices for 19 industries. The industries show a great deal of variation in the importance of intraindustry trade. Almost all trade is intraindustry in SIC 24 (lumber), but less than one-half of trade is intraindustry in SIC 21 (tobacco), SIC 23 (apparel), SIC 29 (petroleum), and SIC 31 (leather). Although intraindustry trade fell in some industries during the mid-1980s, it rose in others and shows no discernible pattern in many others.

8. In 1980, U.S. capital-goods trade with the N countries had the same size and pattern as U.S. capital goods trade with the P countries. By 1994, the former had left the latter in the dust, especially in electrical and scientific/professional equipment (SIC 36 and 38).

9. We control for other variables, including industry price indexes, which some argue are better measures of global pressure than trade-intensity variables, as the debate over "factor content" calculation illustrates.

10. Grubel-Lloyd indices are defined as $GLI_j = 1 - [\,|X_j - IM_j| / (X_j + IM_j)]$, where X_j is the value of exports from country group *j*, and IM_j is the value of imports from *j*. See Grubel and Lloyd (1971).

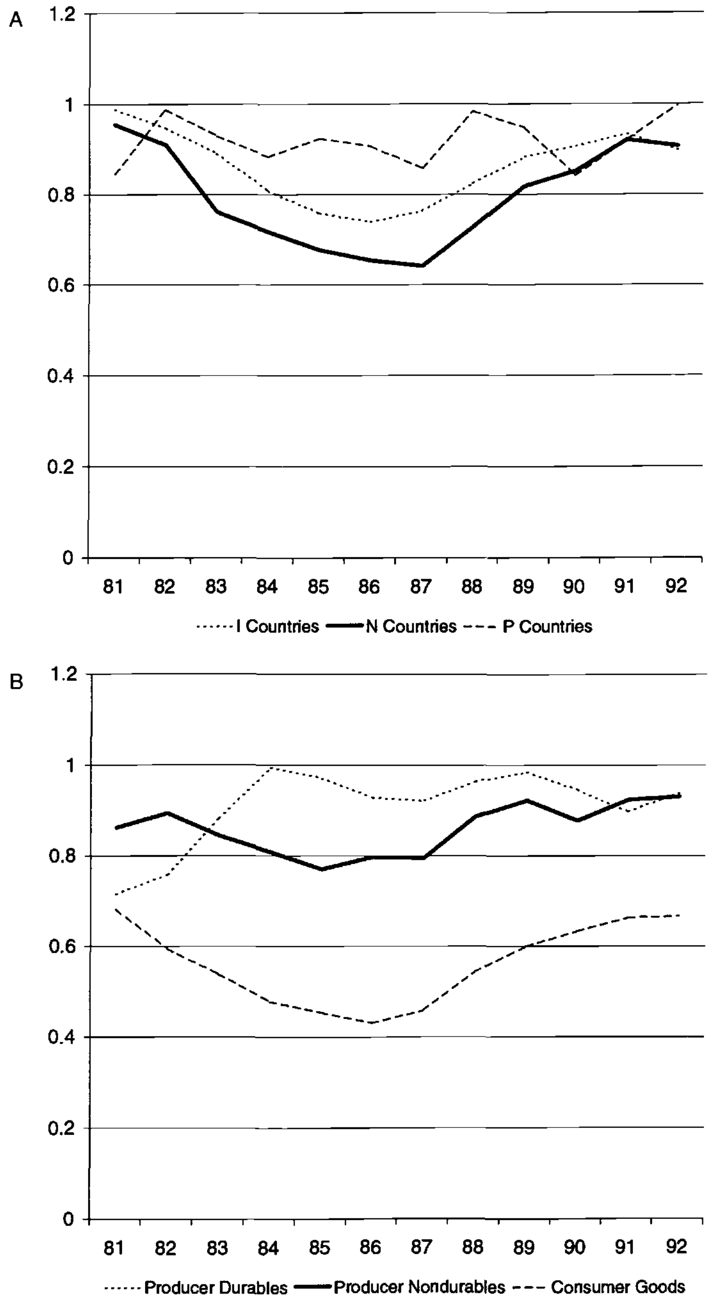

Fig. 9.1 Grubel-Lloyd index, 1981–92: (*A*) by country type; (*B*) by goods type

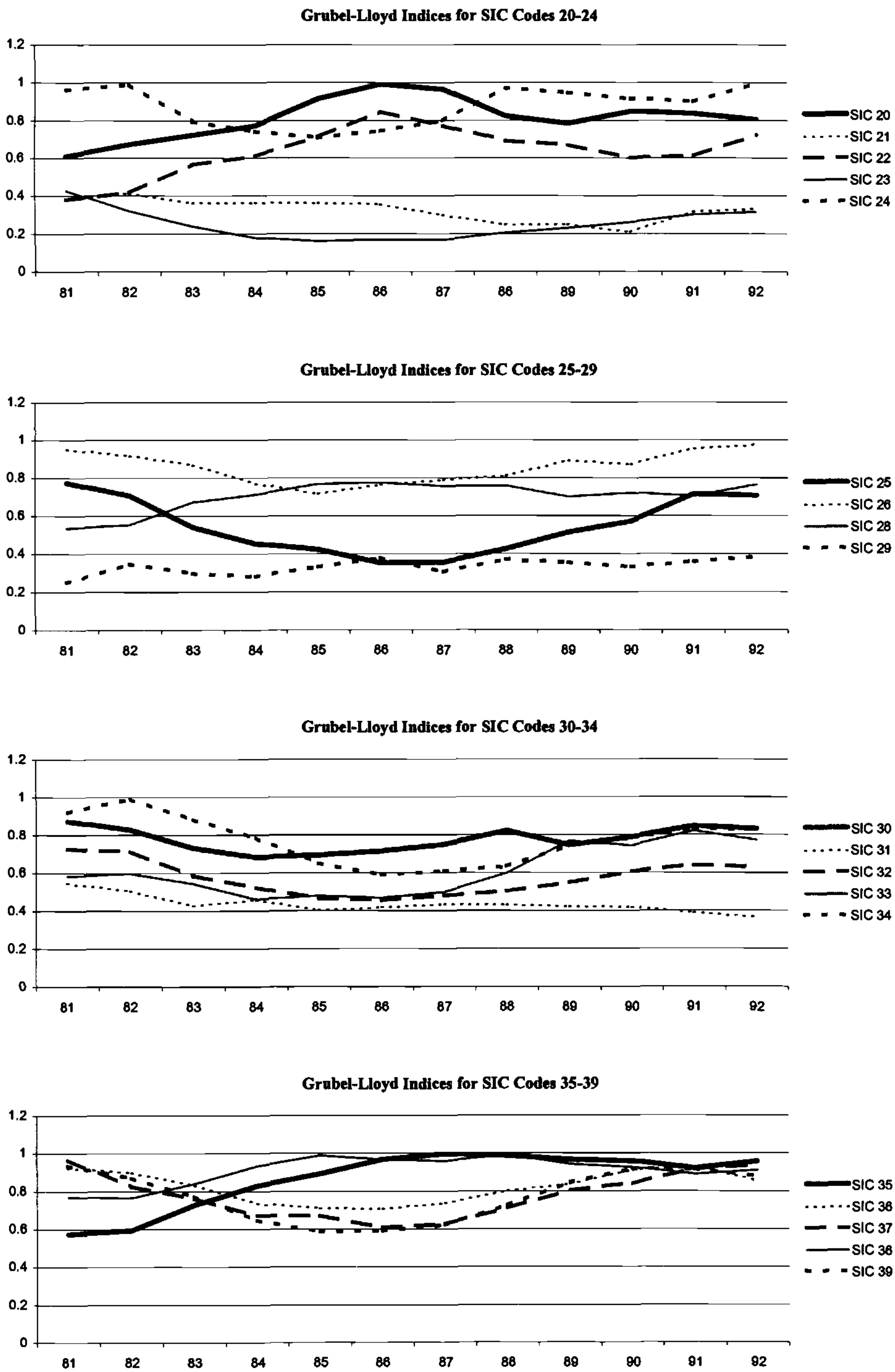

Fig. 9.2 Grubel-Lloyd indices for 19 industries

Although by 1994 trade with industrial and newly industrialized partners seems similar at the two-digit level, other evidence suggests that the skill intensity of the goods traded may differ.[11] Industry classifications span subproducts and processes with widely differing skill intensities. Trade with newly industrialized countries may be more concentrated in the less-skill-intensive subproducts and processes within the broad aggregates than is trade with traditional industrial partners. In the next section, we present a model of trade in which an industry consists of two distinct processes. The home country trades manufactures with both industrial and newly industrialized partners, but the factor contents of these trade flows are quite different. In this context, we see that shocks to the trading system have different wage and distributional implications depending on whether they originate in the economies of industrial or newly industrialized partners.

9.3 Theoretical Considerations

We explore two separate theoretical approaches to understanding the wage implications of trade with industrial and newly industrialized countries. First, we consider a model that maintains many of the standard assumptions of neoclassical trade theory with intermediate goods, including perfect intersectoral factor mobility. This model provides a basis for understanding why the relationship between trade flows, outsourcing, and the skill differential is more complex than simple intuition and popular alarm allow. Similar changes in the volume and country source of trade can arise from alternative causes and may be correlated with either positive or negative movements in the relative return to skill. The model provides some cautionary lessons for our empirical work, which correlates wage changes with volume of trade measures and with intraindustry trade.

Second, we deviate from the standard neoclassical assumptions to permit industry wage premiums. Using a general form of compensating differentials to explain the existence of industry-specific wages, we present a framework for thinking about the effect of trade shocks on industry-specific returns to skilled and unskilled labor.[12] We use this framework to develop methods for estimating the relationship between wage premiums and trade flows.

11. Grossman (1982) and Bailey and Sandy (1998).

12. Anderson (1998, 6) concludes in a recent survey paper that this conception explains, at least, an important part of measured interindustry wage differentials. The other important part is thought to spring from unobservable worker characteristics that are valued differently by different industries in matching (sorting) equilibria, as modeled, for example, by Gibbons and Katz (1992). We do not attempt to explore this explanation, nor do we address the econometric selection problems it raises.

9.3.1 A General Equilibrium Model with Outsourcing

We review here the main findings of the model presented in Lovely (1999). The purpose of this formal modeling effort is to capture the response to shocks of a human-capital-abundant economy that trades with both developed and developing countries. The economy is simultaneously engaged in the outsourcing of labor-intensive production activities to relatively labor abundant countries and in intraindustry trade in producer inputs with other human-capital-abundant countries. This model of intraindustry trade in horizontally and vertically differentiated inputs is built on Ethier's (1982) model of the international division of labor and Feenstra and Hanson's (1996a) model of outsourcing.

There are two regions of the world, distinguished by their proportionate endowments of pure labor and human capital. The "South"—representing the newly industrialized countries—is labor abundant relative to the "North"—representing the traditional industrial countries. Production patterns differ between the two regions and factor-price equalization between the South and the North does not obtain. The South produces a traditional good, grain, and engages in assembly of bundles of northern-producer intermediates into final manufactures. While assembly is human capital intensive relative to grain, it is labor intensive relative to producer intermediates.[13] Comparative North-South factor endowments are such that producer intermediates are produced only in the North. This relative intensity ranking and specialization pattern capture in a simple way the relative intensity continuum developed by Feenstra and Hanson (1996a).

The North consists of two countries, "East" and "West," with the West designated as the home country. These countries have similar proportions of labor to human capital, in the sense that both produce positive quantities of assembly activities and producer intermediates in equilibrium. Producer intermediates and assembly use labor and human capital. As in Ethier's (1982) division-of-labor model, there is an international external economy from diversity in producer intermediates. Because we assume that there is free trade in producer intermediates, the productivity of intermediates in final manufactures will be the same in the East and the West and, as shown by Ethier (1982, 396), factor-price equalization will obtain in equilibrium. For this reason, we are able to treat the North as an integrated equilibrium.

The equilibrium is characterized by two-way trade between northern countries (East-West trade) in producer intermediates and by outsourcing, which we define as southern assembly of northern-producer intermediates into final manufactures. Intermediate varieties of differentiated inputs are

13. We assume there are no factor-intensity reversals.

exchanged by the East and West, generating an intraindustry flow in producer inputs. The direction of trade in final manufactures is indeterminate, as it depends on the equilibrium location of assembly activities. If the East, for example, produces a larger share of world assembly activities than its share of world income, it will be a net exporter of assembly services, visible as net exports of final manufactures. North-South intraindustry trade, in contrast, does not involve the exchange of intermediate varieties but, rather, reflects stages of production. The South assembles producer intermediates, which are produced and exported by the North. Again, the direction of net trade in final manufactures is indeterminate. We assume that the South is a net exporter of assembly activity and that final manufactures flow from South to North. The South also exports the traditional good, grain. Its exports of grain and assembly activities fund its net imports of producer intermediates, which are embodied in its consumption of final manufactures. Thus, the model is characterized by both conventional interindustry trade and by horizontal (East-West) and vertical (North-South) intraindustry trade. We turn now to a more detailed description of the model.

Production in the South

The South produces grain (G) and assembly activities (A_S) with production functions that we assume are linearly homogenous. Grain is chosen to be the numeraire and it is produced using labor only. Because of this production technology, the grain sector determines the southern wage. Assembly activities require both labor and human capital. We assume that the production technology for assembly is linearly homogeneous and twice differentiable. Because human capital is used only in assembly in the South, it has the characteristics of a sector-specific factor. Southern labor is fixed in total supply and is allocated so that its value of marginal product is equalized across sectors. Thus, a change in the stock of human capital will lead to a reallocation of labor across sectors without altering the southern wage.

Production in the North

Because the two countries of the North have similar endowments and engage in free trade in producer intermediates, we treat the East and West as an integrated equilibrium. The North produces two goods, assembly (A_N) and producer intermediates, (x_i), where i indexes intermediate varieties. We assume that both are freely and costlessly traded. Assembly activities are supplied by perfect competitors using human capital (H_A) and unskilled labor (L_A) in a constant-returns-to-scale technology. These factors may also be combined, again in a constant-returns-to-scale technology, to produce factor bundles (f), which are used to produce intermediates. In the final stage, intermediates and assembly combine to form the finished manufactured good (M). Both factors are intersectorally mobile and internationally immobile.

The production technology for assembling the manufactured good M is given by

$$(1) \qquad M = \min\left[A, \left(\sum_{i=1}^{n} x_i^{\beta}\right)^{(1/\beta)}\right],$$

where A is assembly activities, which may be performed in the North or outsourced to the South ($A = A_S + A_N$). Intermediate varieties are imperfect substitutes; β measures the degree of differentiation of intermediates ($0 < \beta < 1$). The productivity of intermediates exhibits constant returns to scale for a given number of intermediate varieties and increasing returns with higher degrees of specialization, as measured by the number of intermediate producers n. These economies are external to the finished manufactures industry and each competitive firm assembling finished manufactures takes n as given.

As does Ethier (1982), we assume that all intermediates have identical homothetic cost functions, implying that in equilibrium any produced variety will be produced in the common quantity x. The properties of the monopolistically competitive sector are well known.[14] Intermediates producers equate marginal cost and marginal revenue, setting a price for intermediates that is proportional to the price of factor bundles. Free entry implies zero profits in equilibrium and that the common value of x will be a constant. The price of finished manufactures is the international trading price, P_M. Free entry generates zero profits in the assembly of intermediates into final goods, implying that the value of finished manufactures equals the value of total factor bundles embodied in intermediates plus the value of total assembly activity.

Market Equilibrium

The free-trade relative price of manufactures to grain, the two final goods in the model, equates world supply and demand. We assume that demand is identical across countries and individuals and that it takes a simple Cobb-Douglas form, so that world expenditure on final manufactures is a constant share of world income.

The demand for assembly activities must equal the supply of assembly activities. Given the Leontief technology for creating final manufactures from assembly and producer inputs, clearance in the market for assembly

14. Because intermediate varieties are imperfect substitutes, each producer experiences some market power. There is free entry into the industry and the number of firms is large enough so that each firm behaves as a monopolistic competitor. Each intermediate producer takes the price of factor bundles as given.

activities may be written as $A = M$. Similarly, clearance in the market for producer intermediates may be written as $n^{\alpha}x = M$.[15]

The comparative-static exercises that we review here reflect our judgment about the most important changes in the trading environment during the time period of our empirical analysis, 1981–92. We consider three shocks to the international trading system. The first is an increase in human capital in the South, which in the model is used only in manufacturing. This simple exercise is meant to capture the response of the economy to a variety of shocks that enhance the South's ability to perform outsourcing activities, including increasing human-capital-to-labor proportions, particularly among the newly industrialized countries; the development of local technology and managerial stocks; and the provision of supporting public infrastructures. Our second comparative-static exercise considers an increase in the relative abundance of human capital in the North. As documented by Baldwin and Cain (1997) the share of the U.S. labor force completing 13 or more years of education rose from 38 percent of the labor force in 1980 to 53 percent in 1992. Our third exercise considers demand shocks to the manufacturing sector, reflecting the growing demand for capital goods and other manufactures as developing countries have pursued growth and liberalization of restrictions on manufactured imports, as documented by Rodrik (1994).

An Increase in Southern Human Capital

This first exercise shows how growth in the southern human capital endowment concentrates assembly in the South, increasing the extent of outsourcing between the South and the North. An increase in human capital in the South raises the share of southern labor devoted to assembly activity, so as to ensure equal-value marginal products across sectors in the South. The additional southern assembly places downward pressure on the world price of assembly services relative to intermediates, inducing the North to increase production of and intraindustry trade in producer intermediates. These changes alter northern factor prices, driving up the return to human capital and driving down the return to pure labor, while increasing the East-West exchange of producer input varieties. These changes occur even though the relative price of manufactures falls relative to the southern traditional good, grain, to ensure international final-goods market clearance.[16] This case illustrates the effect of an increase in the

15. The same results obtain from a more general Leontief technology in which one or both inputs are multiplied by a scalar, which would in turn scale the relationship between $n^{\alpha}x$ and A. Throughout our analysis of the model, we assume that the northern price-output response is normal (in Ethier's terminology, the intersectoral effect outweighs the scale effect) and that this assumption implies that the relative supply curve for manufactures is upward sloping.

16. If final-goods prices are held fixed, the proportionate change in the skill differential will be larger. Of course, such a conditional exercise ignores market clearance.

southern supply of assembly—it will result in an increase in intraindustry trade that is accompanied by an increase in the northern skill differential, defined as the return to skill relative to the return to pure labor.

An Increase in Northern Human Capital

A second exercise examines an increase in the northern human capital endowment. An increase in human capital raises the production of intermediates and reduces assembly activity in the North, holding the relative price of factor bundles fixed (a Rybczynski effect), raising productivity of intermediates in manufacturing. Taken by itself in isolation from price adjustments and other endogenous responses, this boost in productivity would raise the return to human capital and reduce the return to pure labor. The increase in producer intermediates, however, calls forth an increase in global assembly activity. In both the North and the South, the relative price of assembly must rise to induce this new activity. In the North, the price of assembly rises relative to the price of intermediates (factor bundles); in the South, it rises relative to the price of grain. But in the world as a whole, the price of assembly-and-intermediates combined into final manufactures must fall relative to the price of grain. That is, world market clearance requires a decrease in the relative price of final manufactures. These effects may combine to decrease the relative price of human-capital-intensive factor bundles and the return to human capital relative to labor. For our purposes, we emphasize that this decrease in the skill differential may occur even though intraindustry trade between the South and the North has risen due to greater outsourcing of assembly activity. This case illustrates the effect of an increase in the global demand for assembly—it can result in an increase in intraindustry trade that is accompanied by a decrease in the northern skill differential.

Demand Shocks

Shocks to the demand for final manufactures can be treated in the model as an exogenous increase in the share of income spent on finished manufactures. A positive shock of this sort raises the price of final manufactures relative to grain, bringing forth greater northern output of producer intermediates and reducing northern assembly activity. In the South, resources are transferred from the traditional sector, grain, to the assembly of northern inputs as the price of assembly activity relative to grain increases. These adjustments raise the relative price of factor bundles used in producer intermediates in the North, increasing the relative return to human capital there. Thus, a positive shock to manufacturing demand raises the extent of outsourcing from the South and the skill differential in the North. When the source of the disturbance is a finished-manufactures demand shock, then outsourcing and the skill differential will be positively correlated.

Summary of Comparative-Statics Results

These comparative-statics exercises have a number of lessons concerning the relationship between the northern skill differential and trade with industrial and newly industrialized countries.

- Final-goods price changes do not tell the whole story when we move away from the two-by-two Heckscher-Ohlin framework. Skill-intensive final-goods prices may be negatively correlated with the skill differential.
- Neither an increase in outsourcing nor an increase in North-South trade intensity is always associated with a larger skill differential. Since both trade flows and factor prices are endogenously determined, unless the production structure ties outsourcing directly to factor-price movements, there is no reason that outsourcing and wages need move together in one direction or the other.
- The sign of the correlations between North-South trade volumes or intraindustry trade and the skill differential depends on the source of the shock. These exercises suggest that shocks that raise the supply of assembly in the South raise the northern skill differential. The initial excess supply of assembly induces a reduction of these activities in the North and an expansion of complementary producer inputs. These production responses bid up the price of human capital relative to pure labor in the North.
- Shocks that raise the global demand for assembly lead to different results for the skill differential. An increase in the northern human capital endowment creates an excess supply of producer inputs and excess demand for assembly activities, at initial prices. The demand for southern assembly rises, raising outsourcing in manufacturing, but the skill differential decreases as prices adjust to obtain market clearance in producer intermediates and final manufactures.
- An increase in the global demand for final manufactures raises the relative return to the factor used intensively (skilled labor in the North) or exclusively (skilled labor in the South) in that sector.

These observations reflect the fact that outsourcing is one endogenous piece in the system, just as prices are another. The most direct formal testing of the model's implications would require time-series data on relative wages for a group of countries and measurement of the true underlying shocks to endowments, demand parameters, and so on.

Given the enormous data requirements of such an approach, we consider a second approach that uses the interindustry variation in wages to assess the relationship between trade with industrial and newly industrialized countries and the relative return to skill. This second approach has the advantage of being both empirically tractable and policy relevant. Much of the concern about heightened trade with newly industrialized countries is its effect on "good jobs"—manufacturing jobs that pay above-average wages[17]—an issue that requires one to deviate from models in which all similar workers receive the same return, regardless of the sector in which they are employed. Indeed such industry wage premiums for comparable workers are a ubiquitous fact of life for both industrial and newly industrialized countries (Anderson 1998; Cragg and Epelbaum 1996; Kahn 1997; Krueger 1998; Robertson 1998).

9.3.2 A Model with Interindustry Wage Premiums

The existence of interindustry wage premiums remains a puzzle for labor economists. Wage premiums may be attributable to the fact that the industry of affiliation is important per se, as in the case of compensating differentials, or it may be that industry affiliation is systematically correlated with unobserved worker attributes (as would result from a worker-sorting process based on unobserved ability), or both.[18] We take a broad version of the former approach, treating industry premiums as compensation for particular industry characteristics.

We model the labor market in a partial equilibrium context, incorporating the pattern of specialization used in the previous general-equilibrium model. Each firm takes the outside wage as given, but pays a premium to compensate workers for loyalty, firm-specific skill acquisition, or for the disutility from higher effort, longer work weeks, unpleasant or risky working conditions, and so on, associated with employment in the industry. Firms are assumed to face two distinct labor markets, one for unskilled workers and another for skilled workers, and may pay a different premium above the outside wage to each type of worker. We assume that the (dis)-utility arising from employment in the industry varies within the population and that workers in each labor market can be arrayed from those who experience low to those who experience high (dis)utility from working in a given industry. Based on these supply conditions, a firm in a particular industry faces an upward-sloping supply curve for labor of either type.

We assume that the demand curve for each type of labor for a given industry is downward sloping. We conceive changes in the volume of trade as shocks to the demand for labor. Changes in the volume of trade arise outside the industry from fundamental shocks such as endowment changes in the South or in other northern partners, or in the global demand for industry output, as previously described.

The pattern of specialization in our general-equilibrium model provides grounds for reasoning differently about volume-of-trade shocks for north-

17. For an expression of this concern, see, for example, Borjas and Ramey (1995).

18. Once again, a more direct approach would measure the true underlying shocks to endowments, demand parameters, and so on, rather than the admittedly endogenous trade volumes. The further assumption we are making is that the volume of trade shocks is uncorrelated with shocks to industry labor-supply curves.

ern and southern trading partners. Northern countries form an integrated market equilibrium in which relative wages and returns to skill are everywhere comparable, whereas southern factor returns differ from those in the North.[19] Trade among northern countries involves significant "horizontal" two-way trade in intermediate goods; North-South trade involves "vertical" trade of skill-intensive intermediates for labor-intensive finished manufactures.

Trade between northern partners involves the two-way exchange of skill-intensive inputs as well as trade in products of different skill intensity. We thus conceive an increase in imports in the same industrial classification from industrial countries as a negative shock to the demand for skilled labor.[20] Northern imports are substitutes for skill-intensive inputs or processes, reducing the demand for skills in the domestic industry. This shift in the demand curve for skilled labor moves the industry down the labor-supply curve, reducing the premium paid to skilled workers. If the size of the industry is held fixed (i.e., controlling for the value of industry shipments), the composition of domestic production shifts away from skill-intensive activities toward labor-intensive activities. Thus, when shipments are held constant, an increase in northern imports should be associated with an increase in the premium paid to pure labor in the industry. The increased premium is necessary to draw additional workers (who have a higher (dis)utility from industry characteristics) into the industry.

Conversely, industry exports to northern partners are assumed to correspond to increased demand for skilled workers and lower demand for unskilled workers, again holding shipments fixed. Thus, a larger volume of exports to I-country partners should be associated with a higher premium for skilled workers and a lower premium for labor.

In contrast, exports and imports from southern newly industrialized countries reflect vertical-chain trade based on differences in factor proportions, and reflected in North-South factor-price differences. Imports from southern partners are assumed to substitute for labor-intensive activities within the industry, such as assembly. Consequently, we view an increase in southern imports as a negative shock to the demand for unskilled labor. Given an upward-sloping supply of labor to the industry, this shock should result in a reduced premium for unskilled workers. Holding industry shipments constant, increased southern imports imply a shift within the domestic industry toward skill-intensive activities. Thus, we expect increases in N-country imports to be associated with a higher premium for skilled workers.

19. Even interindustry wage differentials are similar in rank ordering, although less similar in size, among industrialized countries (Kahn 1997).

20. For example, one northern country's increased northern imports would be the expected consequence of human capital growth in the other northern country.

Exports to southern partners are expected to raise the relative demand for skilled workers, just as southern imports do. An increase in exports to newly industrialized partners is likely to be based on comparative advantage and, thus, to raise the relative demand for high-skilled intermediate inputs or processes within the industry. Using this reasoning, we expect an increase in N-country exports, as well as N-country imports, to be associated with a lower premium for labor and a higher premium for skilled workers. We note again the asymmetry between our treatment of I-country and N-country trade.

In the next section, we use this framework to develop a method for estimating the correlation between premiums for skilled and unskilled workers and trade flows distinguished by trading-partner aggregates.

9.4 Estimating the Correlation among Wage Premiums, Skill Premiums, and Trade Flows

To estimate the correlation among wage premiums, skill premiums, and trade flows, we use two approaches. The first approach modifies a standard two-step procedure for estimating industry wage premiums and their correlation with trade flows, by distilling a pure wage premium and a separate industry-specific premium to skill. The second approach estimates the wage and skill premiums and their relationship to trade flows in a one-step procedure. We are able to account for individual fixed effects in this second approach, thereby controlling in some measure for the way that industry premiums may reflect industry selection by heterogeneous workers who sort themselves according to unmeasured characteristics. In both approaches, we associate skill with years of formal education.

9.4.1 Cross-Sectional Estimation

To estimate the premium paid to unskilled and skilled workers, we modify an approach used by Dickens and Katz (1987), Dickens and Lang (1988), Katz and Summers (1989a), Gaston and Trefler (1994), and Richardson and Khripounova (1997) to estimate interindustry wage premiums and their correlations with trade flows. In the first stage of this procedure, industry wage premiums are estimated. Our modification of the procedure is to simultaneously estimate an industry premium to pure labor and an industry-specific return to education (skill).

Let $i = 1, 2, \ldots, I_j$ index workers in industry j. Let $\ln(w_{ij})$ be the natural logarithim of the hourly wage of individual i in industry j, X_{ij} be a vector of individual characteristics that affect wages, and S_{ij} the years of schooling of individual i in industry j. In the first stage of our procedure, we estimate the following set of equations for each year in the sample period:

$$(2)\quad \ln(w_{ij}) = X_{ij}\beta_X + D_{ij}w_L^* + D_{ij}S_{ij}w_S^* + \varepsilon_{ij}, \quad i = 1,\ldots, I_j, j = 1,\ldots, J,$$

where D_{ij} is a dummy for industry j, β_X, w_L^*, and w_S^* are vectors of estimated coefficients and ε_{ij} is an error term assumed to be independent and identically distributed. We interpret w_L^* as the premium to pure labor in industry j, and w_S^* as the premium to skill (education) in industry j. Because our data include 20 industries[21] and 12 sample years, we estimate 240 premiums to labor and 240 premiums to skill.

We use these sets of estimated premiums as dependent variables in a second-stage regression, designed to estimate the relationship between unskilled and skilled premiums and industry-specific trade flows. Let Z_j be a vector of industry characteristics other than trade and T_j be a vector of measures of trade flows. The second-stage regressions take the form

$$(3) \qquad w_L^* = Z_{jt}\rho_L + T_{jt}\beta_L + \mu_{jt}, \qquad j = 1,\ldots,J,\ t = 1,\ldots,T,$$

$$w_S^* = Z_{jt}\rho_S + T_{jt}\beta_S + \nu_{jt}, \qquad j = 1,\ldots,J,\ t = 1,\ldots,T,$$

where μ_{jt} and ν_{jt} are random error terms. As discussed by Dickens and Katz (1987) and Borjas (1987), the dependent variables in the second-stage regressions are themselves estimated regression coefficients. Hence, the disturbances in these regressions are heteroskedastic. Because the exact form of the heteroskedasticity in these regressions is not known, we use White's (1980) method to estimate robust standard errors for the second-stage coefficients.

To control for economywide changes in the return to labor and skills, and general-equilibrium factor return changes due to product-price changes, we include year dummies and industry producer price indexes among the elements of Z_j. The elements of the estimated coefficient vectors β_L and β_S indicate the relationship between our measures of trade and the premium paid to labor and skill, respectively. We estimate this relationship for several trade measures. One is trade intensity—industry imports and exports, expressed as a share of industry shipments. A second disaggregates by partner, distinguishing industry imports and exports with countries in each of the three groups, industrial, newly industrialized, and primary-producer countries, also expressed as a share of industry shipments. A third measure employs GLIs of the extent of two-way intraindustry trade in the industry, and a fourth measure defines GLIs for each of the three partner groups.

9.4.2 Fixed-Effects Estimation

In the second approach, we estimate the correlations between trade flows and the skill differential, taking advantage of the panel nature of our individual data and controlling to some degree for worker heterogeneity.

21. Nonmanufacturing is the base industry against which the 20 premiums are measured.

We regress the log of hourly earnings on years of education and other individual controls, interpreting the industry-specific intercepts as the return to pure labor and the industry-specific coefficients on educational attainment as the premium to skill. We look for correlations between these premiums and trade measures by adding two sets of trade variables to the standard wage equation, T_j, and T_j interacted with S:

$$(4)\quad \ln(w_{ijt}) = X_{ijt}\beta_X + D_{ijt}w_l^* + D_{ijt}S_{ijt}w_S^* + T_{ijt}\beta_L^* + T_{ijt}S_{itj}\beta_S^* + \eta_{it},$$

$$i = 1,\ldots,I_j,\ j = 1,\ldots,J,\ t = 1,\ldots,T,$$

where all variables are as previously defined and η_{it} is an error term assumed to be independent and identically distributed. We interpret w_L^* as the average premium to pure labor in industry j, and w_S^* as the average premium to skill (education) in industry j paid during the whole sample period. The interaction terms β_L^* and β_S^* indicate the correlation of these premiums with trade measures.[22] The trade measures we use are the same set we use in the two-stage procedure, imports and exports, expressed as a share of industry shipments, in the aggregate and by trading partner group. We also use the aggregate and partner-specific GLIs of intraindustry trade. As before we control for time-dependent changes in relative prices, which themselves may be correlated with trade volumes in general equilibrium (including as controls an industry-specific producer price index, PPI_{jt}, and the interaction of this variable with education) and for trends in the return to labor and human capital that affect the economy as a whole, but are not related to trade patterns in particular industries (including dummy variables for year, Y_t, both directly and interacted with education).

In this approach, wages could clearly be affected by unobserved characteristics of each individual. These individual effects could be random or fixed. If they are random, an ordinary least squares (OLS) estimation of equation (4) will understate the standard errors, perhaps substantially. If they are fixed and correlated with the trade variables, then our estimated coefficients for these variables are subject to omitted variable bias. For example, individuals with high motivation or high-quality schooling might be the first ones attracted to (or recruited by) industries with strong export growth. We follow the standard approach to this issue. We estimate both a random- and a fixed-effects model and then use a Hausman test to determine which one applies.[23] The test results always support the use of a fixed-

22. Including industry dummy variables reduces the extent of problems caused by correlation across errors from individuals in the same industry, but it also causes collinearity with the trade-volume measures, making estimation of these effects difficult.

23. To be specific, we use the "xthaus" procedure in Stata (1995 release). In our case, this procedure uses the Baltagi (1985) generalization of the Hausman test for an unbalanced panel.

effects specification, so we use that as the basis of the results presented here.

The use of a fixed-effects model is not without cost. This model effectively eliminates variation in initial education across individuals, and may therefore make it difficult to estimate β_S with precision. However, fixed effects do not eliminate all variation in the interaction between individual education and the trade measures, which is the variation needed to estimate β_S. Some variation remains both because individuals obtain more education and because trade flows change over time.[24]

9.5 Data and Base Regressions

Our data on individuals and their personal and employment characteristics were drawn from the Panel Study on Income Dynamics (PSID). We selected the PSID because it is a longitudinal panel, permitting us in our second approach to control for individual fixed effects when we estimate the return to skill (measured as years of formal education).[25]

To rule out people with long-term employment problems, we include those individuals in the data set only for years in which they had earnings and that were preceded or followed by another sample year in which they had earnings. Following standard practice with the PSID (see, e.g., Abraham and Farber 1987), we also restrict our sample to individuals between 18 and 60 years old who are not retired, permanently disabled, self-employed, employed by the government, or residents of Alaska, Hawaii, or Washington, D.C. The sample includes workers from all industries, including those employed outside the manufacturing sector. We begin with information on 6,606 individuals. After deleting years with no earnings or missing information for job tenure or education, we are left with 6,477 individuals and 41,834 observations for these individuals. Following standard practice with the PSID, our dependent variable is the log of average hourly earnings, defined as total earned income during the previous year divided by total hours worked during the previous year, divided by the GNP implicit price deflator for consumption. Table 9.1 describes our individual control variables. Table 9.2 reports typical cross-sectional estimates of coefficients for the control variables used in equation (2), almost all significant and of familiar size from studies of this sort.

The control variables listed in table 9.1, along with year dummies, were used to estimate a base version of equation (4) that omits measures of trade. Figure 9.3 displays these fixed-effects estimates of the industry-

24. The years-of-education variable in the Panel Study on Income Dynamics has some implausible entries. We developed an error-correction procedure designed primarily to eliminate cases in which an individual's education declined over time.

25. As shown by Haisken-DeNew and Schmidt (1998), about one-half of the cross-sectional variation in wages can be accounted for by individual effects.

Table 9.1 Definitions of Control Variables and Summary Statistics

Variable	Definition	Mean	(Std. Dev.)
Food	Individual is employed in SIC 20	0.015	(0.120)
Tobacco	Individual is employed in SIC 21	0.001	(0.034)
Textile	Individual is employed in SIC 22	0.004	(0.060)
Apparel	Individual is employed in SIC 23	0.010	(0.101)
Lumber	Individual is employed in SIC 24	0.009	(0.094)
Furniture	Individual is employed in SIC 25	0.005	(0.073)
Paper	Individual is employed in SIC 26	0.005	(0.069)
Printing	Individual is employed in SIC 27	0.016	(0.126)
Chemical	Individual is employed in SIC 28	0.012	(0.111)
Petroleum	Individual is employed in SIC 29	0.002	(0.039)
Rubber	Individual is employed in SIC 30	0.006	(0.080)
Leather	Individual is employed in SIC 31	0.008	(0.088)
Stone	Individual is employed in SIC 32	0.005	(0.069)
Primary metals	Individual is employed in SIC 33	0.005	(0.071)
Fabricated metals	Individual is employed in SIC 34	0.012	(0.110)
Machinery	Individual is employed in SIC 35	0.029	(0.168)
Electronics	Individual is employed in SIC 36	0.021	(0.144)
Transport equipment	Individual is employed in SIC 37	0.028	(0.165)
Instruments	Individual is employed in SIC 38	0.005	(0.067)
Other manufactures	Individual is employed in SIC 39	0.005	(0.069)
Age	Individual's age	36.362	(10.198)
$Age^2/100$	Age×Age divided by 100	14.262	(8.048)
Tenure	Length of present employment, in months	77.713	(88.643)
$Tenure^2/1,000$	Tenure×Tenure divided by 1,000	13.897	(28.390)
Education	Highest grade completed up to that year	13.226	(2.283)
Black	Head of household is African American	0.074	(0.261)
American Indian	Head of household is Native American	0.016	(0.126)
North central	Individual lives in the north-central region	0.290	(0.454)
South	Individual lives in the southern region	0.326	(0.469)
West	Individual lives in the western region	0.175	(0.380)
Work limitation	Individual has a work-limiting disability	0.040	(0.196)
Gender	Individual is female	0.489	(0.500)
Union	Individual is a member of a union	0.153	(0.360)
Number of children	Number of children under age 18 in household	1.070	(1.153)
Married	Individual is married	0.809	(0.393)
Head of HH	Individual is a PSID household head	0.622	(0.485)
MSA residence	The nearest city has more than 50,000 people	0.532	(0.499)
Local unemployment rate	County unemployment rate	6.468	(2.850)
Ship	Total shipments, by industry and year (millions of dollars)	35,418.99	(84,787.78)
PPI	PI, by industry and year	21.484	(42.908)
ED×PPI	Education×PPI	272.718	(556.712)

Notes: Means and standard deviations are for pooled regression sample used in fixed-effects estimation (n = 41,834). Ship and PPI (producer price index) are set equal to 0 for nonmanufacturing industries.

Table 9.2 Typical Cross-Section Regression Results for Control Variables

	1982		1992	
	Coefficient	Standard Error	Coefficient	Standard Error
Age	0.056**	0.007	0.042**	0.008
$Age^2/100$	−0.0650**	0.00876	−0.0436**	0.009790
Tenure	0.003**	0.000	0.004**	0.000
$Tenure^2/1,000$	−0.00563**	0.0008420	−0.00664**	0.0009420
Education	0.081**	0.005	0.116**	0.005
Black	−0.169**	0.033	−0.170**	0.038
American Indian	−0.076	0.057	0.037	0.080
North central	−0.026	0.025	−0.186**	0.027
South	−0.007	0.026	−0.148**	0.027
West	0.039	0.028	−0.099**	0.030
Work limitation	−0.112**	0.047	−0.137**	0.046
Gender	−0.197**	0.039	−0.146**	0.042
Union	0.205**	0.025	0.123**	0.029
Number of children	−0.024**	0.009	−0.023**	0.009
Married	0.169**	0.034	0.159**	0.035
Head of HH	0.218**	0.044	0.185**	0.046
MSA residence	0.139**	0.019	0.126**	0.019
Local unemployment rate	−0.002	0.002	−0.005	0.004
N	3,506		4,310	
R^2	0.42		0.37	
$F(45, 4251)$	43.7200		42.4400	
Probability value (F-test)	0.0000		0.0000	

Notes: Dependent variable is log of hourly wage. Regressions also contain industry dummies and education-industry interactions.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

specific skill premiums attached to different amounts of education. The skill premium declines in most industries as the years of formal schooling of the employee increase. This declining premium could reflect a variety of factors, including lower industry-specific (dis)utility experienced by more highly skilled workers, greater locational mobility of more highly educated workers, or greater intersectoral mobility of educated workers.[26]

Together, these profiles suggest that an important piece of an explanation of industry wage premiums is differing labor market conditions for skilled and unskilled workers. In several industries there is no premium for workers with some education beyond high school and in most industries there is no premium for workers with a college degree. The existence of industry wage premiums, therefore, may be less a phenomenon of

26. Only three industries have rising premiums—petroleum, primary metals, and stone—while one industry—tobacco—has a profile that is essentially flat.

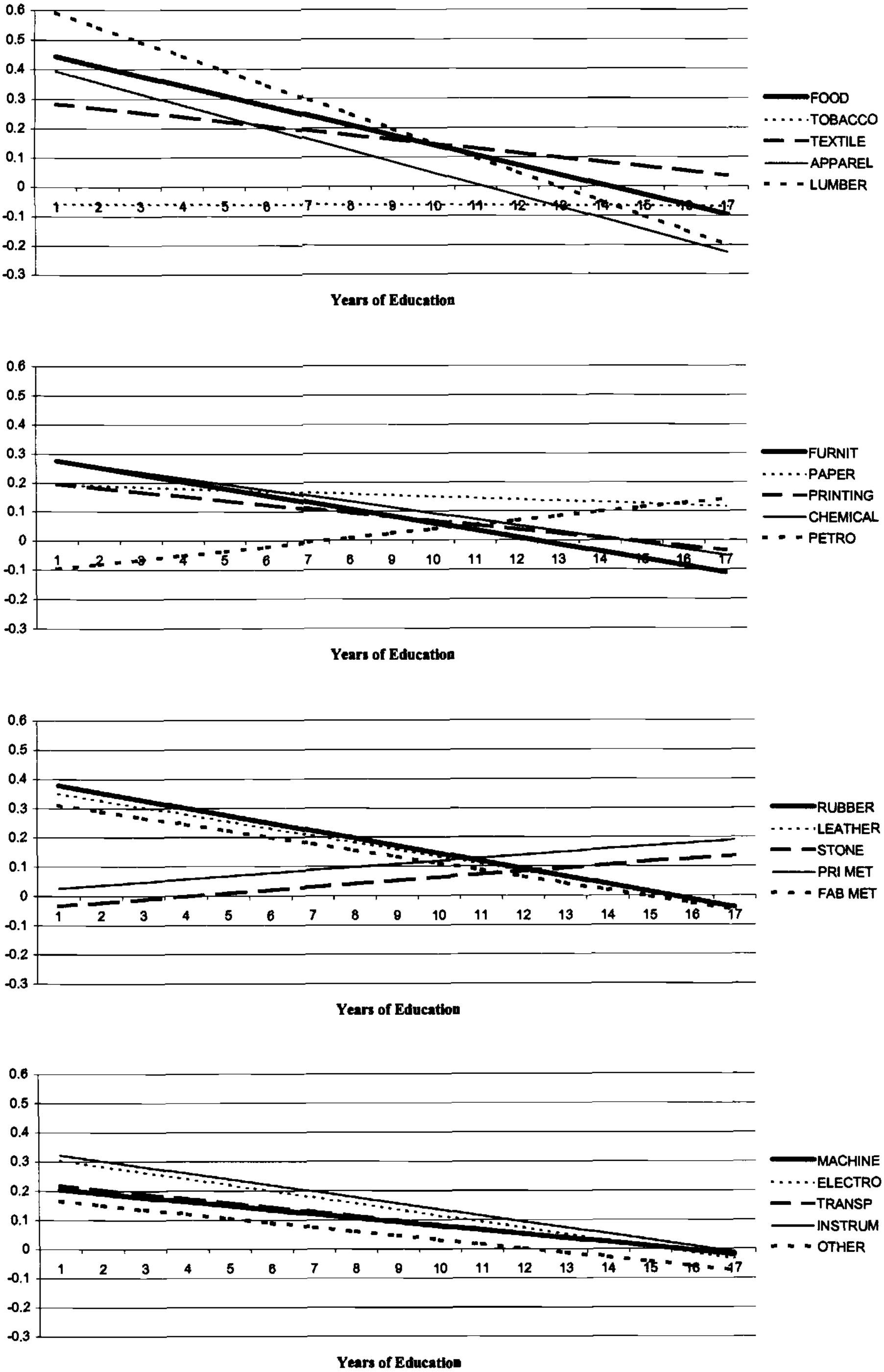

Fig. 9.3 Industry wage premiums by education level (deviations from employment-weighted average log real wage)

particular industry structure and more a reflection of the local industry-specific nature of the labor market facing the less skilled.

9.6 Results

Our particular interest is how these wage and skill premiums correlate with measures of trade, both as an aggregate and disaggregated by type of trading partner.

9.6.1 Two-Stage Regression Results

In the first stage of our cross-sectional approach, we estimate labor and skill premiums for each industry in each sample year. Table 9.3 records the results of second-stage regressions in which the estimated premiums from the first stage are regressed on import penetration rates and export intensity rates,[27] controlling for overall industry shipments,[28] and on our measures of intraindustry trade.

Most of the extant literature assumes that skilled and unskilled workers in an industry experience the same industry wage premiums. So for comparison purposes, we estimated standard premiums (that is, premiums estimated without industry-schooling interactions) and related them to our measures of trade. The results appear in the first column of table 9.3. The upper-left results ("Total imports" and "Total exports") replicate the qualitative results other researchers have found (e.g., Gaston and Trefler 1994), although the magnitudes are smaller.[29] One interpretation of these results is that the reward to industry-specific experience is larger in industries (and years) where comparative advantage is more relevant (because natural and policy barriers to trade are low) and more pronounced.

Subdividing the influences by trading partner indicates important

27. The import penetration rate and export intensity rates are defined as the ratio of imports and exports to shipments, respectively.

28. The second-stage regressions also contain year dummies, producer price indexes, and shipments, as previously outlined. The year dummies, although largely insignificant, tend to peak in size in the mid-1980s. The pattern of results is similar whether unweighted or employment-weighted least squares is used. Table 9.3 reports only the results from unweighted least squares.

29. The year dummies bleed away the size of these coefficients. Comparable workers in two similar industries or years that differ only in import penetration, with one import-penetration rate being 5 percent higher than the other, have wage premiums that are smaller by roughly 0.1 percent. Comparable workers in two similar industries or years that differ only in export intensity, with one export-intensity rate being 5 percent higher than the other, have wage premiums that are larger by a little more than 0.3 percent. Comparable workers in two similar industries or years that differ in both import and export intensity, with one industry's rates being 5 percent higher than the rates of the other, have wage premiums that differ by somewhat more than 0.2 percent, with the more globally engaged industry having the larger wage premiums. Richardson and Khripounova (1997) show that these cross-industry patterns also characterize socioeconomic subsamples of manufacturing workers. Thus, for example, industries with higher export intensity, lower import penetration, and greater trade engagement have larger wage premiums, ceteris paribus, for both women and men, and for ethnic minorities and majorities.

Table 9.3 Selected Coefficients (Standard Errors) from Pooled Regressions of Differentials on Various Trade Measures

	Standard IIWD		Distributional IIWD: Labor Premium		Distributional IIWD: Skill Premium	
			A. Total Trade			
Total imports	−0.243	(0.0479)**	0.0790	(0.172)	−0.0237	(0.0135)*
Total exports	0.586	(0.104)**	−1.37	(0.544)**	0.151	(0.0426)**
R^2	0.48		0.14		0.13	
F (16, 224)	20.17		3.08		2.67	
			B. Trade by Trading Partner			
I-country imports	0.544	(0.186)**	3.31	(1.15)**	−0.206	(0.0902)**
I-country exports	−0.192	(0.288)	−3.31	(1.62)**	0.235	(0.128)*
N-country imports	−0.824	(0.121)**	−0.375	(0.689)	−0.0321	(0.0529)
N-country exports	3.30	(0.548)**	−4.25	(3.55)	0.578	(0.277)**
P-country imports	−0.0193	(0.266)	0.0896	(1.10)	−0.0109	(0.0876)
P-country exports	−1.05	(1.10)	2.37	(5.25)	−0.262	(0.422)
R^2	0.55		0.17		0.16	
F (20, 200)	28.99		4.32		3.00	
			C. Intraindustry Trade			
Overall GLI	121	(33.4)**	183	(171)	−4.31	(13.7)
R^2	0.43		0.11		0.08	
F (15, 225)	17.36		3.03		1.73	
			D. Intraindustry Trade, by Trading Partner			
I-country GLI	−93.5	(35.5)**	−112	(184)	0.617	(13.9)
N-country GLI	173	(41.6)**	262	(167)	−7.41	(13.5)
P-country GLI	−17.8	(30.4)	251	(130)*	−21.1	(9.93)**
R^2	0.45		0.13		0.10	
F (17, 223)	14.44		2.56		1.63	

Notes: Dependent variable is the etimated coefficient on industry dummy variables (labor premium) or their interaction with education (skill premium) from cross-sectional wage regressions, pooled across all years. Regressions also contain year dummies, PPI, and Ship. Standard errors are in parentheses, calculated using White's (1980) method. IIWD = interindustry wage differentials.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

differences. First, looking at the left-column results by country type (panel B), we find that the familiar aggregate coefficients are driven almost entirely by trade with newly industrialized countries. In fact, imports from traditional industrial trading partners are positively correlated with U.S. wage premiums (and exports negatively, although insignificantly correlated).[30] Second, the coefficients for trade with newly industrialized coun-

30. We do not discuss the panels for trade with primary-producing (P) countries, where trade is low and coefficients are uniformly insignificant. In trade with primary-producing countries, skilled workers appear to "lose" from deeper export intensity, while unskilled

tries suggest large effects. Comparable workers in two similar industries that differ only in export intensity with newly industrialized countries by 5 percent would have wage premiums that differ by as much as 1.2 percent.

Distinguishing skilled from less-skilled workers provides some insight into these results. The right-column results, under the heading "Distributional IIWD" (interindustry wage differential) suggest that trade has opposing effects on the return to pure labor and the return to skill. While increased trade (larger import and export shares of shipments) is associated with a higher return to skill, it is associated with a lower return to pure labor, as seen by the signs and magnitudes of the estimated coefficients. Shifting down those same right columns, it can be seen that skilled workers are the ones who enjoy strongly positive wage premiums in industries or years with high export intensity and low import penetration, whether traditional or newly industrialized partners are concerned. In contrast, the industry wage premiums earned by less-skilled workers are insignificantly related to trade with newly industrialized countries, and oppositely related to trade with traditional industrial partners—higher where import penetration ratios are higher, lower where export intensity is higher. These results are consistent with a model in which import surges displace high-skilled workers in home intermediates and increase the demand for lower-skilled workers; export surges of intermediates to fellow northern countries require more high-skilled workers and reduce demand for the less skilled.[31] These results suggest broadly that distributional conflict is more likely from trade with newly industrialized countries than with traditional partners, as popular debate often assumes.

The results for the GLIs of intraindustry trade[32] maintain the conclusion that trade with traditional and newly industrialized countries has differently signed strong impacts on wage premiums. But they do not suggest any significant distributional conflict. The aggregate GLI is significantly, positively correlated with the standard premium measure (undifferentiated by skill) in the first column, panel C, due largely to trade with the newly industrialized countries. The correlation with newly industrialized–partner trade overwhelms the tendency for higher intraindustry trade with industrial partners to be negatively associated with the standard wage premium (first column, panel D). However, the distributional effects in the "Labor Premium" and "Skill Premium" columns are all insignificant.[33]

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workers "gain." Unreported results suggest that this correlation is driven by foods and beverages, and in any case P-country trade is much smaller than I- and N-country trade.

31. Seven of the eight estimated coefficients have coefficients with the signs predicted by the partial equilibrium model of compensating differentials presented previously. Only the correlation of N-country imports and the skill premium has an unexpected sign.

32. Such indices cannot be meaningfully included in the same regression with export intensity and import penetration ratios; these measures are nonlinear transformations of the others. One cannot meaningfully hold two constant and let the third vary.

33. Unreported regressions that distinguish the wage effect of trade by industry indicate

9.6.2 Single-Stage Fixed-Effects Regression Results

In the single-stage approach, we estimate labor and skill premiums and their relation to our trade measures across all years, controlling for the appearance of the same worker multiple times in our sample.[34] We regress log real wages on the individual control variables listed in table 9.2, industry dummy variables, industry-education interactions, industry shipments, an industry producer price index, and various trade measures. We interpret the sign of the coefficient on a trade measure as the sign of the correlation between that flow and the return to pure labor (given by the industry-specific intercepts). Similarly, we interpret the sign of the coefficient on the interaction between education and a trade measure as the sign of the correlation between that flow and the return to skill.

Table 9.4 records results for the one-stage estimates that account for individual fixed effects. In the first two columns, we report results without the inclusion of year dummies; we report results including year dummies in the last two columns. The year dummies are entered to account for economywide, rather than industry-specific, trends. The inclusion of the year dummies absorbs most of the temporal variation in the trade measures, however, reducing their magnitude and generally eliminating their significance.

The results in panel B estimate the correlation between total import penetration, total export intensity, and the returns to pure labor and to skill. The sign pattern is reversed from the pattern that appeared in the cross-sectional two-stage results in table 9.3, but none of the estimated coefficients in table 9.4 are significant. Taken by itself, this seems to suggest that the distributional conflict described in the previous results is accounted for by sorting of workers with unmeasured productivity (whatever their measured skills) into industries with strong comparative advantage (high exports, low imports).

But this conclusion would be premature. When trade is broken down by trading partner (panel C), the distributional conflict seen in the cross-sectional results reappears, although not significantly in the right-column results with year dummies. As found in the two-stage results, skilled workers in industries with high export intensity to newly industrialized

that the significant P-country distributional results reflect conditions in the food sector alone. Greater intraindustry trade in that sector is correlated with lower premiums for skilled workers and higher premiums for less-skilled workers.

34. Incorporating individual fixed effects eliminates much of the variation in education, forcing identification of the education-industry interactions through those individuals who change industry or acquire more education during the period. (As noted previously, the education-trade interactions, which are our focus here, are also identified through changes over time in trade flows.) Some of the "industry switchers" in the PSID sample may be individuals whose industry is misidentified in one or more sample years; research on this same misidentification in the Current Population Surveys by Rothgeb and Cohany (1992) shows that many, not only a few, industry switchers are misidentified. Reducing this source of error, however, is our use of broad (two-digit) industry classifications.

Table 9.4 Selected Coefficients (Standard Errors) from Fixed-Effect Regression of Real Log Wage on Various Trade Measures

	No Year Dummies		With Year Dummies and Year-Education Interactions	
	Labor Premium	Skill Premium	Labor Premium	Skill Premium
	A. Producer Price Index			
PPI	−14.0	1.05	0.467	−0.0378
	(2.62)**	(0.201)**	(2.85)	(0.218)
F (6476, 35299)	8.118		8.185	
	B. Total Trade			
Total industry imports	−0.465	0.0426	−0.269	0.0200
	(0.374)	(0.0295)	(0.384)	(0.0302)
Total industry exports	0.353	−0.0429	0.993	−0.0752
	(0.821)	(0.0632)	(0.851)	(0.0653)
PPI	−13.2	1.00	−0.328	0.0260
	(3.01)**	(0.231)**	(3.18)	(0.243)
F (6476, 35295)	8.114		8.183	
	C. Trade by Trading Partner			
I-country imports	0.756	−0.0268	2.42	−0.148
	(1.52)	(0.115)	(1.54)	(0.117)
I-country exports	1.23	−0.0791	0.542	−0.0645
	(1.88)	(0.146)	(1.90)	(0.147)
N-country imports	1.13	−0.0710	−0.102	0.000201
	(1.11)	(0.0861)	(1.12)	(0.0869)
N-country exports	−10.3	0.736	−5.36	0.461
	(4.24)**	(0.328)**	(4.28)	(0.331)
P-country imports	−0.789	0.000593	0.345	−0.0760
	(1.92)	(0.155)	(1.92)	(0.154)
P-country exports	22.6	−1.83	20.0	−1.57
	(5.54)**	(0.430)**	(5.63)**	(0.437)**
PPI	−9.18	0.730	2.00	−0.119
	(3.19)**	(0.245)**	(3.32)	(0.255)
F (6476, 35287)	8.118		8.184	
	D. Intraindustry Trade			
Overall GLI	−879	61.9	−602	41.8
	(234)**	(18.4)**	(236)**	(18.4)**
PPI	−12.8	0.967	1.03	−0.0788
	(2.62)**	(0.203)**	(2.87)	(0.220)
F (6476, 35297)	8.117		8.184	
	E. Intraindustry Trade, by Trading Partner			
I-country GLI	−461	20.0	−343	13.2
	(305)	(24.6)	(311)	(25.0)
N-country GLI	−357	32.8	−169	17.1
	(200)*	(15.8)**	(202)	(16.0)
P-country GLI	−116	9.18	44.7	−3.31
	(202)	(16.0)	(202)	(16.0)
PPI	−11.8	0.904	1.25	−0.0805
	(2.74)**	(0.211)**	(2.93)	(0.224)
F (6476, 35293)	8.119		8.185	

Notes: Dependent variable is log of real hourly wage. Regressions also include the individual control variables listed in table 9.2, industry dummies, industry-education interactions, and Ship. Estimated with individual fixed effects. Based on 41,834 observations, 6,477 individuals. Standard errors are in parentheses.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

countries enjoy higher-than-average wage premiums; unskilled workers in such industries receive lower premiums. Moreover, in keeping with the predictions of our partial equilibrium model, we find that skilled workers in industries with high import penetration from newly industrialized countries enjoy higher-than-average premiums; unskilled workers receive lower premiums. Conversely, and as predicted, high import penetration from traditional partners is associated with larger premiums for unskilled workers and lower premiums for skilled workers.

The results for the GLIs of intraindustry trade in panels D and F have a very similar interpretation. Industries with strong two-way trade links pay significantly higher premiums to skilled workers, and lower premiums to unskilled workers. The size of these effects is quite large. But it is precisely accounted for by two-way intraindustry trade with newly industrialized countries; other trading partners have insignificantly (although similarly signed) coefficients.

9.7 Conclusion

Distributional issues in the globalization debate are surging in importance. At the same time that consensus has grown that global engagement has positive overall effects on average living standards and growth, suspicion has grown that the averages hide great unevenness, with some identifiable groups even losing from global engagement. In the United States, the suspicions seem greatest when trade-liberalizing initiatives are aimed at poorer, developing countries, and are more subdued when perceived peer countries are involved. In other words, the distribution of our trading partners may matter to the distribution of our gains from trade.

This paper has examined these distributional issues for American workers in the 1980s and early 1990s. In general, we find that the suspicions are supported by evidence, once we control for the usual correlates of wages (including unobserved worker characteristics). We find that skilled (educated) American workers seem to have received higher rewards for their skill in industries and years with high export dependence on newly industrialized–country markets, and even when two-way, intraindustry trade with them is high (that is, both exports and imports). Workers with little education seem correspondingly to have lower industry-specific wage premiums (rewards for specific training or compensation for industry amenities or disamenities) in industries and years where exports to newly industrialized countries were large, or where intraindustry trade with them was large. Trade with established industrial countries appears to have a different relationship to wages and rewards to skills. Skilled workers in industries or years in which export intensity was high and import penetration low received larger-than-average premiums. Conversely, low export intensity and high import penetration with traditional partners is associated with larger-than-average premiums for unskilled workers.

We interpret these results in the light of models that assume differences in the types of trade that the United States conducts with traditional industrial and newly industrialized trading partners and differences in the types of labor markets that less-skilled and more-skilled workers face. Our empirical results are largely consistent with variegated outsourcing—horizontal intraindustry trade in specialized, skill-intensive intermediate producer goods between highly integrated industrial economies, but vertical intraindustry trade of those same intermediates for less-skill-intensive assemblies and finished manufactures between industrial and newly industrialized economies that are not yet fully integrated. The results also support a view of labor markets that is to some extent industry specific, generating different industry-specific components to wages and the return to education. The data show pronounced differences in the size of these industry wage premiums across industries and between workers, and in turn, pronounced differences in the way trade affects them. Industry wage premiums for less-educated workers are, in particular, far larger than for more-educated workers (for whom they are sometimes 0).

In sum, our results suggest that both what we trade and with whom we trade seem to matter for U.S. wage inequality. The way in which "what" and "whom" matter, however, is complex, and we do not claim to have provided more than a beginning interpretation. But we believe that this paper suggests both interesting new answers and nuanced new questions for the debate about trade and wages.

Appendix

Trade Data: Product Aggregation, Concordance, Assignment

Trade data are a reaggregation from the Statistics Canada compilation of United Nations bilateral trade by commodity, Standard International Trade Classification, revision 3.[35] As described previously data were first aggregated across products and then across trading partners. The product aggregation constructed three broad types of goods: intermediate inputs (raw materials, primary products, and producer nondurables), capital-goods inputs (producer durables), and consumer goods. The three types were allocated to the 20 two-digit manufacturing sectors in the Standard Industrial Classification, either according to end use (raw materials and primary products) or according to the corresponding manufacturing sector (producer nondurables and durables).

35. Omitted SITC categories included 27xx, 29xx, and 9xxx, mostly miscellaneous products.

Intermediate Inputs (Raw Materials, Primary Products, and Producer Nondurables)

SIC sector	SITC categories
20	0xxx minus (01xx + 02xx + 03xx + 05xx + 09xx)
	22xx
	4xxx
21	121x
22	26xx
	65xx minus (652x + 653x + 654x + 655x)
23	652x + 653x + 654x + 655x
24	24xx + 63xx
26	25xx + 64xx
28	5xxx
29	3xxx
30	23xx + 62xx
31	21xx + 61xx
32	66xx
33	28xx + 67xx + 68xx
34	69xx

Capital-Goods Inputs (Producer Durables)

SIC sector	SITC categories
25	82xx
34	81xx
35	71xx + 72xx + 73xx + 74xx + (0.5)75xx[36]
36	764x + (77xx minus 775x)
37	7621 + 782x + 783x +784x + 786x + 79xx
38	87xx + (88xx minus 885x)

Consumer Goods

SIC sector	SITC categories
20	01xx + 02xx + 03xx + 05xx + 09xx
	11xx
21	122x
23	84xx
31	83xx + 8510
35	(0.5)75xx
36	76xx minus 7621 minus 764x

36. Computers and office machines (SITC 75xx) were divided equally between producer goods and consumer goods.

37	7810 + 785x
38	885x
39	89xx

Trade Data: Trading-Partner Aggregation

Aggregation across trading partners created three groups: traditional industrial trading partners (the I group), newly industrialized trading partners (the N group), and primary-product producers (the P group). The groups are detailed in table 9A.1 and were based loosely on per capita income and judgment about product mix.

Table 9A.1 Country Categories

I Countries (Traditional Industrial)				
Australia	Canada	Germany	Netherlands	Sweden
Austria	Denmark	Ireland	New Zealand	Switzerland
Belgium-	Finland	Italy	Norway	United
Luxembourg	France	Japan	Spain	Kingdom
N Countries (Newly Industrialized)				
Argentina	Greece	Korea Rp.	Singapore	
Brazil	Hong Kong	Malaysia	South Africa	
Chile	Hungary	Mexico	Taiwan	
Czechoslovakia	Israel	Portugal	Uruguay	
P Countries (Primary Producers)				
Afghanistan	Comoros	Iraq	Oman	Trinidad and
Albania	Congo	Jamaica	Pakistan	Tobago
Algeria	Costa Rica	Jordan	Panama	Tunisia
Angola	Côte d'Ivoire	Kenya	Papua New	Turkey
Bahamas	Cyprus	Korea D.P.Rp.	Guinea	Uganda
Bahrain	Dominican	Kuwait	Paraguay	United Arab
Bangladesh	Republic	Laos P.D.R.	Peru	Emirates
Barbados	Ecuador	Lebanon	Philippines	USSR (former)
Belize	Egypt	Liberia	Poland	Venezuela
Benin	El Salvador	Madagascar	Qatar	Vietnam
Bermuda	Ethiopia	Malawi	Romania	Yemen
Bhutan	Fiji	Maldives	Rwanda	Yugoslavia
Bolivia	Gabon	Mali	Saudi Arabia	(former)
Brunei	Gambia	Malta	Senegal	Zaire
Bulgaria	Ghana	Mauritania	Sierra Leone	Zambia
Burkina Faso	Guatemala	Mauritius	Somalia	Zimbabwe
Burundi	Guinea	Mongolia	Sri Lanka	
Cambodia	Guinea-Bissau	Morocco	Sudan	
Cameroon	Guyana	Mozambique	Suriname	
Central African	Haiti	Myanmar	Tanzania	
Republic	Honduras	Nepal	(United	
Chad	India	Nicaragua	Republic of)	
China	Indonesia	Niger	Thailand	
Colombia	Iran	Nigeria	Togo	

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Comment George J. Borjas

This paper addresses the interesting question of whether intraindustry trade matters. In their theoretical discussion, Lovely and Richardson note that intraindustry trade can occur when developed countries (the North in their exposition) export intermediate products to developing countries (the South). The labor-abundant South takes these intermediate products and converts them into final products, which it then exports back to the North. Intraindustry trade can also occur when the same types of finished products are traded between countries.

Lovely and Richardson's concern is not with estimating the volume of intraindustry trade, but with measuring the effect of this trade on the U.S. wage structure. To formalize their ideas, the authors develop a general-equilibrium model that allows for various types of trade flows between industrialized and developing economies. The main lesson of the model is that there may be a positive correlation between measures of intraindustry trade and the rate of return to skills in the United States. Put differently, an increase in intraindustry trade may widen the wage gap between skilled and less-skilled workers in the United States. This is the theoretical implication that the authors test in their empirical work.

Because of the general-equilibrium nature of the model, the link between the measure of intraindustry trade and the rate of return to skills in the United States is simply a correlation, not a causal relationship. The authors suggest two channels through which this positive correlation can arise: an increase in human capital in the South (which raises the share of southern labor devoted to assembly activity, inducing the North to increase production of intermediate products, which raises the return to human capital); and demand shocks such as an increase in the demand for finished manufactures (which also raises northern production of intermediate products). The authors also note, however, that different comparative-statics exercises (such as an increase in northern human capital) would generate a negative correlation between intraindustry trade and the rate of return to skills in the North. In the end, the sign of the link between intraindustry trade and the skills wage gap remains an empirical question.

The main contribution of the paper, therefore, is simply to establish empirically the sign of this correlation. So I will devote most of my comments to the empirical work. Let's first start out with the Grubel-Lloyd index, the measure of intraindustry trade that Lovely and Richardson use in the analysis. This index is given by

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$$GLI = 1 - \frac{|X_N - IM_N|}{X_N + IM_N}, \tag{1}$$

where X_N gives the value of manufacturing exports from the North to the South, and IM_N gives the value of manufacturing imports from the South to the North. *GLI* takes on a value of 1 if exports and imports are exactly equal to each other, and takes on a value of 0 if the North only exports the manufacturing good or only imports it. The higher *GLI*, therefore, the greater the importance of intraindustry trade. The calculation of *GLI* for the United States generates one interesting result: To a large extent, the United States trades inputs, not outputs.

From the perspective of analyzing changes in the U.S. wage structure, I think this particular index is somewhat problematic for the analysis. Suppose that the value of the manufacturing exports is exactly half the value of the imports, $X_N = \frac{1}{2}(IM_N)$. It is easy to work out that $GLI = \frac{1}{3}$. In contrast, suppose that the value of the manufacturing imports is exactly half the value of exports, $IM_N = \frac{1}{2}(X_N)$. In this case, the index also takes on a value of $\frac{1}{3}$.

The point is that the index is symmetric in terms of the importance of imports and exports. Moreover, the index is invariant to the actual volume of trade. Although I can appreciate that there may be sound theoretical reasons as to why, in a general-equilibrium setting, such a distinction might not matter, we know that the difference between imports and exports does matter, and that the volume of exports and imports also matters. Toward the end of the paper, for example, Lovely and Richardson report empirical evidence that a higher volume of exports greatly increases the wage in the industry, while a higher volume of imports reduces (but by a smaller absolute amount) the wage in the industry. The use of the GLI masks the potentially important distinction between imports and exports. I conjecture that the rate of return to skills is substantially different in a manufacturing industry, where all the intraindustry trade is composed of exports, than in one where all the intraindustry trade is composed of imports.

The authors calculate the GLI for manufacturing industries over the period 1981–92, and they link these industry- and time-specific data with individual-level data from the Panel Study of Income Dynamics (PSID). The empirical analysis presented in the paper often disaggregates the measure of the GLI across different types of countries (industrialized, newly developing, and primary producers), as well as among different types of goods trade (e.g., durables and nondurables), but I will tend to focus my remarks on the simplest calculations.

A general specification of the regression model that Lovely and Richardson use in their empirical analysis is

$$(2) \quad \log w_{ij}(t) = X_{ij}(t)\beta_1 + \beta_2 s_{ij}(t) + \delta_1 GLI_j(t) + \delta_2(s_{ij} \times GLI_j(t)) + \kappa_i + \gamma_t + \varepsilon_{ij}(t),$$

where $w_{ij}(t)$ gives the wage of work i employed in industry j at time t; X_{ij} gives a vector of socioeconomic characteristics of the worker; $s_{ij}(t)$ gives the worker's educational attainment at time t; κ_i gives a fixed effect for the worker; and γ_t gives a fixed effect for the period. The standardizing vector X contains a large number of variables—perhaps too many. For example, the regressions control for a worker's occupation. If one wants to estimate the impact of trade on the rate of return to skills, it seems to me that controlling for occupation nets out a substantial part of what higher skill levels do for a particular worker.

The authors report the initial estimates of their regression model in table 9.3. In this table, the specification in equation (2) is simplified in a number of important ways. First, they omit the period fixed effects (γ_t) from the regressions. Second, they aggregate over all manufacturing industries in the economy at time t to obtain a single measure of intraindustry trade at that time, GLI_t. Lovely and Richardson motivate this particular specification by noting that there may be perfect factor mobility in the U.S. labor market, and the impact of intraindustry trade in a particular industry would then be diffused throughout the entire economy.

The results in table 9.3 are among the strongest presented in the paper. Intraindustry trade has significant impacts on the wage structure both in terms of wage levels (δ_1) and on the return to skills (δ_2). The sign of these coefficients, however, is not consistent from one specification to the next. The analysis reports one particular sign pattern when intraindustry trade is with industrialized economies, and the opposite sign pattern when the trade is with the newly developing countries. I am not sure I understand precisely why this sign inconsistency occurs, and the authors' attempt at explaining the results (which relies on the possibility that increases in intraindustry trade occur for different reasons across different countries) is not fully convincing. At the very least, some type of reduced-form estimation seems to be required to explain the sign pattern, where the wages of U.S. workers are related to the factors that actually changed in the particular countries (rather than to the GLI).

Even if one accepts the authors' explanation, I have a number of questions about the regression model. First, the regressions in table 9.3 ignore period effects. We know, for example, that there were dramatic changes in the U.S. wage structure during the sample period, particularly in the wage gap between skilled and less-skilled workers. Admittedly, part of these changes in the U.S. wage structure may be due to intraindustry trade, but there are many other factors that are probably at work—and none of these factors are controlled for.

A second potential problem—and one that continues throughout the empirical analysis—is the authors' use of the PSID data to analyze the link between intraindustry trade and the U.S. wage structure. In particular, I am concerned about using regressions that control for individual fixed effects to analyze these types of questions. The parameter δ_2 can be identified if the worker's educational attainment is changing within the sample period. There is nothing inherently wrong with this procedure, except that the parameter of interest to the study is being identified from a very small sample. Moreover, many of the changes in schooling reported by a particular worker can probably be attributed to measurement error. Why not just estimate the returns to schooling and the industry wage levels from Current Population Surveys (CPS)? This type of analysis—which is the standard in the wage-structure literature—would probably give a much more robust answer to the questions that Lovely and Richardson ask.

Finally, the estimation procedure essentially regresses individual-level data (the worker's log wage) on an aggregate variable (the GLI) that takes on the same value for a subset of the individuals in the sample. It is well known that this type of regression leads to downward-biased standard errors if the estimation ignores the possibility that there may be an intercorrelation among individuals who share the same value of the GLI. I suspect that some of the statistically significant results reported in the paper would disappear if the estimation allowed for this type of random-effects stochastic structure.

Table 9.4 generalizes the regression model by allowing for variation in the GLI measure across manufacturing industries and by adding in the period effects. For the most part, this specification does not provide many statistically significant findings. Moreover, this regression introduces an alternative problem into the estimation. Throughout the individual-level analysis of the PSID data, Lovely and Richardson use a sample of workers, ages 18–60, who, among other things, are not retired, disabled, self-employed, or employed by the government. By construction, the sample includes workers in both manufacturing and nonmanufacturing industries. In these regressions, the GLI is set to 0 for workers not employed in manufacturing at time t, and the regressions include an industry fixed effect to capture the "main effect." It is not clear to me why workers employed in nonmanufacturing are in the analysis in the first place. A much cleaner approach would exclude these workers from the study—since they cannot contribute any information whatsoever to the estimation of the impact of interindustry trade. Moreover, it is unclear why one would want to impose the restriction that the other parameters of the model are the same for production and nonproduction workers.

Lovely and Richardson shift gears toward the end of the paper, and do, in fact, conduct part of the "cleaner" analysis that I have been advocating. In particular, using the PSID data, Lovely and Richardson estimate the adjusted industry wage for each manufacturing industry in each year between 1981 and 1992, and "stack" these industry fixed effects. The analysis is conducted only for manufacturing industries. They then relate these adjusted industry wages to measures of exports, imports, and the index of intraindustry trade. Generally, industry wages are higher in manufacturing industries with more exports, fewer imports, and more intraindustry trade. This part of the analysis, however, does not investigate the link between the rate of return to skills and intraindustry trade (or exports or imports). I suspect that a much clearer picture would be obtained if the authors conducted this type of analysis with CPS data.

Overall, Lovely and Richardson have embarked on a very interesting (and important) research path. Although the preliminary results reported in this paper are not conclusive, they are suggestive that intraindustry trade may be playing an important role in the U.S. labor market.