

The Performance of the U.S. Capital Goods Industry: Implications for Trade Adjustment

Throughout the 1970s, the capital goods industry was the strongest U.S. export sector and enjoyed mounting trade surpluses that culminated in a surplus of over \$45 billion in 1981. Between 1982 and 1987, however, the trade performance of the industry sharply deteriorated, generating a surplus of only \$3 billion in 1987 and accounting for roughly 30 percent of the increase in the merchandise trade deficit over those six years. Although the industry's trade performance improved in 1988, the marked decline in the surplus that had occurred earlier and the strong growth in imports that continued even after the dollar depreciation began in 1985 suggest that U.S. capital goods producers may have lost some of the underlying competitive strength they demonstrated in the 1970s. This article examines the extent to which a loss of competitiveness has occurred and analyzes its implications for the near-term course of adjustment in the capital goods trade balance.

A framework for the analysis is established by projecting how the capital goods trade balance would have evolved in the 1980s if exports and imports had followed their 1975-81 growth patterns. Deviations in the 1980s in the factors determining these 1970s growth patterns are then examined to see if the capital goods trade balance in the 1980s could have been expected to evolve differently than a simple extrapolation of its 1970s trend projection would have suggested. These underlying factors include exchange rate changes and other macroeconomic factors as well as longer term structural changes in the capital goods industry itself.

A continuation of 1970s trends would by itself have

implied that the huge surpluses of the early 1980s were not going to be sustained. A narrowing of the capital goods trade surplus to roughly one-half of its 1981 value by 1988 would have been predicted by the trend growth pattern—more rapid import growth than export growth—already observed in the 1970s. The surplus in 1988, however, was even smaller than that projected by 1970s trends, suggesting that new developments in the 1980s adversely influenced U.S. capital goods trade.

The long-run implications of macroeconomic factors in the 1980s do not appear to explain this poorer-than-expected 1988 trade performance. Rather, they seem to be beneficial to the U.S. trade balance. The net impact of 1985-88 dollar depreciation following 1982-84 dollar appreciation left the relative price competitiveness of U.S. capital goods in 1988 at about its initial 1981 level. The behavior of prices between 1982 and 1988 contrasts sharply with the steady loss of U.S. price competitiveness in the 1975-81 base period. The positive effect on the trade balance that ultimately can be expected to arise from the overall 1980s price pattern replacing the deteriorating 1975-81 price trend has been only partially undercut by faster average U.S. economic growth and slower average foreign growth during 1982-88 than during 1975-81.

Structural developments in the 1980s on net did hurt the U.S. capital goods trade position. The Asian newly industrializing countries (NICs)—Hong Kong, South Korea, Singapore, and Taiwan—began to offer stiff competition, particularly to U.S.-based information-processing equipment producers. U.S. producers of traditional factory equipment were hurt by a relatively

poor productivity performance combined with a sharp drop in sales to indebted developing countries. On the plus side, 1980s shifts in the composition of demand toward capital goods in which the United States was particularly competitive offered some help to the U.S. capital goods trade position.

Rough estimates suggest that the overall adverse effects of 1980s structural shifts about offset the positive effects that could ultimately be expected from macroeconomic developments. However, adjustment to macroeconomic developments, particularly the sharp dollar swings of the 1980s, is probably still incomplete, especially on the export side. It takes time for U.S. producers to set up foreign distribution centers and for foreign purchasers to become re-attuned to U.S. products. This delayed adjustment appears to explain in large part why the 1988 capital goods trade balance fell short of its projected level based on 1970s trends.

Even if full adjustment to 1980s macroeconomic developments is achieved in coming years, without further macroeconomic changes a continuation of the structural changes that occurred in the capital goods market during the 1980s is likely to result in a gradual deterioration in the capital goods trade balance during the 1990s. The pace of the deterioration may be rela-

tively slow, however, because of the favorable effects of the changing composition of world demand for capital goods and the likely slowing in the rapid expansion of productive capacity abroad. If full adjustment to 1980s macroeconomic developments is not achieved because foreign producers are able to maintain some of their market share gains from the 1980s period of dollar appreciation, the U.S. capital goods position will be weaker and its deterioration may quicken in pace.

The following section briefly describes the U.S. capital goods industry and its recent performance. The next section discusses the trends in capital goods exports and imports during 1975-81 and, on the basis of these trends, shows how capital goods exports and imports would have evolved in the 1980s. The macroeconomic and structural factors influencing capital goods trade in the 1980s are then compared with their 1975-81 trends. Changes in these factors are examined and estimates are made of the impact of the changes on capital goods trade. A final section adds the estimated effects together and discusses the role of delayed adjustment in explaining the export shortfall. This is followed by some concluding observations on the trends in place in the 1980s and their effect on the evolution of the capital goods trade balance in the 1990s.

Table 1

Major Products of the U.S. Capital Goods Industry

Industry†	Major Products
Noncomputer machinery and equipment	Generators; motors; transformers Steam and gas turbines Nuclear power boilers Robots; numerical controls Machine tools; hand tools Mining equipment; oil rigs Pumps; compressors; fans Heating, plumbing and refrigeration equipment Farming equipment; food processing equipment Textile machinery; papermaking machinery Hospital and medical equipment
Computers and information-processing equipment	Mainframe computers; PCs Supercomputers Magnetic and optical disks Semiconductors Telecommunications equipment
Nonautomotive transportation equipment	Aircraft; satellites Railroad equipment

†Industry groups reflect the Department of Commerce method of classifying exports and imports of capital goods.

The U.S. capital goods industry: products and recent performance

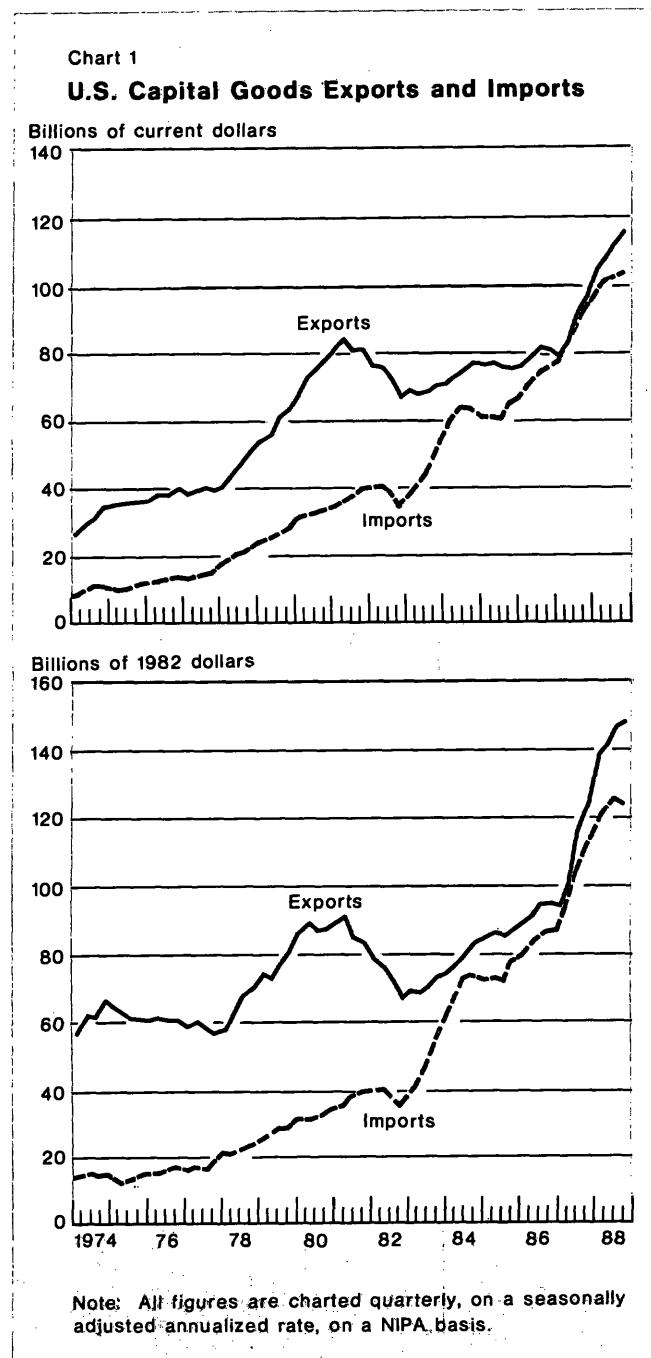
The U.S. capital goods industry manufactures a broad range of production-oriented machinery and equipment, as well as all nonautomotive transportation equipment. Examples of the major products of the U.S. capital goods industry are listed in Table 1. Although the products are all of an investment nature, they span a broad range of type, cost, and technological sophistication. One category of machinery and equipment covers computers and other information-processing equipment; it includes telecommunications equipment, semiconductors, and precision measuring instruments. A second category covers noncomputer machinery or more traditional factory equipment. A third category consists primarily of aircraft.

The traditional competitive strength of the U.S. capital goods industry is reflected in a current and constant dollar net export surplus throughout the 1970s and early 1980s (Chart 1). Strong export growth generated a peak nominal net export surplus of over \$45 billion in the first quarter of 1981. Thereafter, the picture changed. Sustained growth in imports virtually eliminated the net export surplus by the first quarter of 1987. Since then, however, the U.S. trade performance has shown steady improvement.

Capital goods trade has expanded rapidly relative to

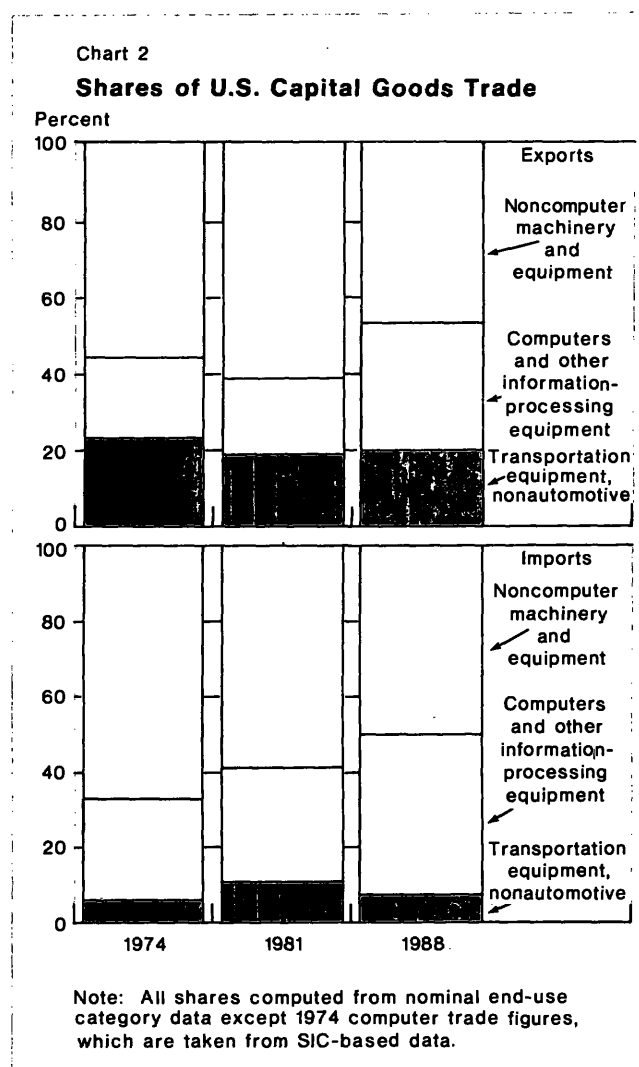
the trade of other commodities. In 1988, capital goods accounted for 47 percent of total nonagricultural exports.¹ This share compares with 44 percent in 1981 and 40 percent in 1970. Capital goods also raised their

¹Shares refer to real (inflation-adjusted) exports and imports.



share of nonpetroleum imports from roughly 11 percent in 1974 to over 30 percent by 1988. The shifting composition of exports and imports within the capital goods sector since 1974 can be seen in Chart 2. The share of information-processing equipment in both exports and imports has expanded largely at the expense of the noncomputer factory equipment category.

Western European and Japanese producers have been major competitors with the U.S. capital goods industry in world markets. Japanese producers are major suppliers of power generators, paper mills, and office machines, among other types of capital goods. West German producers command a large share of world exports of turbines, nuclear reactors, printing machinery, and several types of machine tools. In addition to these traditional competitors, the Asian NICs



have greatly improved their competitiveness across a wide range of information-processing equipment industries in the 1980s, raising their world market shares in all categories of office machines.

Factors influencing trade adjustment in capital goods

The first step in the analysis of the trade evolution of the capital goods sector in the 1980s is to project a trade performance level that could have been expected for the industry in 1988. This projection is made by estimating how the capital goods trade balance would have evolved in the 1980s had there been no change from earlier trends in the underlying factors—exchange rates, economic growth in the United States and abroad, and structural demand and supply factors—that determined the performance of the industry.² The analysis then turns to a comparison of the 1980s trends in these underlying macroeconomic and structural factors with those of the 1970s. This comparison not only helps to explain the extent to which the deviation in the performance of the industry from its projected path may be due to 1980s deviations in the underlying factors, but also clarifies how these 1980s trends will govern the evolution of the capital goods trade balance into the 1990s. Rough estimates of the effect of individual factors on the 1980s trade performance of the industry suggest the importance of each factor in the evolution of the capital goods trade balance.

The period 1975-81 is used as the base period to establish a projected growth pattern for exports and imports of capital goods. The first half of the 1970s is excluded to allow for adjustment to the sharp exchange rate movements accompanying the switch to floating exchange rates at the beginning of 1973. For an end point, 1981 is the year preceding the deterioration in the U.S. capital goods trade balance; the industry's loss of competitive strength in subsequent years is the focus of this analysis.

From a 1974 base, capital goods exports increased

40.1 percent, or 4.9 percent annually in volume terms, by 1981. Capital goods imports increased by 156.3 percent, or 14.4 percent annually, in volume terms. Since imports grew from a very small base, however, they continued to be dwarfed by expanding exports in dollar value.

These volume growth rates may be converted into nominal growth projections for the 1980s by assuming that the falling export and import price deflators for capital goods over the last seven years led to an equal increase in the volume of capital goods purchased.³ Falling capital goods price deflators in the 1980s primarily reflected technological advances in computers—in other words, for a given price a purchaser could buy a better quality computer in 1988 than in 1981. This shows up as a fall in the price of computers according to the price deflators. It is assumed that purchasers bought better quality computers as the decade progressed rather than reduce the amount they spent on computer purchases.⁴

If both these 1975-81 export and import volume trends had continued, by 1988 nominal capital goods exports would have been roughly \$115 billion and imports would have been \$95 billion.⁵ These trends alone would have reduced the capital goods trade surplus from \$45 billion in 1981 to roughly \$20 billion by 1988. Thus these trends suggest that developments in the macroeconomic environment and in the microeconomic factors relevant to the capital goods industry in the 1970s on net would have an adverse effect on the capital goods trade balance.

In contrast to the projected 1988 surplus of \$20 billion, the actual capital goods surplus last year was only about \$10 billion. An accounting of the deviation of roughly \$10 billion between the projected and actual capital goods trade balance in Table 2 shows that it was the result of a \$5 billion, or slightly less than 5 percent, shortfall in exports and a \$5 billion, or slightly more than 5 percent, overshoot in imports relative to their projected levels. These deviations of exports and imports from their estimated levels suggest that factors appeared in the 1980s that altered the growth patterns of the 1970s and at least to some extent adversely

²An alternative procedure would be to estimate pure competitiveness trend growth rates for exports and imports econometrically. Unlike actual growth rates, pure trend growth rates are independent of the impact of price and demand conditions. However, removing the impact of relative price and demand conditions on trade flows during the base period would make an understanding of why trade flows changed between the two periods more difficult. Consequently, the analysis here relies on a two-step procedure of first calculating actual export and import growth rates during the base period and projecting them through 1988, and then calculating the impact of a change in the trends in relative price movements and demand between the two periods. The analysis does assume that firms and consumers responded to changes in price and income in the 1980s similarly to the way they responded in the base period—in other words, that the price and income elasticities of demand remained constant.

³The capital goods export price deflator fell 18 percent between 1982 and 1988; the capital goods import price deflator fell 17 percent. The effect on purchases of the change in relative price between capital goods exports and capital goods imports is explicitly treated in the text.

⁴Some of the less advanced computer models of 1981 were not available in 1988.

⁵Actual nominal growth rates for 1975-81 were not used because of the high inflation rates of that period. The capital goods export and import deflators rose by roughly 50 percent over the period. If nominal growth rates had been used, projected exports would have been over \$215 billion and projected imports over \$135 billion.

affected U.S. capital goods producers.

The analysis now turns to the role of exchange rates, economic growth, and structural supply and demand shifts in the 1988 capital goods trade performance. The current disposition of these macroeconomic and structural factors will set the initial trend growth conditions for capital goods trade evolution in coming years. Moreover, an analysis of these factors will suggest where the sources of future improvements in the U.S. capital goods trade balance in the 1990s are to be found.

Macroeconomic developments

Exchange rates and price competitiveness

Large exchange rate swings in the 1980s significantly altered the prices of all U.S. goods relative to those of our trading partners. By 1985 dollar appreciation had reduced the price competitiveness of U.S. producers to its lowest level since the start of the floating exchange rate period.⁶ Subsequent dollar depreciation reversed that decline and raised U.S. price competitiveness to its highest rate over the same period.

These relative price movements are broadly mirrored in a comparison of U.S. capital goods prices with the dollar level of capital goods prices in Germany and Japan, our two major capital goods competitors. As Chart 3 shows, U.S. capital goods prices rose sharply relative to German and Japanese prices in the early 1980s through 1985, as measured by the respective capital goods components of the producer price indexes. U.S. capital goods prices then fell sharply, more than regaining their 1981 position relative to German and Japanese prices. In fact, by 1988 U.S. prices were about 20 to 25 percent more competitive relative to German and Japanese prices than they had been in 1981.

These relative price comparisons, although encour-

⁶These price comparisons are based on changes in the trade-weighted value of the dollar against the currencies of six other major industrial countries adjusted for movements in wholesale price indexes.

Table 2

Projected versus Actual Exports and Imports in 1988

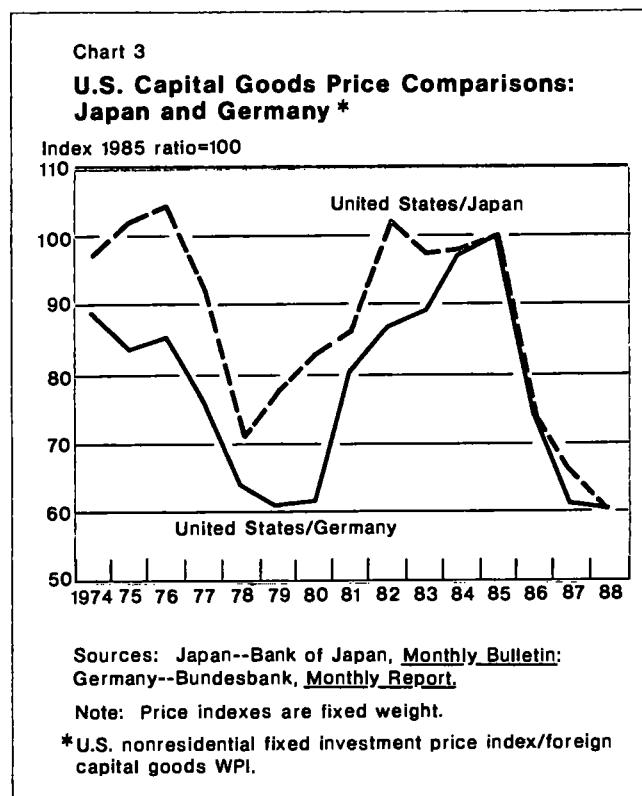
(Billions of Dollars)

	Exports	Imports	Balance
Actual level	110	100	10
Projected level	115	95	20
Deviation (actual-projected)	-5	+5	-10

aging, only partially reflect the price competitiveness of U.S. capital goods in international trade. The reason is that domestic capital goods price indexes both in the United States and abroad tend to give relatively low weight to internationally traded goods, such as computers, and relatively high weight to goods not as prominent in international trade, such as power transmission or heating, plumbing, and refrigeration equipment. Moreover, the United States trades capital goods with many other countries besides Germany and Japan. Notable among other trade partners are the Asian NICs. The currencies and, consequently, the prices of capital goods produced in these economies have followed a significantly different path against the dollar than have the currencies and prices of the major industrial countries.

Measuring U.S. price competitiveness in international trade by comparing U.S. export and import price indexes avoids these problems. Computers receive about equally high weight in both indexes and all U.S. trade partners are represented. Chart 4 shows that these indexes reveal a different picture of U.S. price competitiveness for the 1980s.⁷ U.S. export prices still

⁷These comparisons are based on fixed-weight price indexes. Fixed-weight indexes are a better measure of price competitiveness than



rise relative to import prices in the early 1980s before they reverse as the dollar starts to decline in 1985. By 1988, however, U.S. export prices have only fallen about 3 percent more than import prices compared to their 1981 levels. In other words, by this measure, the United States only marginally gained price competitiveness over the entire 1982-88 period.

On the basis of these trade price indexes, the 1980s relative price performance, netting its sharp up and down swings, contrasts with the relative price performance in the 1975-81 period. As Chart 4 reveals, on net during the 1975-81 period, the United States actually lost significant price competitiveness, with export prices rising 12 percent faster than import prices. Consequently, the ultimate effect of the trend of relative price movements between 1975-81 and 1982-88, once all transitional adjustments have been completed, is a positive impact on the evolution of the U.S. capital goods trade balance in the 1980s relative to its projected course.

The analysis of the effects of relative price movements assumes that no long-run, permanent effects of the 1982-84 dollar appreciation remain. Permanent effects could result if foreign producers had invested

during the 1982-84 period to reorient their factories to meet foreign capital goods specifications or to develop foreign sales and distribution networks. To the extent that such investments occurred, the impact of the 1985-88 dollar depreciation on U.S. exports and imports of capital goods may be weakened.

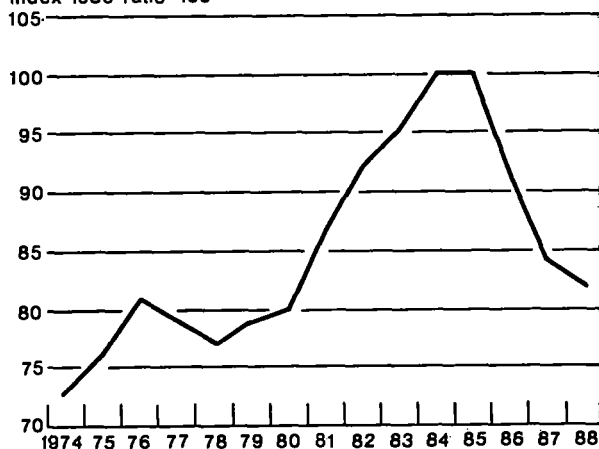
Estimated price elasticities⁸ may be used to judge how much on balance the improved price competitiveness achieved by 1988 benefited us by moving exports and imports away from their projected trend levels. Improved price competitiveness is measured by the relative price declines of U.S. capital goods over the entire 1982-88 period compared to the relative price increases that occurred in the earlier period. The elasticities provide rough estimates of the ultimate effects of dollar movements during the 1980s on U.S. capital goods exports and imports after all adjustments to the dollar appreciation between 1982-84 and to the subsequent depreciation between 1985-88 have been made. These elasticities imply that actual imports in 1988 were roughly \$5 billion less than they would have been if relative import and export prices had continued to follow their 1975-81 path. The improved price competitiveness pattern ultimately achieved between 1982 and 1988 can be expected to raise exports in 1988 by roughly \$20 billion from what the earlier trend would have suggested.

Footnote 7 continued
price deflators because they are not affected by the changing composition of trade.

Chart 4

Relative Trade Prices of U.S. Capital Goods.*

Index 1985 ratio=100



Note: Price indexes are fixed weight.

*U.S. export price/U.S. import price.

Relative economic growth

U.S. exports of capital goods reflect the influence of economic growth abroad. Similarly, U.S. imports of capital goods reflect the influence of economic growth in the United States. A shift in the rate of growth in either area will affect trade.⁹

The pattern of economic growth in the 1980s differed significantly from that in the 1970s both here and abroad. Table 3 shows that, as was the case with exchange rate movements, growth patterns during the early 1980s differed from those later in the period.

⁸Price elasticities state the percentage change in exports and imports that can be expected to arise from a percentage point change in relative prices. Elasticities are normally estimated by regression analysis and can vary significantly depending on the particular model specification, the price and income measures, and the time period used in making the estimates. The elasticities used here were estimated by the author and were 1.4 for exports and 0.6 for imports. Point estimates of the elasticities were used and the resulting changes were rounded to the nearest \$5 billion.

⁹There are several ways of measuring economic growth. Two common measures are domestic demand and GNP. These two measures can differ significantly over a short period of time. During the 1970s and 1980s gross fixed nonresidential investment growth in the United States and abroad more closely followed GNP growth than domestic demand growth. Because investment spending is most relevant for trade in capital goods and followed a path more similar to GNP than domestic demand, GNP is used as the measure of economic growth in the present analysis. Gross fixed nonresidential investment itself is not used because timely data are not available for all countries.

However, unlike the net effects of exchange rate movements, the average rate of growth in the 1980s relative to 1975-81 had clearly unfavorable effects on the U.S. capital goods trade balance.

Rough estimates of the effects on balance of the change in relative growth patterns after 1981 on capital goods exports and imports in 1988 may be calculated by applying estimated income elasticities to the differences between the average growth rates in the two periods.¹⁰ Multiplying the 0.5 percent annual deviation in economic growth in the United States between the two periods by the estimated U.S. income elasticity of demand for imports implies that actual imports in 1988 should be roughly \$5 billion more than their projected level based on the earlier U.S. trend growth rate. Similarly, the annual 0.1 percent decline in economic growth abroad multiplied by the estimated foreign income elasticity of demand for U.S. exports yields a figure for actual 1988 exports that is roughly \$5 billion less than the projected level based on the earlier foreign growth rate.

The combined macroeconomic effects

The macroeconomic environment of the 1980s was characterized by sharp exchange rate swings and changing patterns of economic growth both here and abroad. Table 4 shows the estimated effects on exports and imports of changes in macroeconomic factors that can be expected to occur once all effects of the swings in exchange rates have been completed. The \$5 billion decline in exports over projected levels and the \$5 billion increase in imports over projected levels due to

¹⁰Income elasticities measure the percentage change in exports or imports that can be expected from a percentage point change in a nation's income. The use of average growth rates omits the impact of cyclical changes in growth rates in any particular year on capital goods exports and imports. The income elasticities used here were estimated by the author and were 3.0 for U.S. imports and 2.7 for U.S. exports. Point estimates of the elasticities were used and the resulting changes rounded to the nearest \$5 billion.

Table 3

Annual Average Percent Change in Real GNP

	United States	Foreign†
1974-81	2.5	2.9
1982-88	3.0	2.8
1982-85	2.9	2.5
1986-88	3.3	3.2

†U.S. export-weighted average GNP growth rate for Canada, France, Germany, Italy, Japan, and the United Kingdom. Data for 1988 are based on first quarter annual averages.

relative income growth differences worsened the capital goods trade balance by \$10 billion relative to its projected trend. On the other hand, improved price competitiveness that emerged on balance from the sharp exchange rate swings of the 1980s raised exports by roughly \$20 billion and reduced imports by roughly \$5 billion relative to projected amounts based on the eroding price competitiveness of the 1970s. To the extent that capital goods exports and imports respond to price changes only with a lag, the entire effect may not have been realized to date. If full adjustment is assumed, then the combination of exchange rates and economic growth is estimated to have improved the capital goods trade balance over the level predicted by the 1975-81 trend growth pattern by about \$15 billion.

Structural factors influencing capital goods trade in the 1980s

U.S. capital goods producers faced growing challenges to their shares of both the U.S. and world markets in the 1980s. Principal among these challenges were the rapid expansion of capital goods production capacity abroad, particularly in the Asian NICs, and relatively poor productivity performance by several U.S. capital goods producers. Both of these factors eroded the competitiveness of U.S. producers in particular segments of the capital goods market and were part of a gradual evolution shifting the locus of production for some types of capital goods away from the United States. Because broad productivity and cost comparisons are not always helpful in examining the changes occurring within the capital goods industry, the analysis of these supply-side effects focuses on their impact on the performance of various sectors of the capital goods industry. Rough estimates of the effects of these longer term changes are made for particular industries and for

Table 4

Effects of Macroeconomic Factors on Projected Levels of Exports and Imports of Capital Goods

(Billions of Dollars)

	Exports	Imports
Growth in price competitiveness	+20	-5
U.S. economic growth	-	+5
Foreign economic growth	-5	-
Net impact	+15	0

Note: (+) refers to estimated increases, and (-) to estimated decreases, in exports and imports.

the overall capital goods trade balance.

Growth of new suppliers

Imports of capital goods from the Asian NICs increased from slightly below \$1 billion in 1974 to roughly \$4 billion in 1981 and to over \$18 billion by 1988. Marked growth in NIC exports of capital goods, especially in the computer and information-processing equipment category, has been observed throughout the industrialized world. The growth in capital goods exports between 1982 and 1988 occurred in an environment of high Asian economic growth and rapid productivity growth. When combined with relatively low wages, shown in Table 5, these factors have made Asian NICs extremely price competitive.

The gains in the share of U.S. imports by the Asian NICs in virtually all categories of capital goods are shown in Table 6. The greatest gains were in the computer and telecommunications industries, the largest sectors in the information-processing equipment category.¹¹ These industries had relatively sharp increases in import penetration rates between 1982 and 1988.

A rough estimate of the impact of the exceptionally strong trade growth of the Asian NICs on U.S. capital goods imports in 1988 may be made by comparing the actual level of imports of \$18 billion with what imports from the Asian NICs would have been if the 1975-81 growth in their share of total imports had continued at the same rate in the 1982-88 period. This calculation yields a projection of \$11 billion for Asian NIC imports, implying actual Asian NIC imports accounted for roughly \$5 billion of the overshoot of total U.S. capital goods imports above their projected level.

The growth of the Asian NICs resulted in an increase in their purchases of capital goods from U.S. suppliers,

¹¹Imports of telecommunications equipment from the Asian NICs clearly benefited from the deregulation of the U.S. telephone industry and the 1984 divestiture of AT&T.

Table 5

Hourly Compensation Costs for Production Workers in Manufacturing (U.S. Dollars, Year Average)

	1981	1985	1988†
United States	10.84	12.82	13.44
Germany	10.53	9.60	17.27
Japan	6.18	6.45	12.57
Taiwan	1.18	1.44	2.44
South Korea	1.08	1.46	2.01

Source: Bureau of Labor Statistics

†1987 levels converted at 1988 exchange rates.

expanding from roughly \$2 billion in 1974 to \$12 billion by 1988. As a share of total exports, however, the growth that occurred in the 1982-88 period was largely a continuation of the rapid pace set in the 1975-81 period. Although exports to the Asian NICs in 1988 were above this projected trend level, the difference was not substantial enough to warrant an adjustment to the projected growth pattern of capital goods exports. Moreover, export growth to the Asian NICs offset part of the slowdown in U.S. exports of noncomputer machinery and equipment in the 1980s due to the debt problems of developing countries and the decline in oil exploration activity. These latter effects are addressed directly in the discussion of the trade performance of low labor productivity growth industries within the non-computer machinery and equipment category.

The growth of the Asian NICs did have some adverse effects on U.S. capital goods exports. Declines in the world market share of U.S. producers in several computer and electrical machinery industries between 1981 and 1986 (the latest year for which data are available) coincided with gains in world market shares in these

Table 6

Regional Source of Supply of Selected Capital Goods Imports

Industry	Import Share (Percent) 1981		
	Asian NICs	Japan	Western Europe
Engines, turbines	0.5	19.5	62.9
Electrical equipment	12.0	27.2	33.3
Farm machinery	0.4	13.5	37.9
Construction machinery	1.3	16.4	40.1
Metalworking machinery†	6.4	38.3	41.6
General industry machinery	13.6	19.4	47.9
Computers†	17.5	37.5	22.9
Telecommunications†	20.4	39.8	5.9

Industry	Import Share (Percent) 1988		
	Asian NICs	Japan	Western Europe
Engines, turbines	1.3	23.9	52.3
Electrical equipment	12.5	31.7	26.3
Farm machinery	1.8	19.7	47.7
Construction machinery	2.5	32.6	44.2
Metalworking machinery†	7.6	46.3	35.6
General industry machinery	12.0	23.5	46.9
Computers†	35.4	44.3	10.4
Telecommunications†	32.9	39.7	7.7

†1988 data may not be strictly comparable to 1981 data due to the reclassification of industries in 1988.

same categories by Asian NIC producers. A rough estimate of the impact of this loss of world market share for U.S. capital goods exports in 1988 may be made by comparing actual U.S. computer and electrical machinery exports in 1986 with what U.S. computer and electrical machinery exports would have been if the U.S. had maintained its 1981 share of the world market.¹² This comparison extrapolated to 1988 suggests U.S. exports were roughly \$5 billion below their projected level because of the competitiveness of Asian NIC producers.¹³

Labor productivity and quality influences on performance

Aggregate labor productivity growth trends in the U.S. manufacturing sector between 1982 and 1988 largely reversed their 1975-81 relative decline compared to the productivity trends of major competing capital goods producers—Japan and Germany. This aggregate U.S. productivity improvement is to some extent reflected in relative price movements. To assess the role of labor productivity trends on the competitiveness of U.S. capital goods producers in the 1982-88 period, this analysis focuses on the performance of capital goods industries that exhibited marked differences from the average performance of the manufacturing sector.

High labor productivity growth industries

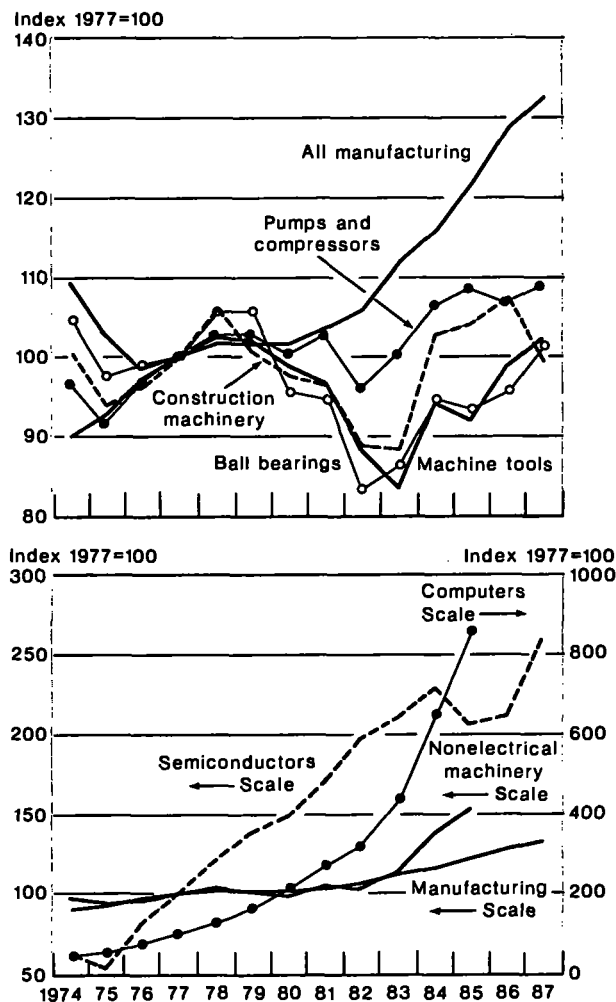
An examination of the available data on labor productivity trends in industries producing U.S. capital goods suggests that relatively high productivity growth has been seen in the information-processing equipment industries. Data describing the performance of the semiconductor industry show above-average productivity growth over the entire 1975-87 period (Chart 5), although the industry's performance slowed somewhat between 1982 and 1987. The data describing the aggregate category of nonelectrical machinery—a category that includes the computer industry in addition to a broad range of other more traditional factory equipment industries—show that it achieved above-average performance over the 1974-85 period. Productivity trends in the computer industry itself indicate that its performance was well above average and dominated

the overall performance of the category (Chart 5).¹⁴ The employment performance of selected U.S. capital goods industries (Table 7) offers still further evidence that industries in the information-processing category

¹⁴The labor productivity measures for both the nonelectrical machinery industry and the computer industry are only available through 1985 and are taken from unpublished data of the Bureau of Labor Statistics.

Chart 5

Labor Productivity in Selected U.S. Capital Goods Industries



Source: Bureau of Labor Statistics. Data for the computer and nonelectrical machinery industries are unpublished.

Note: All indexes calculated by output per hour.

¹²Loss of U.S. market share may, of course, be due to factors other than strong competition from the Asian NICs. Nevertheless, estimates of the loss of U.S. export markets in a limited set of industries where Asian exports have been increasing may be assumed to reflect largely the growth of supply capacity in the NICs. World market share is measured as world exports minus U.S. imports. Data on Taiwanese exports are taken from the 1988 Statistical Yearbook of the Republic of China.

¹³World market shares shifted away from the United States to the Asian NICs in other capital goods categories as well. However, the dollar magnitude of these shifts was relatively small.

generally performed substantially better than the other capital goods industries between 1981 and 1988.

This favorable performance, however, did not prevent the information-processing equipment industries from experiencing about the same degree of growth in import penetration ratios as the other industries experienced over this period, as shown in Table 7. The apparent reason is that productivity growth in foreign information-processing equipment industries was also high. Support for this explanation is provided by the data on the manufacturing sectors in Japan, South Korea, and Taiwan in Table 8. Although strictly comparable international data are not available, the table presents data describing the performance of the overall

manufacturing sector in each of the three Asian countries and the performance of the broad electrical equipment industries, a grouping that in each of these three countries includes the computer industry (in distinct contrast to U.S. classifications). Despite the above-average performance in the U.S. semiconductor and nonelectrical machinery industries, here representing the U.S. information-processing equipment industries, the Japanese electrical machinery industry achieved rates of growth at least as high as those shown by both U.S. industries. Furthermore, high productivity growth in the manufacturing sectors of South Korea and Taiwan was exceeded by growth in those industries representing their information-processing categories.

Table 7

Employment Indexes and Import Penetration Ratios for Selected U.S. Capital Goods Producers

Industry	Employment Index†			Import Penetration‡		
	1974	(1981 = 100) 1981	1988	1974	1981	1988
Noncomputer machinery						
Electric transmission equipment	105	100	82	.03	.05	.10
Engines and turbines	95	100	66	.03	.13	.28
Construction, oil-field	86	100	58	.05	.07	.18
Machine tools§	93	100	83	.06	.22	.37
Information processing equipment						
Computers§	66	100	111	.10	.10	.31
Telecommunications§ (telephones)	98	100	75	.03	.04	.16
Electronic components	76	100	119	.14	.20	.31
Instruments	81	100	98	.08	.12	.22
Aircraft	84	100	108	.06	.07	.07

†Used as a proxy for real output.

‡Imports / domestic consumption.

§1988 data may not be strictly comparable to 1981 data due to the reclassification of industries in 1988.

Table 8

Labor Productivity Growth Comparisons: United States, Japan, South Korea, and Taiwan†

(Annual Percent Growth)

	United States			Japan		South Korea		Taiwan	
	Manufacturing	Semi-conductors	Nonelectrical Machinery‡	Manufacturing	Electrical Machinery	Manufacturing	Electrical and Electronic Machinery	Manufacturing	Electrical and Electronic Equipment
1975-81	2.0	15.1	1.0	6.5	15.0	n.a.	n.a.	8.0	8.7
1982-87	4.2	7.2	10.3	4.2	10.1	11.5	19.9	6.7	11.5

Sources: Japan — Statistics Bureau, *Monthly Statistics of Japan*; South Korea — Korea Development Bank, *Monthly Economic Review*; Taiwan — Council for Economic Planning and Development, Industry of Free China, *Monthly Bulletin*. Nonelectrical machinery data for the United States are taken from unpublished data of the Bureau of Labor Statistics.

†U.S. data refer to output per hour. Foreign data refer to output per employee.

‡Includes the computer industry. Data for this category are available only through 1985.

Consequently, the fact that U.S. producers had relatively high labor productivity growth does not appear to warrant an adjustment to 1988 exports or imports relative to their trend projection level.

Low labor productivity growth industries

Labor productivity growth was relatively low in several manufacturing industries in the noncomputer machinery and equipment category (Chart 5). Significant productivity declines in these industries generally began in the early 1980s, a major break from the 1970s trend, and continued through 1987 (the latest data available). Declining output was also observed over the 1982-88 period in several of these low labor productivity growth industries, particularly in the construction machinery industry, and reflected the decline in exports to the indebted countries of Latin America, the decline in oil drilling equipment exports, and the shift in the composition of world investment spending away from noncomputer machinery and equipment (discussed in more detail in the following section). Trade performance in these industries, measured by import penetration rates, also deteriorated, particularly after 1981. Some of these industries, such as construction machinery, have seen companies move production facilities abroad. Mergers and acquisitions have become relatively common in several other industries in the noncomputer category as they seek to adjust to shrinking markets.

Because of the strong association between output and productivity, it is difficult to separate the effects of relatively low productivity growth from other factors in accounting for the decline in output. Therefore, the estimates of the decline in exports in these industries with relatively low labor productivity growth encompass the effects of both lower productivity and the declines in demand that occurred in the 1982-88 period. A rough estimate of the impact of low labor productivity growth on capital goods exports may be based on exports in four representative industries: metalworking machinery; construction machinery; farm machinery; and specialized machinery for the textile, food, paper, and printing industries. If the world market share of U.S. exports in these industries (measured by world exports minus U.S. imports) had evolved in the same way as the U.S. share of the world market for all capital goods over the course of the 1980s, U.S. exports from these low productivity industries would have been about \$10 billion greater than they actually were by 1988.¹⁵ Consequently, low labor productivity growth in these industries is associated with a reduction in overall U.S. capital goods exports of roughly \$10 billion relative to their projected trend level in 1988.

¹⁵The above calculations are made on the basis of the evolution of market shares between 1981 and 1986 extrapolated through 1988.

A rough estimate of the effect of the relatively low labor productivity performance in the noncomputer machinery and equipment category on U.S. capital goods imports may be made based on imports in these same four industries. If it is assumed that the share of imports in each of these industries between 1982 and 1988 had grown at the same rate as the share of imports in total capital spending, imports would have been roughly \$5 billion less than their actual level in 1988. Relatively low labor productivity is thus associated with an increase in capital goods imports of roughly \$5 billion above their projected trend level.

Quality

It is difficult to get information on the changing quality of U.S. capital goods relative to the products of our major competitors. The evidence available suggests that in some capital goods industries, notably aircraft, the United States has maintained a superior quality reputation. In some other, generally less technically-advanced capital goods industries such as textile machinery, the U.S. quality reputation has suffered. In still other industries—for instance, electronic components—aneecdotal evidence suggests that U.S. quality deteriorated in the late 1970s and early 1980s before improving as the 1980s progressed.¹⁶ This scattered evidence indicates that overall the United States has had about an average reputation as a capital goods producer relative to that of our competitors. This reputation may have improved recently, but over the entire 1982-88 period the improvement has not been significant enough to warrant a separate adjustment in the explanation of the deviations between actual and projected U.S. capital goods exports and imports.

Shifts in the composition of capital spending

In addition to the shifts affecting the supply side of the capital goods market in the 1980s, important shifts between the major categories of capital goods being purchased can also be observed both in the United States and worldwide. The changing pattern of demand for capital goods has been characterized by an increase in the shares of information-processing equipment and, to a lesser extent, in the shares of aircraft, and a corresponding decline in the share of noncomputer machinery and equipment in total U.S. and world capital goods purchases.

This shift in the U.S. capital goods spending pattern carries implications for capital goods trade because

¹⁶Susan Hickok, Linda Bell, and Janet Ceglowski provide some quality comparisons in "The Competitiveness of U.S. Manufactured Goods: Recent Changes and Prospects," this *Quarterly Review*, Spring 1988, pp. 20-22.

imports provide a greater share of total U.S. purchases in some capital goods categories than in others. Roughly 25 percent of information-processing equipment purchased in the United States is imported. This exceeds the roughly 20 percent share of noncomputer equipment that is imported and is much larger than the 7 percent share of imports of aircraft and other non-automotive transportation equipment purchases.

To assess the effects on imports of the shift in the composition of U.S. investment spending between 1982 and 1988, the trend growth rates in the shares of information-processing equipment, noncomputer machinery and equipment, and nonautomotive transportation equipment in total U.S. capital goods expenditure between 1975 and 1981 were computed. The growth rates of these shares were then used to project the composition of total capital goods spending in 1988 that would have been observed had the 1975-81 trends continued. Applying the projected 1988 shares of spending in each category to the actual level of 1988 total spending on capital goods, and then multiplying by the 1988 shares of imports in total spending in each category produced the level of capital goods imports that would have been recorded for each category had there been no deviation from the 1970s trend in overall spending composition. These levels were then compared to the levels of capital goods imports that actually occurred.

The analysis shows that the share of information-processing equipment in total U.S. business spending in 1988 was roughly equal to that predicted by the 1975-81 trend. The share of nonautomotive transportation equipment in total spending, however, increased above its 1975-81 trend while the share of noncomputer machinery and equipment declined relative to its 1975-81 trend. Imports of computers based on trend shares, as a result, would have been roughly equal to their actual levels in 1988. Imports of nonautomotive transportation equipment, however, would have been about \$1 billion to \$2 billion lower than their actual 1988 level while imports of noncomputer machinery and equipment would have been about \$5 billion to \$6 billion above their actual 1988 level. The net effect of the changing composition of capital spending was to reduce the level of imports by roughly \$5 billion in 1988 below its projected level.

Although data for total world capital goods demand are not available, total world exports excluding U.S. imports may be used as a proxy to trace the outlines of worldwide shifts in capital spending.¹⁷ These data, available only through 1986, suggest that the shift in

the composition of demand toward information-processing equipment that was observed in the United States is occurring worldwide. World spending on information-processing equipment (represented by trade in the computer and telecommunications industries) increased as a share of capital spending from 9.5 percent in 1974 to 13.4 percent by 1986. The share of nonautomotive transportation equipment, however, decreased slightly, from 12.3 percent in 1974 to 10 percent by 1986. The share of noncomputer machinery and equipment fell from 78.2 percent in 1974 to 76.6 percent in 1986. Since U.S. producers had roughly a 40 percent share of the world market in 1986 in both computers and nonautomotive transportation equipment, compared to a 10 percent share in noncomputer machinery, this shift in demand suggests a stimulus to the exports of U.S. capital goods producers in the 1982-88 period.

A method similar to that used to estimate the effects on U.S. imports of the shifting composition of U.S. capital goods spending was used to estimate the effects of the changing composition of world capital goods spending on U.S. exports. That is, projected shares of total world demand (using world exports minus U.S. imports as a proxy for world demand) in each category of spending in 1986 were calculated by assuming that the 1975-81 growth pattern in the shares of world demand in each category continued through 1986. Applying the 1986 U.S. share of world exports in each category to the projected level of world demand in each category yields a projected level of U.S. exports. Deviation of the actual from projected levels is then attributed to the changing composition of world demand.

This calculation suggests that U.S. exports in 1986 would have been roughly \$10 billion greater than the level projected by assuming that the composition of spending in 1986 followed its earlier growth pattern. Increases in computer exports of roughly \$11 billion were offset by a decrease in exports of noncomputer machinery and nonautomotive transportation equipment of roughly \$3 billion.

The combined structural effects

Table 9 shows the estimated effects of the 1980s structural changes in the capital goods industries on the projected levels of capital goods exports and imports. The shift in the sources of supply of capital goods toward the Asian NICs had the effect of raising imports by \$5 billion and reducing exports by \$5 billion relative to their projected levels and worsening the capital goods trade balance by \$10 billion. Exports were further reduced by roughly \$10 billion as a result of poor productivity performance, which also raised imports by

¹⁷Data on world exports of capital goods are taken from the United Nations, *International Yearbook of Statistics*, 1977, 1981, and 1986.

\$5 billion. Shifts in U.S. investment spending away from the noncomputer machinery and equipment category in the 1982-88 period compared with the 1974-81 period resulted in a \$5 billion decrease in imports in 1988 while the worldwide demand shifts raised U.S. exports by \$10 billion, again relative to their projected level. The net impact of the structural changes in the 1980s was to reduce exports by \$5 billion and raise imports by \$5 billion relative to what the trend projections would have suggested.

Summing up

The net effects of the macroeconomic and structural factors on capital goods exports and imports are presented in Table 10. Macroeconomic developments in the 1980s compared to the 1975-81 trend period on balance are estimated to ultimately raise exports by \$15 billion relative to their projected trend level while leaving imports unchanged, and thus to improve the net surplus by \$15 billion. Structural changes, in contrast, hurt the performance of the U.S. capital goods industry in the 1980s. The estimated \$5 billion reduction in exports due to these changes partially offset the estimated improvement in exports due to the changes in macroeconomic conditions. Adverse structural changes also contributed \$5 billion to import growth. On net, the macroeconomic developments and structural shifts suggest that the actual 1988 capital goods trade surplus should have exceeded its projected level by roughly \$5 billion. But the actual 1988 balance fell short of its projected level by \$10 billion, leaving a \$15 billion gap unexplained.

If imports are considered separately from exports, the combined macroeconomic and structural changes largely account for the excess of actual imports over projected levels. These changes leave unexplained, however, a shortfall of roughly \$15 billion in actual

exports compared to projected exports. Part of this gap may be traced to the assumption that the full impact of the macroeconomic and structural changes has been realized. If adjustment to the sharp price changes that occurred in the 1980s has not yet been completed, some of the \$20 billion boost to exports estimated to have been provided by the net price developments of the 1980s compared to the 1970s price trend deterioration may be still to come. Consequently, the calculated overall macroeconomic effect on exports of \$15 billion shown in Table 5 may significantly overstate the macroeconomic effect experienced to date. A substantial decrease in the unexplained gap on the export side would result if the macroeconomic effect actually realized so far has provided significantly less strength to exports than the \$15 billion estimate.

Full adjustment of exports to the net result of the 1980s relative price swings may not have occurred yet for several reasons. The unprecedented runup of the dollar between 1981 and early 1985 greatly reduced the competitiveness of U.S. capital goods producers. With foreign purchasers turning away from U.S. products during this period, U.S. distribution networks languished abroad. Foreign manufacturing assembly lines also became geared to foreign capital goods specifications, while familiarity with U.S. products declined. The sharp fall in the dollar beginning in mid-1985 made U.S. capital goods much more price competitive. Substantial time is needed, however, for U.S. capital goods producers to rebuild and expand foreign distribution networks, reestablish foreign market awareness, and regear to meet foreign product specifications. Moreover, many U.S. companies started to produce abroad the capital goods they sold abroad as the dollar rose.

Table 9

Effects of Structural Factors on Projected Levels of Exports and Imports of Capital Goods

(Billions of Dollars)

	Exports	Imports
Demand shifts	+10	-5
Growth of Asian NIC suppliers	-5	+5
Productivity performance	-10	+5
Net impact	-5	+5

Note: (+) refers to increases, (-) refers to decreases, in projected levels of exports and imports.

Table 10

Combined Effects of Macroeconomic and Structural Factors on Projected Levels of Exports and Imports

(Billions of Dollars)

	Exports	Imports	Balance†
Actual 1988 level	\$110	\$100	\$10
Projected 1988 level	\$115	\$95	\$20
Deviation (actual—projected)	-\$5	+\$5	-\$10
Macroeconomic factors	+15	0	+15
Structural factors	-5	+5	-10
Net impact	+10	+5	+5
Unexplained gap	-15	0	-15

†Exports minus imports.

This outward movement of production will also take time to reverse.

These delayed adjustment factors are somewhat less important on the U.S. import side. U.S. purchasers could more easily switch back to purchasing U.S. capital goods as the dollar fell in the mid-1980s because U.S. distribution systems, acceptability of U.S. product specifications, and U.S. market familiarity never disappeared. Similarly, U.S. capital goods production abroad (with the exception of manufacturing operations in the Asian NICs, which have explicitly been taken into account in the structural shift calculations) primarily substituted for U.S. exports rather than becoming a source of supply of U.S. capital goods imports. The analysis has largely accounted for capital goods imports in 1988 and has left little room for further delayed adjustment.

Conclusion

A trend projection of the 1975-81 growth patterns of capital goods exports and imports implies that a narrowing should have occurred over time in the \$40 billion to \$45 billion capital goods trade surplus of the early 1980s. In fact, the 1975-81 trend projection suggests that the U.S. capital goods trade balance should have been only about half of its 1981 value in 1988. Adjusting this trend projection to take account of the effects of the structural changes and macroeconomic developments of the 1980s relative to the 1975-81 trend period implies that the 1988 capital goods surplus should have equalled roughly \$25 billion. The actual 1988 capital goods surplus of \$10 billion was, however, \$15 billion below this expected level, with the difference attributable entirely to a shortfall in exports relative to their expected level. A considerable part of this shortfall may be ascribed to delayed adjustment, that is, the fact that the positive effects of the sharp improvement in price competitiveness starting in 1985 may not have been fully realized to date.

Even if a trade surplus of as much as \$25 billion is

achieved after delayed adjustment is completed, the capital goods trade balance would of course remain significantly below the surpluses achieved in the early 1980s. This gap represents the declining trend already present in the capital goods trade balance in the 1970s due in significant part to the influence of structural factors. Moreover, a further decline in the surplus will likely result if structural developments in the 1990s follow their adverse 1980s pattern. This outcome appears probable although the pace of deterioration from structural developments may slow. New foreign suppliers such as Thailand, Malaysia, and other emerging Asia-Pacific countries could pose an increasing competitive challenge, and U.S. capital goods producers will have to contend with productivity advances by foreign manufacturers of capital goods. The growth of supply capacity in the four traditional Asian NICs, however, may slacken in coming years, and recent currency appreciation in some of the NICs may reduce competitive pressure on U.S. capital goods producers. Nevertheless, given the growing competitiveness of new foreign suppliers, these favorable developments will at best only slow the decline in the U.S. capital goods trade balance.

Consequently, macroeconomic changes are likely to be necessary to stem the capital goods trade deterioration. Some improvement could come from the foreign side if growth rates compensate over the next several years for the below-average 1982-88 performance. On the U.S. side, however, a continuation of relatively high recent economic growth rates would reduce the improvement in the capital goods trade balance arising from faster foreign growth. To go beyond stemming the deterioration and recapture some of the trade surpluses of the early 1980s may require not only stronger foreign growth and moderate U.S. growth but also some slowing of the adverse structural trends in the capital goods industry.

James Orr