

Arndt, Sven

Working Paper

Trade, Technical Change, and Welfare

Claremont Colleges Working Papers in Economics, No. 2000-41

Provided in Cooperation with:

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Suggested Citation: Arndt, Sven (2000) : Trade, Technical Change, and Welfare, Claremont Colleges Working Papers in Economics, No. 2000-41, Claremont McKenna College, Department of Economics, Claremont, CA

This Version is available at:

<https://hdl.handle.net/10419/94606>

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Trade, Technical Change, and Welfare

Sven W. Arndt

The Lowe Institute of Political Economy
Claremont McKenna College
850 Columbia Ave.
Claremont, California 91711-6420
USA

Summary:

The domestic repercussions of trade liberalization have come under intense scrutiny in recent years. Trade liberalization and other aspects of globalization have been blamed for income inequality in the United States and unemployment in Europe. A key concern has been trade with low-wage developing countries. Although economists have studied the issue, no clear-cut answers have emerged. This paper examines some reasons for this ambiguity. Endogeneity and simultaneity can create major problems, causing trade to be blamed for developments that should properly be attributed to other factors. But even taken on its own, trade has ambiguous effects. It is only in the simplest Heckscher-Ohlin set-up that trade liberalization has the unequivocal outcome predicted by its critics.

Keywords: trade; fragmentation; offshore sourcing; income inequality; unemployment

1 Introduction

As trade and economic openness have grown in recent years, so has the debate over their effects on the welfare of various interest groups. Of particular concern have been the potential consequences of globalization for the jobs and wages of less skilled workers. This debate has been intensified as the share of industrial-country trade with developing, low-wage countries has risen. In the United States, as well as Europe, fears are widespread that jobs, wages and living standards are at risk, especially among workers who compete directly with imports from low-wage countries.

Among economists, the debate has focused on the relative contributions of trade and technological change to the observed rise in income inequality in the United States and to high and sustained unemployment in Europe.¹ Trade economists have tended to minimize the role of trade in these developments, while a number of labor economists have advanced the opposite argument. Although the debate is far from resolving the dispute, it has revealed the immense complexity of the issue at both theoretical and empirical levels.

In part, the difficulty arises from the fact that the effects of trade and of technological change are not always easily separated and distinguished. In part it is due to the fact that shifts in trade patterns may occur together with changes in relative income or in employment, without any causal relationship between them. In this paper, we examine several facets of the problem, focusing not only on trade in final products but in components as well. We are interested in recent technological changes which, in addition to their effects on trade patterns, have altered the way goods are produced around the globe. The focus is on offshore sourcing and production of parts and components, a phenomenon which has not only become more pervasive in recent years, but which is particularly well suited to trade relations between advanced and developing countries.

The phenomenon of offshore sourcing is a particularly apt example of the extent to which trade and technological change can become entangled and interwoven, for it has been technical innovations and improvements in transportation and telecommunications which, by reducing the cost of cross-border coordination and production, have facilitated the growth and spread of offshore sourcing and component trade.

Section 2 sets out the basic issues involved and traces the effects on wages and employment in the context of a two-good, three-factor model in which all goods are tradable. Section 3 considers the role of end products which are non-tradable, but some of whose parts and components may be tradable and thus subject to offshore sourcing. Since offshore sourcing may involve offshore production and hence foreign direct investment, Section 4 examines the implications of capital flows. Section 5 examines the potential for unemployment. Section 6 provides some concluding observations.

2 Offshore Sourcing and Relative Wages

One of the cornerstones of traditional trade theory is the role of factor proportions in the determination of specialization and trade. Variations in factor endowments across countries and in factor intensities across products play a key role in the determination of comparative

¹ For key contributions to this debate, see Bhagwati (1998), Feenstra and Hanson (1996), Freeman (1998), Lawrence and Slaughter (1993), Leamer (1998), Rodrik (1997), Sachs and Shatz (1994, 1995).

advantage. When these principles are applied at the level of products, it is easily shown that trade liberalization will reduce the relative returns of factors used intensively in the production of import-competing goods. In today's advanced countries import-competing goods tend to be relatively intensive in unskilled and semi-skilled labor. If trade liberalization increases the flow onto domestic markets of imports from labor-rich, low-wage countries, then the Stolper-Samuelson logic predicts that jobs and relative wages will come under pressure in import-competing industries. The pressure will spread from there to the rest of the economy. Leamer (1998) is an excellent reference for the application of this approach to the problem.

The products entering into international trade are, however, very complex commodities, consisting of many parts and components. In the past, the dominant tendency has been for such products to be produced more or less in their entirety in a single country. Outsourcing of parts and components was, of course, widely used, but it tended to be more national than international in nature, mainly because the costs of coordination rose steeply when outsourcing was pushed across national borders. This tendency to keep production within national borders made it possible for products to be labeled as "Made in Austria" or "Made in the USA."

In recent years, major innovations in transportation and communications technologies have sharply reduced the cost of cross-border coordination, with the consequence that offshore sourcing and production have been growing extremely rapidly. This development has been helped along not only by trade liberalization, but by greater openness of economies around the world to flows of direct investment and to the movement of persons, information and technologies.

Consequently, many products are rapidly losing their national identities as multinationals and others resort increasingly to offshore sourcing and production of parts, components, and assembly. In making their decisions about where to source, produce or assemble, manufacturers pay close attention to coordination as well as production costs. It is not surprising to find that factor endowments and factor intensities play important roles in determining countries' competitiveness in the production of parts and components and in the performance of assembly operations.

Factor intensity tends to vary across the constituent activities of a complex production process. The factor intensity of the end product, which has been the focus of traditional trade theory, is just the weighted average of the associated component factor intensities. Evaluating comparative advantage at the level of components is not very different from doing so for final products. From the factor-proportions point of view, a capital-rich, high-wage country, endowed with plenty of skilled workers, will tend to have comparative advantage in the more capital- and skill-intensive components of a product and comparative disadvantage in components requiring relatively heavy inputs of semi-skilled and unskilled labor.

This implies that such a country can improve its competitiveness in the market for the final product by outsourcing labor-intensive components to low-wage countries.² The gist of this idea is displayed in Figure 1. There are two products, X and Y, and three factors, capital (K), skilled labor (H), whose return is represented by h and ordinary labor (L), whose return is w . Capital is for the moment assumed to be immobile and sector-specific, while the two types of labor are perfectly mobile between sectors. The two products are assumed to be fully tradable. In trade between advanced and developing countries, product X would be the high-wage country's import good and product Y its export good.

² For full expositions of the basic argument, see Arndt (1997, 1998, 1999), Deardorff (1998), Jones and Kierzkowski (1998), Kohler (2000).

Curves X_0 and Y_0 represent the unit-value isoquants for the two products, respectively. In the Stolper-Samuelson framework, a decline in the price of X , brought about by trade liberalization, shifts the X -isoquant out. The subsequent adjustment of factor prices to this change in relative goods prices generates a flatter w/h ratio, tangent to the new X -isoquant (not drawn) and the original Y -isoquant. This deterioration in unskilled labor's position is at the heart of the contemporary debate.

If technological improvement takes place in the X -industry, it will shift the X -isoquant inward (not shown), making the factor-price ratio steeper and thereby improving the relative position of unskilled labor. Thus, if trade liberalization and technical change take place simultaneously in the import-competing industry, the relative position of unskilled labor may improve, deteriorate, or stay the same.

Technical progress in the Y -sector shifts the Y -isoquant inward (not shown), thus worsening the position of unskilled labor. Hence, trade liberalization which brings in imports together with technical progress in the country's export sector would reinforce each other in worsening labor's position. Here, an increase in openness and trade would be associated with a deterioration in labor's income position, but it would be important for policy purposes to know the relative contributions of the two sources.

The problem becomes more complicated when we allow for trade in parts and components. To illustrate, suppose that each final product is made up of two components. Let product X consist of components x_1 and x_2 , with the ray through point a representing the expansion path for x_1 at factor-price ratio w/h , and ray ab giving the slope of the expansion path (not drawn) for component x_2 . The factor intensity along ray Ox , which represents the expansion path for the end product, X , is the weighted average of the factor intensities of the two components. Component x_1 is clearly the relatively capital-intensive component.

When transportation and coordination costs are sufficiently high and trade barriers sufficiently restrictive, the country will produce both components at home. Integrated production of this type was the norm for many commodities in much of the post-war period. In recent years, however, reductions in tariff and non-tariff barriers, as well as innovations in transportation and telecommunications have sharply reduced the cost of offshore sourcing and offshore production. Hence, both export and import-competing industries are making increasing use of offshore sourcing and production of components, as well as offshore assembly. Aircraft makers like Boeing and Airbus, as well as the many industries with maquiladora operations, are examples of the phenomenon.

Suppose, in the context of Figure 1, that removal of the aforementioned barriers reduces the offshore cost of component x_2 to such an extent that its production at home becomes economically non-viable. The X -industry continues to make component x_1 at home and to assemble the product there, but it shifts procurement of component x_2 to foreign sources.³ Assume for simplicity that it pays for imports of x_2 by exporting x_1 .

³ Offshore sourcing may or may not involve multinationals and foreign direct investment. Large firms may establish foreign affiliate operations for the production of components, in which case an outflow of direct investment will precede the shift in component production or assembly. But offshore sourcing may also take place in arms-length relationships, with or without multinationals.

If this realignment of production reduces the resource cost of X , then the family of isoquants representing the new conditions will shift inward and rotate to the north-west. Suppose that the unit-value isoquant representing the new cost conditions is given by X_{11} , so that the quantities of skilled and unskilled labor used at point a represent the amounts required to produce enough of x_1 to make the original quantity of X , plus an additional amount of x_1 to be exported in return for imports of x_2 , all evaluated at the initial factor-price ratio, w/h .

If the country is small, end-product prices are given on world markets and are unaffected by these changes, implying that factor-price ratio, w/h , is no longer an equilibrium ratio. The equilibrium ratio must be tangent to the original Y -isoquant, Y_o , and the new X -isoquant, X_{11} . That factor price ratio, which is not drawn, will clearly be steeper than ratio, w/h , implying an improvement in the relative wages of unskilled workers.

Here, we have a further complication of the process. We saw above that liberalization of trade in final goods shifts the X -isoquants out if it reduces the price of X ; that shift turns factor prices against unskilled labor. But if the trade liberalization extends to components, or if cost-reducing technical change promotes offshore sourcing, then the pressure on isoquants from this source will run in the opposite direction. Both the volume and the pattern of trade will change, while relative wages may rise, fall, or remain the same. Here, the simple Stolper-Samuelson prediction clearly breaks down.

2.1 Component Specialization in the Skill-Intensive Sector

If component specialization were to take place in the skill-intensive sector, Y , it would again be the relatively labor-intensive component in which the country would have comparative disadvantage. This would be component y_2 , whose expansion path is given by the slope of line segment cd . The analysis of the effects of offshore sourcing then proceeds in a manner analogous to the previous case, so that the new unit-value isoquant is given at Y_{11} , again requiring an adjustment in the factor-price ratio. Unlike the previous case, however, the new equilibrium factor-price ratio, which must be tangent to isoquants Y_{11} and X_o , will be flatter than originally, thus implying that the relative wage of unskilled workers declines.⁴

2.2 Employment and Output Effects

While the factor-price ratio may move in either direction, employment and output will rise in the sector engaged in offshore sourcing and fall in the other sector, under the assumption that the economy's resources must be fully employed.⁵ The essential features of adjustment are given in Figure 2, where the initial equilibrium occurs at points Q_o and C_o on indifference curve I_o . P_w is the world price ratio and P_d the domestic, tariff-inclusive relative price. Offshore sourcing has effects analogous to those associated with technical improvement, namely, to expand the production possibility curve along the axis of the industry in which it takes place. As a result, production shifts to Q_1 in both panels. In Figure 2a, in which offshore sourcing takes place in the

⁴ We thus have the well-known result that it is not the factor bias, but the sectoral bias of the technological change that determines the adjustment of relative factor prices. It follows, that if technical change occurs in both sectors, the effects will be neutralizing, meaning that technical progress in the labor-intensive sector will fail to improve the position of unskilled workers if it is matched by progress in the other sector.

⁵ For details, see Arndt (1997, 1998, 1999)

country's import-competing industry, X-output rises and Y-output falls (at Q_1). In Figure 2b, where offshore sourcing occurs in the country's export-sector, Y-output rises and X-output falls.

National welfare clearly rises as a result of offshore sourcing by the Y-industry, but its effect is ambiguous if it takes place in the import-competing industry.⁶ The figure shows the case of a decline in national welfare as consumption moves from point C_0 to C_1 . But this is not the only possible outcome. At the given domestic price ratio, P_d , imagine that this tariff-inclusive price were the result of a smaller tariff than before applied to a steeper world price than before. That steeper world price line (not drawn) would pass through points Q_0 and Q_1 in Figure 2a at an angle which would become steeper as the price line itself became steeper, until the world price line passing through point Q_0 would lie below point Q_1 , rather than above as in the figure. In that case, offshore sourcing by the X-sector would be welfare-improving.⁷ Note, moreover, that the effect of offshore sourcing in the import-competing sector is to reduce trade in final products, as shown by the smaller trade triangles (not drawn) in Figure 2. Thus, while trade liberalization at the level of the end-product increases the volume of imports, trade liberalization at the component level decreases the volume of imports.

As is customary in the Heckscher-Ohlin context, full employment and frictionless reallocation of resources is taken as given. It is easy to imagine, however, that search and retraining costs can slow the speed of adjustment and increase its cost. Nevertheless, it is the sector engaged in offshore sourcing that experiences an expansion in output and employment. This result is strongly at variance with the concerns often expressed by those who oppose trade with low-wage countries, namely, that offshore sourcing will cause jobs to disappear in the industry.

While the results above are driven by the specific assumptions of the model, the outcome is not inconsistent with intuition. Intuition suggests that output should rise rather than fall in the industry which resorts to offshore sourcing, because offshore sourcing cuts costs⁸ and thereby improves competitiveness. A small country, whose end-product prices are given by demand and supply conditions in world markets responds to the cost savings by increasing sales at world prices. A large country is enabled by the decline in costs to lower price and thereby expand market share.

We conclude this section by noting that liberalization of component trade adds an additional layer of complexity to the relationship between trade and workers' incomes. If trade liberalization includes offshore sourcing in the import-competing sector, then workers' relative wages may rise or fall. If trade liberalization makes it easier for export industries to engage in offshore sourcing, then the consequences will be to augment the negative effects of the rise in end product imports on workers relative wages. For unskilled workers, therefore, a worst-case scenario would consist

⁶ This ambiguity is a function of the trade policy regime. Under free trade, as well as in preferential trade arrangements, offshore sourcing is welfare enhancing. For details, see Arndt (2001).

⁷ For details, see Arndt (2001). Note that the welfare decline shown in the figure occurs because offshore procurement pushes productive resources into the distorted X sector. The outcome is reminiscent of the implications of effective protection.

⁸ For small countries, the world price of the end product remains unaffected by these developments. Large countries may help depress the price of the product when they produce more of it. If the product is a country's import good, there is the additional welfare benefit of a terms of trade improvement; if it is the export good whose price falls, then there ensues a welfare-reducing terms-of-trade deterioration.

of a mixture of liberalization of imports of X, offshore sourcing by firms in the export industry, and technical progress in the export industry.

3 Offshore Sourcing in the Presence of Non-Tradables

Some researchers have argued that the presence of industries producing non-tradables could have contributed to the widening of income inequality.⁹ We employ the foregoing approach to identify the conditions under which this would be the case. We return to Figure 1 to sketch the effect of offshore sourcing in a world with non-tradables. We do so by re-labeling the isoquant maps for Y and X as T (for tradables) and N (for non-tradables). This means that the industries, X and Y, have been lumped together into a single tradables sector, which requires us to assume that the terms of trade remain constant during this exercise. In the figure, non-tradables (N) are now the labor-intensive sector, while tradables (T) are skill-intensive. This assumption is consistent with widespread practice in the literature and probably reflects reality pretty well, especially if a broad range of services is included in the non-tradables sector.¹⁰

If it is the tradables sector which engages in offshore sourcing, so that the new unit-value isoquant shifts to T_{11} from T_0 , then the resulting adjustment in factor prices will cause the wages of unskilled workers to decline relative to their skilled counterparts. Under the full-employment assumptions of the model, output and employment both rise in the tradables sector and fall in the non-tradables sector. This development would be interpreted by many as further opening or “globalization” of the domestic economy, with its feared negative implications for the relative position of unskilled workers. However, this outcome brings with it an expansion of the country’s manufacturing sector, and contraction of its non-tradables and presumed services sector. Such an outcome is clearly inconsistent with observed developments, according to which manufacturing has been declining steadily in advanced economies everywhere. If, however, tradable services like finance, insurance, consulting, etc. are included in tradables, where they belong, then the prediction that the sector will expand may be less far-fetched.

When offshore sourcing takes place in the non-tradables sector, the results are reversed, with the relative wages of unskilled workers rising and output and employment in the non-tradables sector rising as well. In this scenario, the services sector expands, while manufacturing declines.

There is nothing logically inconsistent with the notion that an end product may be non-tradable, while some of its components are. Airlines, for example, whose main consumer service - namely, transporting passengers around the country - is non-tradable in the sense that it faces no competition from foreign airlines, nevertheless engage in offshore sourcing of flight reservations, book-keeping services, record storage, etc. Some even perform aircraft maintenance offshore.

3.1 The Real Exchange Rate

While a small country can be assumed to face given commodity prices in a world in which there are only tradables, introduction of non-tradables raises questions about movement in the real

⁹ See, for example, Sachs and Shatz (1994, 1995).

¹⁰ The evidence, however, is far from unambiguous. While many types of services would indeed be classified as labor-intensive (household, custodial, some commercial), others tend to be highly skill-intensive (design, engineering, medical). It would also be incorrect to assume that all services are non-tradables, inasmuch as financial, consulting, accounting, and other types of services are highly tradable and exposed to foreign competition.

exchange rate - defined as the ratio of tradables to non-tradables prices. The real exchange rate not only may change, but must change in order to clear the market for non-tradables. When output of non-tradables declines relative to demand, as in the first example above, the real rate falls in order to eliminate the excess demand for non-tradables; in the second example, of offshore sourcing by non-tradables industries, non-tradables output rises and a real depreciation is needed in order to eliminate excess supply in that sector. If a real-rate change is due to a change in the nominal rate or in the world price of tradables, the effect of this shock will first appear in the T-sector. If the real-rate change is due to disturbances in the price of non-tradables, its initial effect will be felt in the N-sector. We examine two recent episodes below.

3.1.1 Two Historical Episodes

The evidence amassed by researchers seeking to understand the causes of changes in the distribution of income suggests that inequality tended to rise in the 1970s and to fall in the 1980s. A full explanation of this ebb and flow awaits further study, but in the context of this section's discussion, the following is perhaps worth considering. If the 1970s were noted for anything, it was the run-up in oil prices worldwide. If we treat oil as a tradable product, then the rise in its price would shift the T_o -isoquant inward in Figure 1. This shift provokes an adjustment in factor prices to ensure that the new equilibrium w/h ratio is tangent to the new T-isoquant and the original N-isoquant. That price ratio is clearly flatter and thus means that semi- and unskilled workers suffer a deterioration in their income position.

The first half of the 1980s was noted for the huge increase in domestic expenditures, driven by the Reagan defense build-up. The real appreciation of the U.S. dollar and the current account deficit were two consequences of that program. Recalling that the real exchange rate is here interpreted as the ratio of tradables to non-tradables prices, then a real appreciation represents a relative rise in non-tradables prices, which serves to shift productive resources from tradables into non-tradables sectors. Military goods are among the key constituents of the non-tradables sector and a sharp run-up in defense expenditures would require a massive reallocation of the economy's resources from tradables into non-tradables. Unless demand for tradables can be curtailed as well, the decline in tradables output raises imports and reduces exports.

The rise in non-tradables prices has the effect of shifting the N_o -isoquant inward in Figure 1 and provokes a realignment of the factor-price ratio which improves the relative income position of semi- and unskilled workers.

It is thus possible to argue that trade played a role in both episodes, but it is the "wrong" kind of trade story. In the 1970s, it was trade with OPEC and not with low-wage developing countries. The oil shocks certainly exposed the openness and vulnerability of the US economy in the energy sector and its dependence on trade, and an effect of that kind of exposure may be to lower workers relative income position. But this has nothing to do with competition with low-wage countries.

In the early 1980s, the current account deficit rose, again suggesting that trade was the culprit, but the initial disturbance which caused imports to rise and exports to fall was a national defense policy shift. The real rate appreciated in order to bring about the needed reallocation of resources. In this instance, moreover, the rise in non-tradables prices served to improve the income position of semi-skilled and unskilled workers.

4 Foreign Direct Investment

Some critics of globalization have focused on the possibly negative effects of direct investment outflows on jobs and wages in the United States and other industrialized countries. It is well-known that under conditions of domestic factor mobility, an outflow of investment which comes at the expense of domestic capital formation, so that it can be taken in some meaningful sense as a cut in the domestic capital stock or in its rate of expansion, will affect capital-intensive sectors more than labor-intensive ones. In the standard Heckscher-Ohlin model, with world prices given, this kind of outflow causes output and employment to expand in labor-intensive import-competing industries. Thus, the Heckscher-Ohlin effects of investment liberalization run counter to the Heckscher-Ohlin effects of trade liberalization. The intuition is straightforward: a reduction in a country's capital stock shifts its resource endowment in favor of labor and thus plays into the strength of labor-intensive sectors.

If the foregoing output changes are large enough to affect world prices, the country's terms of trade will improve and that will have negative consequences for the relative wages of workers, even though it has positive effects on national welfare. If, however, the investment outflow moves abroad to set up facilities for the offshore production of components, then the effects associated with this aspect of the exercise will tend to raise or lower wages depending on whether the components are designed for the import-competing or the export industries. Output and employment will rise in the import-competing sector if the foreign-made components are destined for that sector. In the tradables, non-tradables context, wages will rise if component imports are destined for the non-tradables industries of the economy, and come under downward pressure otherwise. These considerations suggest again how difficult it is to make categorical statements about the effects of trade on factor prices and income distribution. They help us understand why the relationship between trade and income distribution may be so difficult to pin down statistically.

5 Unemployment

In Europe, the debate on the role of trade has been more concerned about high and sustained levels of unemployment in recent years, rather than worsening income inequality. The analytical approach of the preceding sections can shed light on several aspects of this problem as well. A key feature of the earlier analysis is the importance of changes in relative goods and factor price in adjustment to trade, technology, and other shocks. Another is the high mobility of factors between sectors. When relative price adjustment is sluggish or absent and when resources are immobile between sectors, then unemployment is often the result.

Consider, for example, the earlier discussion of real exchange rate changes. Real exchange rates change even in small countries with fixed nominal exchange rates and tradables prices determined in world markets. We saw above that major domestic policy changes can provoke real exchange rate adjustment. In the run-up to European Monetary Union (EMU) many countries struggled to bring their fiscal policies into compliance with the Maastricht criteria. Suppose that a country engaged in such an exercise cuts back fiscal outlays which lead to a reduction in the demand for non-tradables. This in turn requires a decline in the relative price of tradables, that is, a real depreciation. Under fixed nominal exchange rates and given world tradables prices, the only way to achieve this depreciation is by means of a decline in the nominal price of non-tradables. In the context of Figure 1, this decline shifts the N-isoquant out and brings about a decline in the wage (both relative and absolute) of semi- and unskilled workers. If wages are downwardly rigid, then unemployment will be the consequence.

Preparation for EMU was a major event for many of the European Union's member countries. The adjustments were large in relation to GDP and continued over a long period of time. In the presence of factor-price rigidities and factor immobilities, such structural adjustments can easily generate a pattern of large and sustained unemployment.

If trade liberalization occurs under such circumstances, it can worsen an already difficult situation, but it would be a mistake to blame trade for the full extent of the problem. If offshore sourcing and trade in components increase under such circumstances, our earlier analysis has shown that the effect may be to worsen but also to improve the situation. If the situation worsens, it would be a mistake to blame trade for the full extent of the woes, if it improves partly it would be entirely inappropriate to blame trade for the remaining unemployment and economic weakness.

6 Conclusion

In recent years, problems of income inequality in the United States and of high and sustained unemployment in the European Union have received increasing attention from scholars and policy makers alike. These years have also witnessed the "globalization" of national economies and the emergence of low-wage countries as important trading partners. It is not surprising that some perceive a causal relationship in this coincidence of developments. It has, however, not been possible thus far to firmly establish such a relationship empirically - or to disprove its existence.

In this paper, we have examined the major ways in which trade shocks and the two policy concerns may be related. We have seen that it is not easy analytically to make the case for a clear-cut relationship between trade and income inequality or trade and unemployment. Among the insights, is the realization that there are other forces at work which affect trade and the other variables, making any apparent causality spurious. Second, even where changes in trade or in trade policy affect relative incomes and the pattern and level of employment, those influences may be positive as well as negative.

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