FTC STAFF REPORT

INTERNATIONAL COMPETITIVENESS AND THE TRADE DEFICIT

JOHN C. HILKE AND PHILIP B. NELSON

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AND

THE TRADE DEFICIT

by

John C. Hilke and Philip B. Nelson

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EXECUTIVE SUMMARY

AND

POLICY IMPLICATIONS

Although a trade deficit in manufacturing is not a new phenomena for the United States, the growth of this deficit since the 1970s has stimulated substantial public concern. A commonly advanced theory is that deteriorating competitiveness in specific industries has caused the increase in the trade deficit.

Using statistical analysis, the study concludes that deteriorating competitiveness in specific industries is not an important explanation of the increasing aggregate trade deficit. The same industry-specific strengths and weaknesses that shaped U.S. trade flows in the mid 1970s continue to determine the general pattern of tradeflows in the 1980s. Instead, the increase in the trade deficit appears to be the result of economy-wide changes, such as the exchange rate and the growth of the U.S. economy.

Since the trend in aggregate trade deficits results from economy-wide, rather than the industry-specific factors, policies such as industry-specific quotas and tariffs will not have a significant effect on the aggregate trade deficit. Such policies are much more likely to hurt, rather than help, the productive capabilities of the U.S. economy. Finally, attempting to get foreign countries to remove restrictive trade practices may help particular American industries, but would have little effect on our overall trade balances.

The approach used in the study is to identify the factors that could cause deterioration of competitiveness in specific industries, and statistically estimate the effect of these factors on imports and exports in 360 industries. Seven industry-specific factors are considered, including unfair trade practices in other countries, supposed lack of research and development (R & D) in the U.S., union work rules, and restrictive antitrust laws. [1]

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[1] The effects of some of these other factors affecting competitiveness in specific industries, such as foreign quotas and tariffs, could not be fully quantified because of data limitations. For the variables that were not available over the full period of the study, supplementary information confirms that they were generally stable over the period. Results from the statistical analysis also indicate that trade flows are relatively insensitive to the changes in these variables.

INDUSTRY-SPECIFIC EXPLANATIONS OF THE INCREASED TRADE DEFICIT

Among economists, there is widespread agreement that changes in exchange rates and relatively rapid U.S. growth underlie the increasing trade deficits. [2] The results of this study confirm that conclusion. However, not everyone agrees with these so-called "macroeconomic" or "economy-wide" explanations. Some contend that deteriorating competitiveness in specific industries ("microeconomic" explanations) is the source of the deficits. For example, it is frequently alleged that an important reason for the decline in the U.S. manufacturing trade balance is unfair foreign trade policies. Another theory suggests that the decline is the result of inadequate capital investment or a lack of research and development (R&D) during the middle 1970s. Excessive wage increases in certain industries or union work rules that inhibit U.S. firms are put forward by some as being responsible for the increased trade deficits. Still others attribute

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[2] See **The Economic Report of the President** (1987), p. 97-123.

the recent decline in our manufacturing trade position to oil price increases or the restrictiveness of U.S. antitrust policy.

To test whether these explanations have any merit, the report attempts to quantity how the structure of individual markets and governmental policies affect trade flows. The study begins by identifying industry characteristics and government policies that the industry-specific "competitiveness" explanations predict will affect trade flows. We then analyze the relationships between these industry characteristics and imports, exports, and net imports (imports minus exports) to see if changes in these characteristics are important in explaining the increased trade deficit.[3] The study also examines international direct investment to see if direct investment is being substituted for trade. Finally, the impact of economy-wide factors on the trade deficit is examined.

Although each industry's competitiveness affects the level of imports and exports in that industry, in general we find that there have been no significant industry-specific changes affecting

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[3] Somewhat more detailed industry data are used in the analysis than have been used most prior studies. The analyses also include measures of foreign nontariff barriers, European industrial targeting, and Japanese industrial targeting not previously used in studies of this kind.

competitiveness that would explain the increase in the overall trade deficit.[4] The study examines seven major industry-specific explanations.

1. <u>The Foreign Trade Practices Explanation</u>. It has been asserted that significant increases in the assistance received by foreign firms from their governments have disadvantaged U.S. firms. It has been further argued that the cumulative effects of the assistance became critical by the late 1970s, resulting in a deterioration of the trade deficit. If this theory is correct, we would expect to see that U.S. firms in the industries most substantially affected by foreign governments' trade policies would have become relatively less competitive over time. For example, we would expect exports to fall relatively more in industries subject to significant foreign government import restrictions than in industries not similarly restricted. Similarly,

[4] In addition, the report finds that instances in which the trade flows have changed are generally associated with changes in direct investment by foreign firms in the U.S. or direct investment by U.S. firms in foreign countries. These changes in direct investment tend to amplify previously identified strengths and weaknesses of U.S. manufacturing, rather than indicate a change in the competitiveness of specific industries. For example, flows in international direct investment suggest that firms in unionized U.S. industries invest abroad to exploit U.S. technology.

U.S. firms that compete with foreign firms that have received the benefits of foreign governmental targeting should exhibit a deterioration in international competitiveness. Alternatively, we would expect to find that foreign trade restrictions had increased substantially over time. We use measures of tariff restrictions, non-tariff barriers, and industrial targeting by European nations and Japan to determine whether foreign restrictions on imports have increased the trade deficit. We find no evidence that existing trade barriers are associated with decreasing U.S. international competitiveness. However, the available data on changes in trade restrictions are very limited. We cannot determine the extent of changes, if any, in trade policies of foreign governments and the effect of such changes on the level of the trade deficit. Thus, while the study's findings provide no support for the hypothesis that foreign countries' trade policies are responsible for recent changes in trade flows, these conclusions are tentative.

2. <u>The Inadequate Investment Explanation</u>. Another assertion is that inadequate investment in the U.S. has been an important factor contributing to the trade deficit. For example, some argue that U.S. tax policies have led to a lower savings

rate and distorted investment incentives. These policies supposedly lowered the U.S. capital base in the late 1970s and made the U.S. less able to apply new production technologies. If this is the cause of declining U.S. competitiveness, we would expect exports to decrease or imports to increase more in capital intensive industries than in others, since these industries would be most affected by a decline in the availability of capital. However, no such change was observed.

3. The Declining Research and Development (R&D) Explanation. It has been claimed that expenditures on R&D in the U.S., which fell during the mid-1970s, allowed foreign firms to close the post-war R&D gap by the late 1970s and undermined our advantage in R&D-intensive products. Traditionally, U.S. industries that are relatively R&D-intensive have exported more and imported less that other industries, thus leading to lower net imports in those industries. However, statistical tests provide no evidence that changes in R&D have reduced exports and increased imports. Indeed, the results suggest that, if there is any change, U.S. firms have expanded their leadership position in R&D intensive industries by making foreign investments that employ their technological advantages.

4. The High Labor Cost Explanation. It has been argued that U.S. labor costs and unions have reduced U.S. competitiveness in recent years. Our analysis shows that exports tend to be lower and imports higher in labor intensive and unionized industries than other industries, but this should only cause an increase in the trade deficit if there has been a significant change in these factors over time. We first examined the relationships between imports and various measures of labor cost to see if the relationship changed, and found no evidence that shifts occurred. We then checked to see if there was any evidence that industries had become more unionized or labor intensive, and found none. Thus, we conclude that labor costs have not been a major cause of increasing trade deficits. [5]

5. The Union Work Rules Explanation. It has been suggested that union work rules and related practices reduced the productivity and adaptability of U.S. firms and thus encouraged imports, particularly in the late 1970s. If this were true, then industries that are highly unionized should, over time, have

[5] In regressions that include international direct investment in our measures of imports and exports, the relationship between foreign compensation and trade flows did change. The change suggests that foreign firms have invested directly in the U.S. in industries that intensively use skilled workers.

become less competitive internationally -- *i.e.*, imports would increase or exports would decrease in these industries. We tested for this by determining whether there were significant changes over time in the level of unionization and the unionization/trade-flows relationship. Although unionization is related to higher imports at any point in time, we found no shift in this relationship using the unadjusted trade flow data. This finding contradicts the simple union work rule explanation of trade deficits. However, when we adjust trade flow data to include international direct investment, our analysis suggests that U.S. owned firms operating in unionized industries in the U.S. have increasingly moved abroad to exploit U.S. technological advantages.

6. <u>OPEC Cartel Explanation.</u> Foreign cartels, particularly OPEC, hurt U.S. manufacturing firms and contributed directly to the deficit by increasing the price of imported inputs into manufacturing. In addition, it has been argued that U.S. firms that use substantial amounts of energy were disadvantaged relative to foreign competitors by the OPEC supported price

increases of the 1970s.[6] If true, energy intensive industries should have exported relatively less over time and imports of the products of these industries should have risen. We tested this by examining the relationship between trade flows and energy intensity in our sample of industries. There were no significant changes in these relationships.[7] Consequently, although oil prices had a major impact on imports of oil, OPEC pricing is not an important factor behind increases in the manufacturing trade deficits.

7. The Antitrust Explanation. Finally, antitrust regulations in the U.S. have been advanced as as a factor that prevents U.S. firms from rationalizing their production facilities and cooperating in ways required by today's internationally competitive market -- thereby widening our competition. One

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[6] Since U.S. energy costs tended to be relatively low before the OPEC price increases, the price of energy has risen relatively more for U.S. firms than for their competitors.

[7] In regressions that adjusted trade data for international direct investment, the relationship between our energy intensity measure and net imports did increase in significant ways. A similar change appeared for the variable representing intensive industry use of non-oil, depletable natural resources -- primarily in metals-based industries. We attribute at least some of this to the nationalization and divestiture of some U.S-owned foreign operations.

line of argument suggests that antitrust policies have prevented U.S. firms from merging to attain the size needed to compete in the world marketplace. This implies that the U.S. should have been increasingly disadvantaged in industries where size is important and/or where a few large firms account for most sales. We tested this explanation by determining whether there have been changes in the relationships between trade flows and measures of industry structure (such as the Herfindahl Index of concentration and a measure of minimum efficient size). The statistical tests evidence no changes in these relationships over time, and thus do not support an antitrust explanation of trade deficits.

ECONOMY-WIDE EXPLANATIONS FOR INCREASED TRADE DEFICITS

If the observed trade deficits do not result from changes in industry-specific characteristics, what is their source? Our conclusion is that the recent deficits are attributable to shifts in several economy-wide factors. Consistent with this view, we found that nearly all U.S. industries experienced declining trade balances to some degree during the 1980s. In addition, we observed a fairly direct relationship between U.S. trade deficits and key economy-wide factors, such as exchange rates and the growth in the U.S.'s total demand for goods and services relative to other nations' growth.

Our conclusion aligns with both economic theory and the findings of other economists.[8] The argument that exchange rates are largely responsible, is straightforward: changes in the exchange rate that increase the value of the dollar make U.S. goods more expensive relative to foreign goods, increasing imports and decreasing exports. While common delays associated with contracting for sales causes this basic relationship to operate with a lag, we nonetheless observe this fundamental international trade relationship to be present.

It would be expected that the demand for imports should increase with increases in the total national demand for goods

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[8] For example, the 1987 Economic Report of the President concludes: "The increase in the U.S. trade deficit is a macroeconomic phenomenon. Imports have grown strongly and exports have stagnated primarily because of the strong growth of the U.S. economy (especially in terms of demand growth) relative to other countries, the difficulties faced by many developing countries in managing their external debts, and the fall in U.S. price competitiveness associated with the large appreciation of the dollar between 1980 and early 1985." Economic Report of the President, 1987, p.97.

and services. From 1975 to 1986, real Gross National Product grew 36 percent in the United States,[9] and this growth exceeded the growth in demand in most foreign countries. Under these circumstances, U.S. import demand should have outpaced foreign demand for U.S. goods and services and increased the trade deficit. This is borne out by the data.

POLICY IMPLICATIONS

Sorting out the sources of recent trade deficits is important, since identifying the origin of the trade deficits helps determine what government actions, if any, are appropriate. Specifically, if transitory phenomena such as changing exchange rates and extremely rapid U.S. growth underlie the deficits, policy prescriptions based on concerns about industry-specific competitiveness will be misguided.

Our conclusion that recent trade deficits result from economy-wide changes, rather than the seven industry-specific explanations, suggests that policies such as quotas and tariffs that focus on relatively narrow industry characteristics do not address the fundamental causes of the trade deficit and are

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[9] Economic Report of the President, 1987, p. 246.

unlikely to have much affect on it. In addition, such policies are likely to hurt, rather than help, the productive capabilities of the U.S. economy. For example, an incorrect belief that restrictive trade practices are responsible can increase the pressure for "retaliatory" trade restrictions against countries that restrict imports of U.S. goods. Such retaliatory restrictions actually harm U.S. consumers by making imports more expensive. Such restrictions can also increase the cost of imported intermediate products used in U.S. export industries, making many U.S. products less, rather than more, competitive in the world market. Similarly, unjustified incorrect concerns about the roles of R&D and capital spending may encourage policies that could result in inefficient subsidies by the government. These misunderstandings about the cause of the deficit can lead to regulatory changes that benefit certain interest groups at the expense of consumers and exporters, but will not reduce the trade deficit. To the extent any government action is needed to deal with the trade deficits, policies should focus on economy-wide phenomena such as exchange rates and relative economic growth.

There are also policy implications from the analysis that explicitly includes international inflows and outflows of capital.

This analysis finds that firms move their investments from one country to another, taking the place of importing or exporting goods where overseas investment is cost-effective. Under these circumstances, trade policies that focus on improving imports or exports in the short-term can encourage firms to locate their operations at relatively high cost locations. Such policy-induced investments divert funds from the most productive investments which are needed to make America more competitive, and are unlikely to benefit producers or consumers on net.

CONCLUSION

Industry-specific trade policies are likely to be misdirected. Changes in industry characteristics have had only a minor impact on changes in U.S. trade flows and the trade balance. Changes in economy-wide factors such as exchange rates and differential growth rates provide a much better explanation. Consequently, there is little reason to believe that policy interventions such as quotas and tariffs in specific industries will substantially improve the overall trade balance. They may, for example, disrupt imports in one industry, but since the overall trade accounts must balance, imports are likely to increase in some other industry. Such disruptions and shifts in imports usually occur in ways that are economically inefficient, penalize exporters and other producers, and are costly to U.S. consumers.

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CHAPTER I
INTRODUCTION AND FINDINGS

A. OVERVIEW

Since the beginning of the 1970s, the United States has experienced a virtual trade revolution. Trade has increased much faster than the economy as a whole. As Table 1.1 shows, both imports and exports expanded during the past fifteen years. In the late seventies, imports started outstripping exports by historically large margins. A merchandise trade deficit has been present every year since 1976. Moreover, this deficit has increased dramatically in the 1980s.

What economic changes underlie the shift in U.S. competitiveness evidenced by the recent trade deficits? While economists who have addressed this question have employed different approaches, most have examined changes in macroeconomic variables to see if they generated the economic pressures that led to the recent trade deficits. Economists who have employed this approach have generally concluded that macroeconomic changes probably are the cause of the recent deficits.

Although macroeconomic theory suggests that trade deficits may be associated with a wide variety of factors, two events in the late 1970s and early 1980s have received particular attention, the rise in U.S. aggregate demand relative to foreign aggregate demand and the increase in U.S. interest rates relative to foreign interest rates. A relative increase in aggregate demand, whatever its source, is expected to lead to a trade deficit because a country's demand for imports is positively associated with the level of its aggregate demand. In this instance, the entry predicts that U.S. demand for imports is expected to rise relative to foreign demand for U.S. exports as U.S. aggregate demand grows relative to foreign aggregate demand.

A relative increase in interest rates can also lead to trade deficits by increasing foreign demand for U.S. financial assets. The link between financial flows that respond to interest rate changes and trade deficits is evident in standard balance of payments accounting relationships. The accounting relationships used in defining trade deficits require that a

Table 1.1

U.S. Merchandise Trade Transactions
(Relative to GDP and in Millions of Current Dollars)

Year	I+E/GDP (%)	Imports (I)	Exports (E)	Balance (E - I)
1962	6.5	16,260	20,781	4,521
1967	7.1	26,866	30,666	3,800
1972	8.8	55,797	49,381	-6,416
1973	10.6	70,499	71,410	911
1974	13.9	103,811	98,306	-5,505
1975	13.0	98,185	107,088	8,903
1976	13.6	124,228	114,745	-9,483
1977	13.9	151,907	120,816	-31,091
1978	14.3	176,001	142,054	-33,947
1979	16.1	212,009	184,473	-27,536
1980	17.7	249,749	224,269	-25,480
1981	16.7	265,063	237,085	-27,978
1982	14.7	247,642	211,198	-36,444
1983	14.0	268,900	201,820	-67,080
1984	14.9	332,422	219,900	-112,522
1985	14.0	338,863	214,424	-124,439
1986	18.5	365,233	218,837	-146.396

Source: Economic Report of the President, 1987.
Note: The 1985 trade values are preliminary. Trade flows for the first three quarters of 1986 were multiplied by 4/3 to estimate 1986 imports, exports, and net exports.

GDP is gross domestic product, the value of all goods and services, minus traded products.

nation's current account (comprised of the merchandise trade balance, the balance of trade on services, and net unilateral transfers) equals in size, but with opposite sign, the capital account. In other words, if there are capital inflows, then there must be a trade deficit. Given this accounting relationship, the inflow of foreign capital that is attracted by relatively high U.S. interest rates must lead to a trade deficit to satisfy the fundamental accounting identities that underlie balance of payments accounting.[1]

While explanations of recent trade deficits that are based on fundamental macroeconomic relationships are attractive to economists, many commentators have advanced alternative explanations that are rooted in microeconomic relationships. These commentators believe that these microeconomic

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[1] For similar treatments of the basic macroeconomic analysis of recent trade deficits see McCulloch (1986) and Tarr (1985). These authors also note that the recent trade deficits can be linked to budget deficits. This part of their argument involves another basic accounting relationship that is regularly used in macroeconomic analysis: Gross National Income (sales from output and consumption, investment, export and government) equals Gross National Product (uses of revenue for consumption, imports, saving, and taxes). Rearrangement of this basic accounting identity reveals that, when the government runs a deficit, private consumers must save more than U.S. firms invest, imports must exceed exports, or both. (Gov. Exp. - Taxes = Net Private Savings + Net Imports) Since the U.S. has run a large government deficit without a corresponding increase in private savings rates, the basic accounting identity indicates that the U.S. must run a trade deficit. Put slightly differently, the government deficit must be financed either by domestic savings or by borrowing from foreigners. Since domestic savings rates are fairly stable, economists expect that a deficit will be financed by borrowing from foreigners. Because the only way foreigners can loan the U.S. money is by running a trade surplus with the U.S., a U.S. deficit will be present when the government runs a deficit and domestic savings rates do not adjust.

characteristics have changed in ways that explain the relatively sudden substantial increases in imports and net imports. In addition, public opinion, for one reason or another, has not fully accepted the power of the macro-economic explanations for the trade deficits. We shall, therefore, investigate the microeconomic explanations of the trade deficit which have been offered by various sources.

The logical connections between these microeconomic changes and trade deficits have not been clearly drawn. In particular, supporters of these microeconomic-based hypotheses have ignored the fact that (absent macroeconomic adjustments) changes in the exchange rate could compensate for shifts in microeconomic relationships, leaving trade flows in balance.[2]

While the link between alleged microeconomic changes and trade deficits is unclear, empirical analysis of the microeconomic explanations can still be very useful. Specifically, if we find that the alleged microeconomic changes in the structure of trade have not occurred, then we will be in a position to directly reject the microeconomic explanations. For advocates of the microeconomic explanations, this approach may be more convincing than one which evaluates the microeconomic explanations indirectly through the use of general equilibrium or macroeconomic models.

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[2] For example, consider a simple trade model with two countries, the U.S. and Japan, and two products, x and y. Now suppose there is a fundamental change in the microeconomic characteristics of the two industries in which the U.S. goes from having an absolute advantage in both products to having an absolute disadvantage in both. After this change the U.S. would still have a comparative advantage in one of the industries and the exchange rate should adjust to restore the equilibrium in the balance of trade. Hence there is no reason even in this extreme scenario for there to be a link between microeconomic changes and the level of the trade deficit.

The microeconomic explanations have focused on identifying three types of microeconomic changes. First, there may be technological changes which alter trade flows. For example, changes in an industry's technology may alter factor intensities so that particular inputs are less important to successful international competition. Second, policy changes may alter trade flows through their effect on the openness of the U.S. or other economies or through their effect on the relative cost structure of U.S. manufacturers. Changes in tariff, quotas, or government subsidies clearly can have this effect, but other government policies may also be important. And third, the availability of needed inputs may change so that the competitive position of U.S. firms is altered. For example, when abundant mineral resources continue to be key for production, the U.S. position will change as the U.S. exhausts its relative supply of these needed resources. Any or all of these types of micro-economic changes might lead to growth in the manufacturing trade deficit. As a result, they have received substantial public attention.

If changes in microeconomic factors are the source of the recent trade deficits, we should observe a recent and major shift in the pattern of U.S. trade, since some industries will be more sensitive to changes in particular microeconomic factors than other industries. For instance, if relative U.S. wage rates have become more important in international competition, we should observe a particularly large rise in net imports in industries that employ relatively large amounts of high cost labor. In contrast, if macro-economic variables underlie the recent deficits, this type of structural shift in trade flows is less likely to be present.[3] As a result, we can reject many of the microeconomic explanations of recent trade deficits which have been advanced if we observe that economic relationships that traditionally have advantaged some industries over others in

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[3] While changes in macroeconomic variables may cause shifts in the structure of U.S. trade flows, this is less likely to be the case because many macroeconomic changes can affect all industries in quite similar ways.

international trade have been stable and that key industry characteristics, such as labor intensity, have also been stable. In the case of U.S. wage rates, if the relationship between wage rates and imports has not changed over time, and U.S. wages rates relative to those in other countries have not changed significantly, then wage rate are unlikely to have contributed to the increased trade deficit. Of course, if we do find that the alleged microeconomic changes have occurred, the trade deficit can not be attributed to them unless logical causal relationships can be identified.

Here, we study U.S. trade patterns from the mid-1970s to the early 1980s to determine if there has been a change in the structure of U.S. trade or in the characteristics of U.S. industries that would account for the increase in the U.S. trade deficit. In particular, we will determine if there are changes in the structure of trade flows that are consistent with microeconomic-based explanations of recent trade deficits (Chapter III). For the industry characteristics that we could observe at several points in time, we will also examine recent changes in industry characteristics that might account for the dramatic increase in the trade deficit even if the structure of trade flow relationships were stable (Chapter IV).[4] Our findings not only allow us to generally assess the relative importance of changes in microeconomic and macroeconomic factors to the observed rise in net imports,

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[4] For industry characteristics observed at only one point in time, we examined the sensitivity of net imports to changes in those characteristics (the elasticities of the trade flow variables with respect to interindustry changes in interindustry characteristics) to determine which characteristics would cause large changes in trade flows if their values shifted over time. Unionization and MES were the only ones with large enough elasticities to cause concern. We then obtained supplementary evidence that these characteristics were stable or changed in ways inconsistent with the microeconomic explanations being explored. Similar supplementary information was also sought for the remainder of the single point variables. Details about this procedure appear in Chapter IV, Section B.

but also provide us with empirical insights into the accuracy of some specific microeconomic explanations for the growth in the U.S. trade deficit.

Although a large number of microeconomic explanations have been offered, we focus on seven. These seven were chosen because they relate to a wide range of concerns and have each received considerable public attention.[5] Our focus is on testing perceptions of major recent changes in characteristics or changes in the competitive implications of industry characteristics. The seven explanations of U.S. trade deficits that we explore argue that recent trade deficits are due to: (1) uncompetitive wage demands by U.S. labor; (2) overly-restrictive union-sponsored work rules; (3) subsidization of industries by foreign governments; (4) OPEC cartel activity; (5) inadequate R&D investments by U.S. firms; (6) distortionary U.S. tax policies; and (7) overly restrictive U.S. antitrust policies.

For each of these seven explanations, we statistically test for the presence of major shifts in the relationship between U.S. trade patterns and market characteristics that are associated with each explanation. These tests were performed on data from 360 manufacturing industries for the period 1975 to 1981. For a smaller sample of 122 industries, we had data that allowed us to test for changes through 1984. These large samples provide us with the benefits of the broad perspective of comprehensive statistics, yet simultaneously allow us to recognize many industry-specific characteristics that affect trade patterns.

Our analysis draws on both international trade theory and our experience with techniques of industrial organization analysis that are frequently employed at the Federal Trade Commission in the review of competition issues. The combination of these theoretical perspectives led us to include in our study new data on foreign nontariff barriers.

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[5] The poll results in Appendix B.5 show that the public also appears to recognize several of these hypotheses as potential explanations for the growth in the trade deficit.

Japanese government industrial targeting, and European government industrial targeting. We believe that this is the first time that these variables have been included in a quantitative study of this type. We also include variables that researchers have previously identified as barriers to entry and as important determinants of the comparative advantages a nation has in competing in different industries.

The balance of this chapter reviews the seven microeconomic explanations for changes in trade patterns in some detail and then summarizes the report's findings. Chapter II outlines the theoretical reasons for including particular industry characteristics and trade policies in our statistical analysis and specifies the model that is to be tested. The third chapter presents the basic empirical findings that test for structural changes in the relationship between key industry characteristics and industry specific trade patterns. Chapter IV (1) examines changes in industry characteristics over time to see if changes in these characteristics could have increased the trade deficit, (2) reviews the empirical findings of Chapter III in light of the experiences of particular industries, and (3) highlights some of the macroeconomic explanations for changes in the U.S. trade balance.

B. *MICROECONOMIC EXPLANATIONS FOR THE SUDDEN AND SUBSTANTIAL CHANGES IN THE U.S. TRADE POSITION*

1. <u>The High Labor Costs Explanation</u>: Real U.S. wage demands and the resulting higher U.S. labor costs increased rapidly in the late 1970s and early 1980s as wage agreements anticipated continued inflation that did not materialize or sought to make up for unanticipated inflation in the late 1970s. These higher labor costs undermined U.S. competitiveness.

Table 1.2 suggests that this explanation has some merit. The last two rows of this table compare the change in output per hour and the change in compensation per hour for the U.S. and other industrialized countries. When compared to European and Japanese compensation, it appears that U.S. wages have risen faster than those of its trading partners. However, this finding must be qualified. U.S. wages have not risen so dramatically relative to other trading partners when measured in national currencies. Indeed, as the first row of the table indicates, U.S. compensation per hour, adjusted for the change in output per hour, has been about average for industrial countries during the 1975-1983 period.

2. <u>The Union Work Rules Explanation</u>: Union work rules and related practices have reduced the productivity of U.S. firms and thus encouraged imports, particularly in the late 1970s.

Table 1.2 reports the overall change in output per hour in the U.S. and some foreign countries during the 1973-1983 period. Among the countries listed, only Canada had a slower rate of change in output per hour than did the U.S.

Some characteristics of manufacturing processes used in the U.S. apparently reduced the ability of U.S. firms to increase their productivity as fast as their foreign rivals. Resistance of U.S. unions to innovative work arrangements

Table 1.2

Changes in Unit Labor Costs in the U.S. and Other Industrialized Nations 1975 - 1983

	U.S.	Canada	Japan	E.E.C.
Change in Unit Labor Costs in National Currency (%)	60.0	93.1	-8.8	89.0
Change in Unit Labor Costs in U.S. $ (%)	60.0	59.2	13.8	27.4
Change in Compensation per Hour (%) (in U.S. $)	91.2	88.3	105.8	72.1
Change in Output per Hour (%)	19.5	18.2	80.5	36.1

Source: United States Trade: Performance in 1984 and Outlook, Department of Commerce, 1985, p. 135.
Note: Unit Labor Costs is a labor cost measure that adjusts for productivity changes. Japan's negative reaching of -8.8% implies that productivity increases in Japan more than kept pace with wage increases.

has been alleged to be key to these differences in growth rates.[6] However, there are others. For example, the U.S. technological lead may mean that in most industries it is harder for U.S. firms to increase their productivity because they must pioneer new technologies. In contrast, it may be easier for foreign firms to improve their productivity since they can imitate U.S. firms. Alternatively, the high level of income in the U.S. may encourage U.S. firms to enter service industries, which traditionally have lower productivity growth rates than manufacturing industries.[7]

3. The Foreign Government Trade Practices Explanation: **Foreign firms have increasingly received assistance from their governments[8] and this aid has disadvantaged U.S. firms trying to compete in these industries. The cumulative effects of these practices became critical by the late 1970s.**

Foreign firms receive assistance in the form of industrial policy subsidies and nontariff barriers. Subsidies are provided both directly, and indirectly through financial controls or other regulations which reduce input costs. Nontariff barriers also are present in direct and indirect forms. Some nontariff barriers involve direct import control measures, such as quotas, voluntary export restraints,

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[6] For a discussion of wage flexibility, see Drucker (1983).

[7] See Lawrence (1984) for a discussion of the growth in the size of the service sector and the relative productivity growth rate of manufacturing.

[8] While foreign governments protect their manufacturers through the use of tariffs, recent arguments have not focused on tariffs as much as on these other forms of assistance. One reason for this is that the Tokyo Round and earlier trade negotiations reduced and placed limits on changes in tariff rates, which encouraged the use of substitutes for tariff protection. For example, Ray and Marvel (1984) argue that nontariff barriers have offset the trade liberalization resulting from the Tokyo and Kennedy Rounds.

voluntary price restraints, import licensing, customs procedures, exchange controls, domestic content requirements, "buy national" policies, discriminatory trading agreements,[9] and nontariff charges.[10] Nontariff barriers which affect U.S. exports indirectly include standards, distributor practices, and financial controls.

While foreign government industrial policy or targeting assistance is evident, it is not clear how widespread and effective it is. Moreover, assistance to domestic firms provided by the U.S. government may more than offset the effects of foreign government nontariff trade policies. As a result, if the affect of foreign trade practices is to be accurately assessed, it is important to include both U.S. and foreign government trade policies in analyses of trade flows.

4. <u>OPEC Cartel Explanation</u>: **Foreign input cartels, particularly the second large price increase associated with the OPEC cartel activities in the late 1970s, hurt U.S. manufacturing firms that use substantial amounts of energy.**

The rise in energy prices, which some analysts have linked to the behavior of OPEC,[11] had a significant direct effect on the U.S. balance of payments during the 1970s. Table 1.3 shows the U.S. crude oil price index from 1972 to 1983. This index indicates that fuel prices increased very rapidly starting in 1974. The reduction in supplies from Middle-eastern countries had a particularly dramatic price

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[9] These include arrangements involving barter, counter purchases of goods, and preferential sourcing arrangements.

[10] These nontariff charges include antidumping duties and countervailing duties.

[11] Exogenous forces, such as the reduction in Iranian output following the fall of the Shah, also contributed to these price increases. It is difficult to identify how much of the price increase was due to these other factors. Here all that is important is that there was a decline in supply, not its source.

Table 1.3

U.S. Crude Fuel Price Index
and
The Merchandise Trade Balance
With and Without Oil Imports

Year Balance	U.S. Crude Fuel Price Index	U.S. Merchandise Trade Total	U.S. Merchandise Trade Not Including Oil
1972	148.7	- 6,416	1,716
1973	164.5	911	9,300
1974	219.4	- 5,505	21,095
1975	271.5	8,903	35,903
1976	305.3	- 9,483	26,117
1977	372.1	- 31,091	13,909
1978	426.8	- 33,947	8,353
1979	507.6	- 27,536	32,964
1980	615.0	- 25,480	53,820
1981	751.2	- 27,978	49,822
1982	886.1	- 36,444	24,856
1983	931.5	- 67,080	-12,080
1984	931.3	- 112,522	- 55,222
1985	909.6	- 124,439	- 73,339

Source: Economic Report of the President, 1987.

effect because the quantity of energy demanded and supplied to the market (by other producers) proved to be insensitive to price (inelastic) in the short run. Since U.S. oil supply and demand did not change significantly in the short run, the value of petroleum imports increased dramatically. They peaked in 1980 at nearly 80 billion dollars, twenty times their 1972 level. The over seventy billion dollar increase in oil imports clearly had a substantial direct impact on the U.S. balance of payments. This is reflected in Table 1.3, which shows the merchandise trade balance with and without oil imports.

There may also have been a significant indirect impact on the U.S. deficit. U.S. manufacturing firms which used substantial amounts of energy may have been disadvantaged relative to foreign competitors. Because U.S. energy prices were considerably lower than energy prices elsewhere during the 1960s, U.S. firms' products and production processes were less well equipped for high energy costs. Moreover, since U.S. energy prices were initially lower, the increase represented a higher percentage increase in U.S. costs.[12] However, the flexibility of the U.S. economy may have allowed a more rapid adjustment than this explanation admits. And recently, oil prices have been falling, indicating that this explanation probably can not explain the most recent increases in trade deficits.

5. The Declining R&D Explanation: Expenditures on R&D in the U.S. fell during the mid-1970s, which allowed foreign firms to close the post-war R&D gap by the late 1970s.

As the first column in Table 1.4 shows, there was a dip in U.S. R&D expenditures relative to GNP in the mid-1970s. Moreover, as the table also indicates, Japan and West Germany increased the portion of their national income that

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[12] For example, while energy costs increased from $2.56 to $6.26 per million BTU's in the U.S. from 1976 to 1982 (244%), energy costs in Germany went from $4.51 to $7.24 (161%). See Brinner and Gault (1983).

Table 1.4

Expenditures for R&D as a Percent of GNP

Year	U.S.	France	W. Grm.	Japan	U.K.
1965	2.90	2.01	1.73	1.52	2.31
1970	2.63	1.91	2.06	1.85	2.05
1975	2.27	1.80	2.23	1.96	2.19
1980	2.38	1.85	2.42	2.22	NA
1981	2.43	2.01	2.49	2.38	2.47
1982	2.58	2.11	2.58	2.47	NA
1983(est.)	2.62	2.16	2.57	2.58	NA
1984(est.)	2.63	2.19	NA	NA	NA

Source: International Science and Technology Data Update, National Science Foundation, 1985.

is invested in R&D during this period. Thus, there is some support for the premise of this argument. However, it is not clear what effect the decline in the percent of U.S. GNP devoted to R&D had on U.S. trade performance. Since the U.S. GNP is much larger than that of its trading partners, the ratio of R&D expenditures to GNP is not indicative of the differences in the absolute expenditures of these countries. Moreover, the "dip" in the mid-1970s only implies a transitory shift in the flow of R&D learning, while it is the stock of R&D knowledge which is central to the relative technological efficiencies of different countries. Only if the flows were similar for a long period of time would these stocks near equality.

6. <u>The Inadequate Investment Explanation</u>: **U.S. tax policies have led to a lower savings rate and distorted investment incentives, sapping the U.S. capital base and making the U.S. less able to apply new production technologies. This long-term problem turned critical in the late 1970s.**

This explanation implies that the competitive position of U.S. firms in capital intensive industries has weakened substantially. To support this hypothesis, analysts have pointed to the contrast between U.S. policy toward capital formation[13] and policies in Japan and Europe where savings rates are much higher.[14] Table 1.5, which reports an index of relative capital investment levels for the U.S. and its

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13 Capital formation responds in part to capital costs. Capital costs include both equipment prices and borrowing costs. When total capital costs are analyzed, the U.S. has not generally been at a disadvantage, except in real interest rate costs in recent years (Eckstein (1983)). Including these real interest costs, costs of fixed assets have been more than twice as high in the U.S. as in Japan since the mid-1960s (Hatsopoulos (1983)).

14 U.S. personal savings rates have averaged about 6% of income since the mid-1970s. Average rates for other industrial countries have averaged two to nearly four times that rate (U.S. **Trade Performance in 1984 and Outlook**, p. 133).

Table 1.5

Indexes of Relative Capital Formation in the U.S. and Other Major Industrial Countries (1960-1981)

Country	1960-1981 Period	1974-1981 period
Canada	115.9	124.8
Japan	83.9	114.8
France	73.1	87.5
W. Germany	79.4	90.3
Italy	52.6	58.5
U.K.	47.2	52.0
U.S.	100.0	100.0

Source: Productivity and the Economy: A Chartbook, Department of Labor, 1983, p. 79.
Note: Comparative levels of real investment are based on international price weights. U.S. equals 100 in all periods.

major trading partners, does provide some support for this view. Apparently, both Canadian and Japanese firms were adding capital more quickly than U.S. firms during the 1970s. Indeed, capital formation was more than 10% greater in both countries than it was in the U.S.[15] Moreover, as a comparison of the two columns in the table indicates, all of the major industrial countries accelerated capital formation relative to the U.S.

While the statistics reported in Table 1.5 lend some credence to this explanation, they are not definitive. As noted above, only Canada and Japan had higher rates of capital formation than the U.S. This means that, while the difference in the rate of capital formation between the U.S. and most other countries may have been reduced, the U.S. is still adding capital more quickly than many other countries. And, given that the U.S. capital stock was much larger at the beginning of the period, the acceleration in foreign annual investment would have to be sustained for a long period of time for the gap to narrow significantly.

7. <u>The Antitrust Explanation</u>: **Antitrust regulations in the U.S. have prevented U.S. firms from rationalizing their production facilities and cooperating in ways that are required by today's internationally competitive market. During much of the post-war period antitrust policy was not a binding constraint on U.S. competitiveness because our major competitors were still impaired. By the late 1970s, the other countries were fully rebuilt and antitrust policy became a binding constraint hampering U.S. competitiveness.**[16]

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[15] U.S. nonresidential capital formation per employed person is used as the denominator, so the ratio for the U.S. is 100%.

[16] A number of trade complaints before the ITC have focused on the competitive strength of cartels seemingly facilitated by foreign governments. For example, see "Account of Japanese Cartel's Creation Is Provided by U.S. Machine-Tool Firm," **Wall Street Journal** (May 3, 1982), p. 20. In addition, U.S. firms interested in major joint R&D projects

Foreign antitrust laws, which govern mergers and joint ventures, appear to be somewhat more lenient than U.S. antitrust laws.[17] Some commentators have argued that this has allowed foreign firms to merge and attain economies of scale that U.S. firms have not been able to achieve. If this is true, it should be reflected in both higher foreign concentration levels and scales of operation. However, other information contradicts the view that foreign firms are able to attain larger scales of operation than U.S. firms. In particular, empirical studies indicate that U.S. firms and plants typically are larger than foreign operations.[18]

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have felt it necessary to obtain antitrust clearance before undertaking such projects. This may retard the ability to form and interest in technological joint ventures by imposing delays and making successful formation of the venture more uncertain.

[17] An international comparison of antitrust laws is complicated by the fact that some countries have substituted direct government regulation of industries for antitrust enforcement. Moreover, in studying the application of foreign laws, it appears that political considerations differ across cases, causing foreign laws to be more stringent in some cases than in others where the basic economics is the same. For a comparison of U.S. and foreign antitrust laws, see the relevant articles in the **Antitrust Law Journal** 50 (November 1981).

[18] Although foreign countries' markets are smaller, their concentration levels have been similar to those in the U.S. Industries concentrated in the U.S. are also concentrated abroad and have similar concentration levels. This means that, at least historically, foreign firms have operated at a smaller scale than U.S. firms. For a statistical analysis supporting this view, see Pryor (1972). One of the most complete studies of foreign firm sizes and plant sizes was published in 1975. It found that U.S. firms and plants (for the 12 industries studied) exceeded the average size of foreign plants (F.M. Scherer, et al. (1975).)

As Table 1.6 indicates, some foreign firms have been increasing in size relative to U.S. firms. Specifically, slightly over 65% of the world's largest firms were U.S. firms in 1959. With the growth of foreign firms during the 1960s and early 1970s, the U.S. share of the world's largest firms fell to slightly more than 45%. One possible reason for the emergence of these large foreign firms is foreign government efforts to rationalize their industries through mergers and joint ventures.

In summary, there is some evidence that is consistent with the view that shifts in fundamental microeconomic relationships underlie recent changes in the composition and structure of U.S. trade flows. However, this evidence is far from definitive. Evidence that contradicts each hypothesis is also present. As a result, more detailed analysis is required to reach conclusions. In subsequent sections, we examine the composition and structure of U.S. trade flows over time to see if there are structural shifts in the microeconomic relationships that underlie trade flows which are consistent with these seven explanations. We also examine changes in industry characteristics to see if such changes might account for the observed changes in the composition and structure of U.S. trade flows.

Table 1.6

Number and Percent of Sales of U.S. Companies
Among the World's Largest Companies by Industry Group
(1959 and 1978)

Industry	Total Number of Companies	Number of U.S. Companies		Sales of U.S. Companies as % of Total	
	1959 & 1978	1959	1978	1959	1978
All Industries	127	84	58	78.5	51.0
High Technology	51	34	24	78.8	47.4
Other	76	50	34	78.3	53.2

Source: U.S. Competitiveness in High Technology Industries, Department of Commerce, 1983, p. 53.
Note: Size is defined by sales. High-technology industries include aerospace, chemicals, electronics-appliances, and pharmaceuticals. Other industries include automobiles, food, general machinery, metal manufacturing, metal products, and paper.

C. FINDINGS

1. General Results

Based on our analysis of seven prominent microeconomic explanations of the trade deficit, there does not appear to be a sudden fundamental weakening in the industrial characteristics that have allowed U.S.-based producers to be successful in international markets. Traditional strengths remain largely intact.[19] Moreover, to the extent that structural change has occurred, it has been gradual and has built on historical U.S. strengths. Specifically, U.S.-controlled firms have found increasingly that investing in foreign production facilities represents their best opportunity to exploit their advanced technological and organizational know-how.

This stability in the fundamental comparative advantage relationships is inconsistent with widely held views linking microeconomic changes to the growth in the trade deficit during the 1980s. Macroeconomic models provide explanations that are much more consistent with empirical observations. We conclude, as have macroeconomists, that changes in macroeconomic factors, rather than any of the many microeconomic explanations which have been advanced, underlie recent U.S. trade deficits.

To a large extent, our findings simply reflect a basic economic fact: the comparative advantage structure that determines a country's trade patterns changes only slowly. For the U.S., comparative advantage forces have meant, and still mean, that the country is a net importer of commodities which are efficiently produced with relatively large amounts

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[19] Our statistical tests are designed to reveal a relatively sharp change in the structural characteristics that underlie trade flows with the rest of the world's, since the recent rise in imports has been quite pronounced. Gradual changes in the production relationships that affect bilateral trade patterns may not be revealed. For a discussion of evidence of this type of change, see Marston (1987).

of unskilled labor and a net exporter of commodities which require the relatively intensive use of skilled labor. These basic relationships have not changed significantly during the 1970s or early 1980s. Similarly, the U.S. continues to be disadvantaged in industries that are energy intensive, use depleting natural resources, or are heavily unionized. Higher minimum efficient scale requirements and higher R&D intensity continue to be associated with both higher imports and higher exports. And only weak relationships exist between capital intensity or industry concentration and the strength of the U.S. trade position.

The relationships between industry characteristics and trade flows are evident despite the presence of tariff and nontariff barriers and other government trade policies. Moreover, the effects of trade policies appear to be weak relative to the economic forces which result from differences in comparative advantage. Nonetheless, trade policies do have identifiable effects.

As one would expect, U.S. tariff and nontariff barriers are associated with lower net import levels. However, the statistical findings for foreign trade barriers are less clear. We attribute this to the fact that U.S. exporters face different trade barriers in different countries. Because our statistics aggregate trade barriers across countries, it may be the case that strong U.S. exports continue in many countries although these exports face substantial barriers in other countries. In addition, foreign trade barriers and industrial targeting efforts may arise as a reaction to U.S. export successes, yet not be strong enough to substantially reduce the U.S. exports in foreign markets generally.

Analyses of U.S. imports and exports test the competitiveness of the U.S. as a geographical unit. However, these analyses do not capture fully the competitiveness of U.S.-controlled firms, since many U.S. firms are multinationals. To measure the competitiveness of U.S.-controlled firms, output manufactured abroad using

U.S. know-how must be considered.[20] Similarly, U.S. output must be adjusted for output produced by foreign-controlled multinationals in the U.S.

To a large extent, the additional perspective offered by the analysis of the adjusted trade flow data simply confirms the findings based on the unadjusted data. The U.S. remains relatively strong in the same industries where it was strong in the previous decade. However, when the trade flow data are adjusted to reflect the presence of multinational corporations, some structural changes in trade patterns become evident. Basically, these changes evidence a strengthening of the relationships that have traditionally shaped U.S. trade flows. Apparently U.S. firms have increasingly exploited their more mobile competitive strengths by investing abroad. There is some evidence that this effort has been undertaken to overcome historical comparative disadvantages associated with producing in the U.S. Most notably, there is some evidence that this foreign investment is increasingly prominent in industries that are heavily unionized in the U.S.

Together, the analyses of adjusted and unadjusted trade flow data indicate that U.S. firms are not losing their relative competitive strengths. The adjusted data suggest that some changes are occurring in international direct investment, but these changes have not been echoed in changes in the composition of U.S. net imports. The gradual nature of any changes that are occurring highlights the basic stability of the structure of U.S. trade flows.

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[20] As Lipsey (1985) points out, there has been "a large shift in the geographical origins of exports by U.S. firms." For U.S. companies in general, the share of total exports supplied by the overseas affiliates of multinationals increased from 17.5 percent in 1957 to over 40 percent (over 45 percent including minority-owned affiliates) in 1977.

2. Specific "Microeconomic" Explanations

The structural stability which we observe is consistent with the view that shifts in microeconomic relationships are not an important source of recent trade deficits. Our statistical results, which relate to specific microeconomic explanations, confirm this conclusion. Indeed, we find that none of the seven microeconomic explanations for the recent increases in the trade deficit, as described in the introduction, are related to changes in the structure and composition of trade. Absent evidence of such changes, there is no reason to believe that these potential microeconomic issues contend with macroeconomic factors as the real explanations for the large observed increases in the U.S. trade deficit.

Turning to the first two microeconomic explanations (**High Labor Cost Explanation** and **Union Work Rule Explanation**), our data indicate that traditional relationships between labor market variables and trade patterns still hold. The U.S. continues to be at a comparative disadvantage in labor intensive industries. To the extent there has been change, it has been gradual and statistically insignificant. Moreover the U.S. appears to be doing well, and has slightly improved its performance, in high wage industries. Evidently, the U.S. continues to have an advantage in industries where human capital is important.

While union activities have affected the structure of U.S. manufacturing industries, this impact has been different from that suggested in the second explanation. Our data indicate that no change in the relationship between unionization and U.S. trade flows has taken place. However, as noted above, the data suggest that multinational corporations in unionized industries have shifted larger and larger shares of their output overseas. Apparently, this direct investment has added to U.S.-controlled output, rather than entirely substituting for exports from unionized industries located in the U.S. While this substitution may have identifiable effects on the structure of trade flows in the long run, we did not observe any significant effects to date.

The third and fourth explanations (**Foreign Government Trade Practices Explanation** and **OPEC Cartel Explanation**) involve actions taken by foreign governments. Although the data to test these explanations was particularly limited, our statistical tests found that foreign governments do not appear to have uniformly targeted "U.S. industries," that is industries where the U.S. has had a competitive advantage. While foreign government interventions are evident, these efforts vary from country to country and do not appear to have a significant effect on overall U.S. trade patterns. This does not mean that particular foreign tariffs, nontariff barriers, or targeting subsidies could not disrupt natural trade flows. However, it does mean that currently these effects are limited among our major trading partners.[21]

Actions by foreign governments which may have supported OPEC's efforts to raise energy prices did not significantly alter the structure of U.S. manufacturing trade, as the fourth proposition contends. The increases in world energy prices during the 1970s were dramatic and clearly had a significant effect on the overall balance of payments. However, our findings indicate that only when trade flows are adjusted to recognize the presence of multinationals is there a significant change in the comparative advantage structure across manufacturing industries.[22]

Turning to the fifth microeconomic explanation (**Declining R&D Explanation**), our data indicate that U.S. firms have not lost their comparative advantage in R&D intensive products. While U.S. imports of high technology products have increased over time, so have exports. Moreover, the overall structural relationships which determine the U.S.'s comparative advantages with respect to R&D do not appear to have changed significantly. To the extent change is evident, it appears that the growth of U.S. multinational

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[21] Offsetting actions taken by the U.S. government might limit the statistical significance of these foreign government policies to some degree.

[22] This shift is primarily in metals-based industries.

firms has allowed U.S. firms to exploit their comparative advantages in high technology through their foreign affiliates.

The remaining explanations (**Inadequate Investment Explanation** and **Antitrust Explanation**) involve policies of the U.S. government. According to these two explanations, high taxes on capital formation and overly aggressive antitrust enforcement efforts have undermined the competitiveness of U.S. firms. However, our data do not support either of these explanations.

The notion that relatively high taxes on capital, and resulting lower U.S. investment rates, have led to a growing U.S. disadvantage in capital intensive industries is not confirmed by our statistical tests. While some earlier studies using 1958 to 1976 data found that the U.S. had a growing comparative disadvantage in capital intensive industries, this trend did not continue in the late 1970s and early 1980s.[23] Our data do not reveal a strong U.S. comparative disadvantage in the production of capital intensive products, as this explanation predicts. Moreover, no significant change over the last decade was observed.

Our data allowed us to perform an indirect test of whether or not antitrust policies have prevented U.S. firms from attaining necessary scale economies. While we found that plant level scale economies were important determinants of trade flows, no evidence was found that suggests that the U.S. was disadvantaged with respect to attaining scale economics. In fact, the U.S. was a strong exporter in industries where economies of scale (MES) are important. Moreover, we did not find substantial advantages of concentration beyond the levels associated with these plant level scale economies. There also was no sign of significant changes in the comparative advantage relationships with respect to scale-related or concentration related variables. Consequently, our data do not support the position that the U.S. has been or is becoming comparatively disadvantaged by

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[23] See Maskus (1981).

antitrust laws that sometimes discourage high concentration levels.

3. Macroeconomic explanations

Given the stability of U.S. comparative advantage relationships over time, why has the U.S. trade deficit increased by so much? For some industries, the rise in net imports may simply reflect the fact that the characteristics of the industry have changed, so U.S. firms no longer have a comparative advantage. In particular, when the know-how needed to produce a commodity becomes standardized and cheap labor becomes a relatively more important input, we should expect that U.S. manufacturers will lose share to foreign manufacturers. However, our data suggest that industry characteristics have been relatively stable and do not explain the sizeable changes in trade flows.

As is suggested by simple macroeconomic models, much of the rise in net imports appears to be attributable to macroeconomic forces that have more than offset the advantages that U.S. firms have traditionally had in some industries. In fact, most industries have experienced increased levels of imports, suggesting that economy-wide changes underlie the problem. Examination of macroeconomic variables that could produce this type of shift in trade flows confirms that the rise in interest rates with the associated increase in the value of the dollar and, during some recent periods, the relatively rapid growth of U.S. aggregate demand appear to have stimulated net imports generally.

4. Summary

Our statistical analyses indicate that recent trade deficits are not due to weakening in the industrial characteristics which historically have been a source of U.S. strength. There has been relatively little shifting in either comparative advantage relationships or in industry characteristics that affect imports and exports. Indeed, the growth in direct foreign investment, which appears to support the most dramatic changes in trade flows that have occurred, has been associated with the exploitation of traditional

U.S. advantages. Moreover, the shift in the overall position of the U.S. relative to its trading partners has been fairly general, which is consistent with the argument that individual microeconomic explanations are unlikely to explain much of the recent rise in U.S. trade deficits. Given this finding, it is probable that the United States' recent loss in competitive position is largely attributable to macroeconomic forces. In particular, it appears likely that changes in relative interest rates and levels of aggregate demand best explain most of the recent increases in the U.S. trade deficit.

CHAPTER II

INDUSTRY CHARACTERISTICS INCLUDED IN THE STUDY

A. THEORETICAL OVERVIEW

Two economic literatures, international trade and industrial organization, analyze market attributes which affect import competition. Comparative advantage studies in the international trade literature deal explicitly with how inter-country differences in cost and demand structures create opportunities for mutually beneficial trade. The relevance of the industrial organization literature may be somewhat less readily apparent. Although early industrial organization studies typically did not focus on the importance of trade flows, the theoretical concepts used to analyze new sources of domestic competition are applicable to the study of international competitiveness. Indeed, there is a growing economics literature that applies traditional industrial organization approaches to trade issues.[24] Moreover, international trade effects are increasingly recognized to be important determinants of U.S. market performance.[25]

1. *The Concept of Comparative Advantage and Gains from Trade*

Fundamental to the economic analysis of international trade patterns is the assumption that countries differ. Some economic models have posited these differences directly, starting from the assumption that pre-trade (autarky) prices will differ across countries. Other economic analyses have gone back a step and shown that differences in the relative

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[24] See, for example, Krugman (1983) and Krugman (forthcoming).

[25] For example, see Esposito and Esposito (1971), Pagoulatos and Sorenson (1976), Marvel (1980) and DeRosa and Goldstein (1981).

quantities of resources,[26] in the relative productivities of resources,[27] and in demand patterns,[28] can cause countries to have different autarky price structures, which in turn shape trade patterns.

The gains from trade that are the focus of these analytical efforts are evident in even simple examples. Assume that a country must sacrifice three units of good X to produce one unit of good Y. In autarky, three units of good X will be bartered for one unit of good Y. If world prices are different (say two units of X are exchanged for one unit of Y), then the country can gain from trade.[29] Specifically, the country can improve its position by shifting resources from the production of X to the production of Y. For example, assume that the country's tastes, available resources, and technology would cause it to produce six units of both goods in autarky. International trade at existing world prices allows the country to produce 24 units of good X (6 plus 6 x 3) and trade 14 units of good X for 7 units of good Y. The net result of this shift in production and international trade is to provide the country with more of both goods than it had in autarky (10 units of X and 7 units of Y).

This numerical example illustrates two key tenets of trade theory: (1) there can be sizeable gains from trade and (2) the direction of trade flows depends on differences in

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[26] Vanek (1963) analyzed the possibility of differences in natural resource availability. Keesing (1967) and Leontief (1956) did early work on human capital/knowledge differences.

[27] Economies of scale may also affect trade patterns. See Keesing (1968) and Katrak (1973) for early discussions of the role of economies of scale.

[28] See, for example, Branson and Junz (1971) and Pugel (1978).

[29] Gains from trade will be present whenever the world prices differ from a country's autarky prices.

relative prices before trade, not absolute price differences.[30] The second of these points has several less intuitively obvious implications that may be useful in interpreting the empirical results later in the report.[31]

* In the framework of comparative advantage models, it is not possible to "lose" competitiveness across the board. If a nation trades internationally, at least some of its industries must have a comparative advantage and thus be competitive internationally.

* If a nation's overall productivity growth is lower than other countries' growth, this need not result in a loss of competitiveness for all industries (if the exchange rate is free to adjust). Instead, there will be a relative decline in real per capital income. To be sure, the effects may not fall uniformly on all industries. Industries for which productivity growth is lower than the national average will be likely to find themselves growing "less competitive" in the comparative advantage sense.

* Capital investment in a particular industry aimed, for example, at improving labor productivity may not make the industry (or firm) internationally competitive. This is true even in cases where the productivity gain exceeds that of foreign competitors. It is possible that the nation's overall productivity growth will exceed that of the industry (firm) in question. If that happens, the international competitive position of the industry (firm) may deteriorate, despite its best efforts at improving productivity, although it will be

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[30] In the example, we did not have to specify whether the world prices which led to the 2x1 ratio were $200 to $100 or $.02 to $.01. Either set of prices, no matter what the country's own autarky prices, would lead to the results noted in the text.

[31] For a more detailed discussion of these points, see **U.S. Industrial Competitiveness**, U.S. Department of Commerce (1980).

less competitively disadvantaged than it would have been without the effort.

* When industries lose international competitiveness because of relatively rising prices, this generally signals that resources should be internally reallocated within the country. Only if relative price changes are transitory or exceptional technological advances are expected, will it be efficient to ignore them.

* If average industrial productivity increases much faster in one country than in others, it is likely that some formerly competitive industries in that country will become noncompetitive. This will be true even if their productivity improves faster than that of their overseas rivals.

2. *Industrial Organization Models of Competition*

Industrial organization economics is concerned with how productive activities respond to the demand for goods and services in particular market contexts. While a comprehensive view of demand and supply forces in markets is typically found in industrial organization analyses, two structural characteristics of the market are often the focus of these analyses: concentration and ease of entry. Concentration measures are used as indicators of the coordination problems faced by existing competitors. The ease of entry is considered because it reflects the pressures which existing firms face from potential entrants. These two market characteristics are expected to be important in the analysis of international trade issues, since imports will be encouraged by monopolistic pricing by U.S. based firms and such pricing will only appear where foreign firms are barred from entry.[32]

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[32] While a number of definitions of "barriers to entry" have been proposed, at the heart of these definitions is the notion that potential entrants are at some disadvantage relative to established firms which allows the established firms to have the option of raising their prices above their costs if they can successfully coordinate their pricing

B. SPECIFICATION OF THE MODEL WHICH IS TO BE TESTED

1. Dependent Variables

Many explanations of the recent trade deficits implicitly assume that there have been fundamental changes in the comparative advantage relationships which determine U.S. trade patterns. Here, we study the factors which determine trade flows over time to assess the nature of these relationships and to examine how these relationships have changed.[33]

Subsequent empirical tests in Chapter III focus on the structure of trade flows. Import penetration (imports/U.S. supply), export penetration (exports/U.S. supply), and net import penetration ((imports - exports)/U.S. supply) are the primary measures of trade activity which are used in this study. However, we also use versions of these variables which are adjusted to account for international direct

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efforts (Bain (1956); Stigler (1968)).

[33] We focus on identifying the presence of structural changes in U.S. trade flows and the characteristics of these changes. We caution readers that our results can not be used to test the predictive accuracy of comparative advantage trade theories or to determine conclusively what factors are relatively abundant in the U.S. Because our model contains more industries than inputs into the production process, the sign of the regression coefficient may not reflect the relative abundance of the factor in the U.S. (Leamer and Bowen (1981)). However, to the extent regression coefficients are stable, the factors which shape U.S. trade patterns (such as industry factor intensities, U.S. consumption patterns, and relative U.S. factor endowments) are stable. For additional criticisms of cross-sectional analysis of trade flow data, see Leamer (1984) and Leamer (1986).

investments.[34] The individual variables are defined in Appendix A. Although trade penetration measures are used as the dependent variables, they are referred to in the text as trade flows, namely imports, exports, and net imports.

Trade flows into and out of the U.S. reflect only the competitive position of the U.S. as a geographic unit. However, as Table 2.1 indicates, the number and size of

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[34] Previous empirical work using direct foreign investment by the U.S. (DFI) and foreign direct investment in the U.S. (FDI) has not combined these international investment measures with trade measures, but rather has sought to compare investment to trade by examining whether the same variables that explain trade also explain investment. Baldwin (1979), Gruber, Mehta, and Vernon (1967) and Pugel (1978) follow this approach. Baldwin finds a nonlinear relationship (positive at low and high levels, negative at middle levels) between education and DFI and positive relationships between DFI and tariffs, concentration, and transportation. Gruber, Mehta, and Vernon (1967) find a positive relationship between R&D and DFI. Pugel (1978) finds that DFI is positively and significantly related to advertising intensity, the fraction of scientists, engineers, and managers in the work force, natural resources, and concentration, but insignificantly related to capital requirements. Connor finds both DFI and FDI to be positively associated with R&D and consumer goods.

Benvignati (1985), Pagoulatos and Sorensen (1975), and Lipsey and Kravis (1985) take a more directly integrative tact. Benvignati finds that DFI complements exports. Pagoulatos and Sorensen find a positive association between DFI and trade generally. Lipsey and Kravis, looking at the 1957 to 1977 period, explicitly combine consideration of trade and investment to try to get an overall assessment of the relative world position of U.S. originated managerial and technological abilities. They find that the U.S. position changed little over the period, if all multinationals are included.

Table 2.1

Direct Foreign Investment by U.S. Private Interests and Foreign Direct Investment in the U.S

Year	Direct Foreign Investment	Foreign Direct Investment
1972	89.9	14.9
1974	110.1	25.1
1976	136.8	30.8
1977	146.0	34.6
1978	162.7	42.5
1979	187.9	54.5
1980	215.4	83.0
1981	228.3	108.7
1982	221.8	124.7
1983	227.0	137.1
1984	233.4	159.6

Source: Economic Report of the President, 1986 and 1979.

multinational operations are growing. As a result, limiting the geographic scope of the analysis by focusing on U.S. trade flows prevents it from fully capturing the competitiveness of U.S. controlled firms. In particular, when factors are fairly mobile, the movement of factors may substitute for international trade. Specifically, direct foreign investment (DFI) abroad by U.S. firms may substitute for U.S. exports and foreign direct investment (FDI) in the U.S. by foreign firms may substitute for U.S. imports.[35] However, direct investment may also encourage exports from the firm's home country to the country where it set up its subsidiary.[36]

To measure the competitiveness of U.S.-controlled firms, output manufactured abroad using U.S. know-how must be recognized, as must the output of foreign-owned enterprises that operate in the U.S. Here, import penetration is adjusted

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[35] Much of the previous work on DFI and FDI has viewed international investment as a way to circumvent restrictions on imports imposed by governments. Indeed, one rationale for such government restrictions has been that importers might be induced to invest in the importing country if restrictions are placed on their importing activities. A relatively early exception to this interpretation is Gruber, Mehta, and Vernon (1967). They argue that U.S. DFI is not simply due to actual or threatened trade barriers, but to the desire to sell a firm's production, finance, marketing or general organizational know-how.

Additional clarification of these two interpretations of international investment might be obtained by examining country by country trade patterns. Gruber, Mehta, and Vernon (1967), for instance, suggest that the U.S. comparative advantage with respect to Europe is much less clear than it might be because of U.S. investment in Europe. Since such U.S. investment has been much less substantial in other areas of the world, trade patterns should more clearly reflect comparative advantage in other areas, according to this view.

[36] See, for example, Wysocki (1986).

by adding an estimate of the output of foreign-owned facilities in the U.S.[37] Similarly, export penetration is adjusted by adding an estimate of the output by U.S. owned facilities that are located outside of the U.S.[38]

Adjustment of trade laws for DFI and FDI is expected to affect the relationship between industry characteristics and the measure of trade flows. These effects are anticipated to differ depending on whether the industry characteristic is associated with mobile or immobile factors of production. Specifically, the adjustment of the trade flow data should help highlight competitive strengths that U.S. firms have which involve mobile factors of production (such as, some types of know-how), since U.S. firms may often exploit these advantages abroad. In contrast, the adjustment of the trade flow data for international, direct investments will cloud the advantages that are associated with immobile factors of production.

We expect, based on the preceding theoretical arguments, that mobile factors for which U.S. firms have a comparative advantage will evidence a stronger positive (negative)

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[37] Adjusted imports are equal to industry imports plus the product of an appropriately scaled measure of the relative size of foreign controlled operations to all industry operations (FDI) and total U.S. output (P). The relative size of foreign operations is measured by taking the ratio of employment at foreign controlled plants to total industry employment. The equation is:
ADJUSTED IMPORTS = IMPORTS + (FDI*P).

[38] Adjusted exports are equal to industry exports plus a measure of U.S. controlled production abroad. U.S. controlled foreign production is measured by multiplying a measure of the size of this production relative to U.S. production in the industry [DFI/(1-DFI)] by total U.S. production in the industry (P). DFI equals a measure of foreign production divided by total (foreign and U.S.) production by the industry.
ADJUSTED EXPORTS = EXPORTS + [DFI*P)/(1-DFI)].

association with U.S. exports (imports and net imports) when trade flows are adjusted for direct international investments. Conversely, factors that are immobile will evidence weaker relationships when trade flows are adjusted for direct international investments.

Following Gruber et al. (1967) we view technological proficiency (measured by R&D expenditures) as somewhat more mobile than most other factors. In contrast, natural resource endowments and labor forces appear likely to be less mobile. Accordingly, we should observe that our adjustments strengthen the relationship for R&D, but weaken it for natural resources and labor force variables.

2. *Independent Variables*

International trade and industrial organization theories highlight the importance of market characteristics in determining trade flows. Our discussion is organized around four market attributes: production costs, demand conditions, barriers to new competition and other structural characteristics.[39]

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[39] Following Leamer (1984), the regression coefficients we report, and that most other authors have reported are of the general form $-(AA')^{-1}AT$, where A is a matrix of industry factor intensities and T is a vector of net imports. Using the Heckscher-Ohlin-Vanek equation, it can be shown that these coefficients also equal $-(AA')^{-1}(V-SV_w)$, where V is a vector of U.S. resource endowments, V_w is a vector of world resource endowments, and S is the U.S.'s share of consumption of V_w. While industry factor intensities will affect the sign of the regression coefficients through A, previous studies suggest that relative consumption adjusted factor endowments, as reflected in $(V-sV_w)$, are key in most cases. Thus, in the following discussion we predict the coefficient's signs based on the assumption that A has a neutral effect. For our stability tests, we simply assume that A, S, V, and V_w do not move so as to exactly offset each other. This appears sensible, since exact offsets of this type seem highly unlikely.

a. Costs

Our examination of the effects of production cost differences on trade flows focuses on three types of costs: labor, raw materials, and capital. Each of these has received considerable public attention as a possible source of competitive disadvantage for U.S. producers.

i. Labor

Labor inputs have been a central element in trade theory since Ricardo. Leontief (1953) featured labor intensity in his tests of the Hecksher-Ohlin comparative advantage model. Subsequent analytical efforts have distinguished between skilled labor and unskilled labor.[40] Given the relative scarcity of unskilled labor in the U.S. and minimum wage regulations, establishing a wage floor higher than those in many other countries, it is not surprising that the U.S. appears to be at a comparative disadvantage in industries which employ unskilled labor intensively.[41] However, the U.S. is a net exporter of goods that embody large amounts of skilled labor.[42]

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[40] Leontief also initiated this differentiation of labor intensity measures (Leontief (1956)).

[41] Most studies have found a negative relationship between net exports and a measure of unskilled labor (Bowen (1980)).

[42] Skilled labor is just one of several variables used to capture the concept of human capital as developed by Kenen (1965) and others to explain Leontief's finding that U.S. imports were capital intensive. The concept has been measured by assessing skill levels of workers in various industries (Keesing (1965), (1968); Hufbauer (1970)), educational levels (Baldwin (1971); Branson and Junz (1971)), and wage differentials (Hufbauer (1970); Bharadwaj and Bhagwati (1967); Baldwin (1971); Keesing (1966); Branson and Junz (1971); and Waehrer (1968)). A review of human capital measurement

Both labor and human capital intensity are included in the statistical analyses reported here. Based on earlier studies, we expect imports and net imports to be higher in labor intensive industries[43] and lower in human capital intensive industries.

The statistical analyses reported here also employ two other labor variables, foreign compensation rates and the U.S. unionization level. Foreign hourly compensation data are used to directly represent comparative labor costs.[44] It is

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issues is presented in Stern (1976).

Calculation of human capital by capitalizing income differentials with a single discount rate, such as used here and by Branson and Junz (1971), assumes that capital markets are in long-run equilibrium. Moreover, it assumes that all income differentials are due to differences in human capital. Observed imperfections in capital and labor markets violate these assumptions.

[43] The labor intensity variable used here includes both skilled and unskilled labor. As a result, it will reflect overall labor conditions. For example, it will reflect the overall usage structure of U.S. firms relative to the foreign competitors. However, the labor intensity variable is likely to be weighted toward less skilled industries, so it may also be viewed as a measure of the extent to which an industry relies on unskilled labor. Human Capital is measured as hourly compensation in an industry minus the minimum wage, multiplied by one over the interest rate, multiplied by labor intensity. If unions produce abnormal wage levels, the human capital variable will capture some union effects as well. The use of a separate union variable, however, will help identify the effect of unionization. The correlation between unionization and U.S. wage was .4 in 1981.

[44] Under the strict assumptions of the Heckscher-Ohlin model there will be factor price equalization. Wage differences do not exist and thus can not affect trade patterns in this model. As a result, economists who have explored this

hypothesized that higher foreign labor costs will strengthen U.S. exports and reduce U.S. imports. A measure of union activity is included to account for the possibility that union work rules and related practices adversely affect U.S. competitiveness.[45]

Our statistical analyses of the relationship these labor variables have with trade flows will help us assess the validity of the **High Labor Costs Explanation** and the **Union Work Rule Explanation.** If industries are not using labor, particularly unionized labor, more intensively today than they were in the past and if the structural relationships between labor variables and trade flows have not changed significantly over time, then these two explanations would appear to have little merit.[46] Put simply, labor force changes will have been too small to effect such a drastic change in the trade flows.

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model have tended to omit wage variables. The foreign wage variable is measured as average foreign compensation by industry expressed in U.S. dollar equivalents.

[45] Baldwin (1971) found a positive relationship between net exports and unionization. This positive association between trade and unionization accords with the generally pro-trade approach of the unions during the 1960s period studied by Baldwin. See Mitchell (1970).

[46] If structural relationships were stable, with labor variables positively associated with net imports and use of (union) labor had increased dramatically, there would be some support for the labor hypothesis. Similarly, if use of (union) labor had remained stable, but the structure of trade showed major increases in net imports where labor use was high, the labor hypothesis would be supported. Increases in both labor use and the association between labor intensity and net imports also would support the labor hypothesis. Absence of both types of changes, however, provides no support to the labor hypothesis.

ii. Research and Development

Both the industrial organization and international trade literatures have recognized that know-how is important to successful entry into some industries. Moreover, it is common for both groups of economists to use R&D expenditures as a proxy for the importance of knowhow. Nonetheless, the overall relationship between R&D expenditures and entry is somewhat ambiguous. On the one hand, large R&D expenditures by incumbents may indicate the presence of a sizeable know-how advantage that insulates incumbents. For a country like the U.S. with advantages in R&D, R&D intensity should indicate an area of competitive advantage. On the other hand, sizeable R&D expenditures might indicate that entrants may be able to replicate this learning less expensively or that entrants may be able to develop new products that are different and/or better than those of established brands, thereby facilitating entry.[47] If so, trade should be greater generally with each country both importing and exporting specialized goods within the same industry.

In the context of international trade, these relationships suggest that R&D intensity will have contradictory effects on U.S. import flows. To the extent R&D allows entrants to develop new (perhaps differentiated) products and, therefore, increases national specialization in producing specific versions of differentiable products, it will promote trade generally. Imports should increase as a result. On the other hand, the U.S. appears to be advantaged in performing R&D, which should reduce imports of products that use R&D

[47] William Comanor, in particular, has hypothesized that R&D activity signals that an industry is rich in opportunities for successful product differentiation. If so, such industries would be expected to experience above-normal rates of entry.

intensively.[48] For exports, the two effects that are contradictory for imports work together to produce a positive relationship between R&D and exports. The U.S. strength in R&D will increase exports, as will the general trade-enhancing effect of product differentiation that often accompanies R&D efforts.

Our statistical analysis of the influence of R&D expenditures on trade flows will help assess the validity of the fifth explanation, the **Declining R&D Explanation.** If industries are not changing significantly with respect to their R&D intensity and the relationship between trade flows and R&D intensity has not shifted significantly, then this explanation can not account for the sizeable shifts in trade flows that have been observed.

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[48] Large amounts of human capital appear to be needed to support R&D efforts. This relationship should give the U.S. an advantage in R&D intensive industries. Some economists have also argued that a large market for new products which is located close to the R&D effort is important for the development of technologically advanced products. Since the U.S. historically has been advantaged in both of these areas, trade theorists have predicted that the U.S. will have a comparative advantage in industries which use R&D inputs relatively intensively (Vernon (1966)). The latter approach leads to the prediction that the U.S. plays the role of innovator for many products. While the production of the new product is novel and changing rapidly, production is centered in the U.S. where critical technical support is readily available. As production becomes more standardized, however, less technically sophisticated labor becomes a more important element in determining cost competitiveness. Hence, over time, production might be expected to shift away from the U.S. Any decline in U.S. R&D effort would consequently be expected to result in declining U.S. competitiveness, with some lag, as production of old products moves to countries with cheaper unskilled labor and as fewer new products arise to be produced in the U.S.

iii. Raw Materials

Both industrial organization and international trade theories recognize that geographic differences in resource endowments can lead to differences in input costs. Where raw materials are costly to transport or face other geographic trade barriers, raw material input prices can vary.[49] This variation in input costs will, in turn, affect the location of manufacturing operations and thus trade flows. Trade theorists have emphasized this view,[50] often overstating the case by assuming that raw materials are completely immobile.

For the U.S., two types of raw materials appear likely to have particularly significant effects on trade flows, energy products and other depleting natural resources.[51] Domestic oil prices differed from prices paid by users in other parts of the world. During the 1960s differences in taxation caused U.S. manufacturers and consumers to face lower energy input costs than many of their foreign counterparts (Brinner and Gault (1983)). Not only did this shape trade patterns during the sudden rise in U.S. energy prices in the 1970s, but the relative increase in U.S. energy prices in the 1970s may have caused trade patterns to change

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[49] Baldwin (1971), for example, found that imports are more natural resource intensive than exports for the U.S. Since earlier empirical work found that natural resource variables were correlated with physical capital intensity, it appears to be important to include these variables to avoid biases.

[50] Vanek (1963) provided the first detailed incorporation of natural resource intensities in the empirical trade literature.

[51] Depleting natural resources are depletable natural resources for which U.S. supply appears to be small relative to U.S. demand. For example, coal is a depletable natural resource that is not classified as "depleting," while many metals appear to be depleting resources from the U.S. perspective.

The U.S. is hypothesized to be at a comparative disadvantage in the production of products that use depleting resources intensively. According to this theory, U.S. firms are disadvantaged by their location. Delivery costs to U.S. firms are thought to be higher. And discounts that foreign producers (often governments) of these inputs may give to their domestic customers are not available to U.S. firms.

Analysis of the nature of the relationship between trade flows and the energy intensity variable is important since it will reflect the importance of the **OPEC Cartel Explanation.** If the energy intensity of industries and the relationship between energy intensity and trade flows has not changed significantly, then this explanation can not be responsible for the sizeable changes in the U.S. trade balance.

iv. Physical Capital

Besides labor and raw materials, most production processes require the use of buildings and machinery. Trade theorists have hypothesized that countries that have abundant supplies of physical capital will be at a comparative advantage in the production of capital intensive goods. However, many types of physical capital can be acquired on world markets. If this is the case, industrial organization theory suggests that capital requirements alone, absent an association with economies of scale or financial market imperfections that inhibit the acquisition of capital equipment, should not differ across countries. Specifically, because the increasingly unified world financial market should provide fairly equal access to the funds necessary to obtain physical capital, countries should not be at comparative disadvantages with respect to capital intensity.[52] Despite

[52] All tests of comparative advantage have included capital as a key resource. In addition, policy analysts have criticized U.S. capital formation. A number of reasons for low U.S. capital formation have been advanced. Low U.S. savings ratios have been criticized; however, world financial flows would appear to compensate for this. Tax provisions that favor real estate development over manufac-

this potential weakness in the theoretical underpinnings of the argument, economists have emphasized the importance of capital to trade patterns. Usually it is assumed that the U.S. is abundant in capital and, as a result, has a comparative advantage in the production of capital intensive goods.

The analysis of the relationship between trade flows and capital intensity provides insights that are helpful in evaluating the weight which should be given to the **Inadequate Investment Explanation.** If there has been no change in the relationship between the capital intensity of U.S. industries and trade flows, and if U.S. industries have not changed their capital intensity significantly, then the capital investment behavior of U.S. firms does not appear to be a good explanation of the recent surge in net imports.

b. Demand Elements

Empirical studies of entry in the industrial organization literature have been fairly unanimous in highlighting the importance of growth in demand in encouraging entry.[53] Stigler and others have hypothesized that growth in demand encourages entrants and fringe producers.[54] This view is based on the belief that increasing demand assures entrants that any new supply they introduce will not depress prices to

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turing investments have also been noted. And finally, some commentators have argued that instability in U.S. fiscal and monetary policies has made it very difficult for capital intensive U.S. firms to successfully plan ahead and invest wisely (Eckstein (1984)).

[53] For empirical studies of entry, see, for example, Duetsch (1975), Gorecki (1975), Harris (1975, 1976), Orr (1974), and Hilke (1984).

[54] Stigler (1968) has been the basis for numerous subsequent treatments.

great extent and, as a result, will be less likely to trigger aggressive responses by incumbents.

International trade theory also predicts that growing U.S. demand will encourage shipments into the U.S. by foreign producers. However, the focus of this literature is on the profitability of diverting product from foreign markets and using excess capacity at foreign plants.

c. Barriers to Import Competition

i. policy barriers to import competition

Barriers to entry either arise from government action or are the product of market forces. Here, we focus largely on barriers imposed by government policies. However, we do recognize that economies of scale (especially with sunk costs) may also deter entry.

Barriers to entry insulate established firms from the competitive pressures of potential entrants. In the case of world markets, firms in protected national markets can raise domestic prices above world market levels without losing sales to imports. Both international trade and industrial organization theory recognize a number of government policies which tend to insulate markets, namely, tariffs, nontariff barriers (such as quotas or regulations that discourage imports), and government subsidization of particular industries (industrial policy).

Subsequent statistical tests consider each of these barriers to entry. Interpretation of the results for any barrier to entry generally follows from the basic theory outlined above. However, the results for the barriers raised by trade policies (tariffs, nontariff barriers, European government targeting, and Japanese government targeting) will be somewhat more difficult to interpret.

Trade barriers which result from governmental policies are a direct form of government intervention in international competition. While it is generally agreed that these barriers are likely to slow or reduce the flow of imports, it is not clear what the expected empirical relationship is between import levels and these trade barriers. Since tariffs, and at least some nontariff barriers, are creations of the government, it must be assumed that some sort of market for such government actions is present. In such markets, it is commonly believed that the supply of government actions does not occur spontaneously, but rather is the result of some demand on the part of constituents.[55] Tariff and many nontariff barriers are unlikely to be an exception to this rule. This would suggest that tariff and nontariff barriers are likely to arise in industries that are subject to increasing foreign competition, since the demand for protection by industry members is likely to be strongest here.[56] Thus the direction of the overall relationship between trade barriers and trade flows is ambiguous. That is that tariffs and nontariff barriers reduce imports relative to what they would have been, but they are most likely to arise in industries where imports have gained a substantial share of the market.[57]

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[55] This is the perspective associated with the extensive literature on public choice (Mueller (1979)).

[56] Demand for trade protection is expected to be a function of the incremental profitability of protection. While the incremental profitability of protection may not be largest where imports are rising, based on earlier empirical work we suspect that this is likely to be the case.

[57] Pugel (1978) reports that imports are positively related to tariffs when tariffs are the only form of trade barrier included in the model, but that the sign is reversed when nontariff barriers are included. Leamer (1974) uses tariff measures and notes the potential distortions in findings caused by omitting nontariff barriers. Ray and Marvel (1984) report interactions between tariff and nontariff barriers and suggest that nontariff barriers are increasing since they substitute for tariff barriers which are falling due to international agreements. However, the reliability of these findings may be affected by a positive correlation between industries subject to tariffs across countries (Balassa (1965)).

The analysis of the effects trade barriers have on trade flows relates directly to the **Foreign Government Trade Practices Explanation.** To the extent that we observe relatively few shifts in government trade practices during this period and that there are no significant changes in the relationships these variables have with trade flows, this explanation can not explain the increase in trade deficits that has occurred.

ii. Other Barriers: Minimum Efficient Scale

For industrial organization economists, minimum efficient scale (MES) indicates the minimum size of an efficient entrant relative to the size of the market. The larger is MES, the more likely it is that entry will result in excess capacity and losses for the entrant.[58] As a result, MES is often interpreted as a form of barrier to small scale entry.[59]

Other tariff research has been devoted to finding relationships between industry characteristics and tariff or nontariff barriers. For example, Baldwin (1976) and Balassa (1965, 1977) suggest that tariffs in the U.S. discriminate against imports of agricultural, textile, and consumer goods. Ray (1981) concludes that both tariff and nontariff barriers arise in industries where the U.S. does not have a comparative advantage and that there are systematic differences between the types of barriers used in various industries. Tariffs are associated with low skill industries. Nontariff barriers are used with capital intensive industries, homogeneous products, and atomistically structured industries.

[58] A complete analysis also requires consideration of whether the assets invested in the industry are sunk. If they can be switched quickly and costlessly to other industries, the problem noted in the text will not be significant. Baumol (1982).

[59] Bain (1956).

Where MES is large,[60] entry is less likely, according to numerous studies.

International trade economists have included measures of MES in their studies of trade flows. In these studies, MES is viewed as a technological characteristic of the production process. Countries are believed to vary with respect to their ability to perform large scale operations. U.S. firms are believed to have comparative advantage because of the relatively large size of the U.S. market.[61]

While these arguments suggest that the U.S. should have a comparative advantage in the trade of products where MES is high, this need not be the case. If MES is important, but access to particular inputs is also important and these inputs are costly to transfer internationally, MES may lead to a concentration of production near a subset of the locations where the inputs are available. This will cause MES to be positively associated with trade (both imports and exports). The direction of this trade will depend on the location of the immobile inputs that are utilized. Combining these

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[60] MES is usually measured at the plant level, as we do here, however, firm level economies of scale may be present as well.

[61] Perhaps the strongest expression of this view appears in Katrak (1973) where it is argued that U.S. trade is largely due to MES. Gruber, Mehta, and Vernon (1967) similarly argue "The sale of products for the overseas markets, especially products that have high technology inputs, cannot easily be achieved by an industry of small firms whose innovational stress borders on artistry. The U.S. model of the highly concentrated mass innovator seems closely to approximate the effective pattern for the successful exporter." Other authors have found somewhat more modest relationships. Baldwin (1971) found the MES was an important factor for exports but less so for imports. Branson and Junz (1971) found little relationship between net trade and MES. Pugel (1978) similarly found only weak support for an association between net trade and MES.

theoretical insights suggests that MES will be positively associated with U.S. exports, but may be positively or negatively associated with imports and net imports.

Alternatively, it might be observed that as trade has become more important, MES effects should become less determinative. If so, MES should be less connected with both imports and exports.

The statistical analysis of the relationship between MES and trade flows provides some insights into the **Antitrust Explanation.** Critics of U.S. antitrust policy suggest that antitrust policies have increasingly prevented U.S. firms from reaching the scale of operation that would allow them to be effective world competitors. Here, we consider whether there is evidence that U.S. firms are unable to attain plant level economics.[62]

If antitrust regulations have increasingly hindered the competitive efforts of U.S. firms to attain plant level economies of scale, it should be reflected in the performance of high MES industries where antitrust policies are most likely to be binding. Specifically, if U.S. firms have been unable to attain plant level economies of scale, then the relationship between MES and imports or net imports should become increasingly positive over time. Similarly the relationship between MES and exports should be decreasing over time if antitrust is increasingly hampering international competitiveness of U.S. producers. If no change is evident in the relationships between MES and trade flows or if the U.S. competitive position in high MES industries has improved, then it is unlikely that antitrust laws have prevented U.S. firms from attaining economies of plant size that they need to compete internationally.

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[62] Subsequently, we will consider firm level economics of scale. See our discussion of the Herfindahl Index which follows.

d. Other Structural Characteristics

A number of other structural characteristics of markets are recognized in statistical tests to control for relationships which may affect trade patterns. These characteristics include: whether the industry is largely a consumer goods industry, the Herfindahl Index of industrial concentration, and a measure of the geographic extent of markets.

i. Consumer Goods

Consumer goods industries have traditionally been treated separately in industrial organization models because it is believed that greater diversity in tastes and different search activity by consumers make competition in consumer goods industries qualitatively different than competition in producer goods industries.[63] To check for this possibility, we follow the convention of examining consumer and producer goods industries separately in part of the analysis.

ii. Herfindahl Index of Industrial Concentration

Industrial organization economists typically include measures of market concentration in their analysis of market performance in order to capture some of the difficulties that firms in an industry will encounter if they attempt to collude. More directly, concentration measures how large the largest firms have become relative to the whole industry. This will be, in part, a function of the stringency of antitrust enforcement policies such as merger regulation and monopolization restrictions.

Using this latter interpretation of concentration measures, it is possible to test an additional aspect of the **Antitrust Explanation**. Specifically, it is possible to consider the extent to which antitrust laws prevent U.S. firms from

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[63] Branson and Junz (1971) note substantially different historical patterns between trade in consumer goods and trade in other products.

attaining firm level economies of scale.[64] Critics of antitrust regulation argue that antitrust laws have prevented U.S. firms from growing to attain firm-level economies of scale, and thus have hindered the ability of U.S. firms to compete in international markets. Since any antitrust constraints are likely to have their largest effects on concentrated markets, this argument implies that the relationship between imports or net imports and concentration should have become increasingly positive over time. Similarly, the relationship between exports and concentration should have become increasingly negative over time. As a result, if the observed relationship between concentration and net imports has not changed in these ways, antitrust policies are unlikely to have been central to the declining trade balance.

iii. Localized Shipments

The extent to which shipments are local (largely within 100 miles of a plant) is employed as a measure of the natural geographic scope of the industry following Elzinga and Hogarty (1973). International trade should be lower than expected in industries that are localized by high transportation costs or other factors, such as spoilage, fragility, local regulations, or local taste differences.[65] Our intent is to separate out industries that would normally have extensive trade flows, but do not because of special technical, demand, or legal conditions.[66]

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[64] Earlier we used MES to evaluate whether the antitrust laws discourage U.S. firms from attaining plant level efficiencies.

[65] Pugel (1978) found that exports were higher in industries which shipped greater distances in general.

[66] While one would expect to see no trade at all in truly local industries, the aggregate nature of SIC classifications means that some trade will be observed in our local industries sample.

C. SUMMARY

The industrial organization and international trade literatures indicate that international trade flows are shaped by a number of industry attributes. In this chapter, we reviewed these attributes, explaining how each relationship is expected to affect trade flows. Table 2.2 summarizes this discussion. It lists the cost, demand, barriers to import competition and other structural characteristics which are expected to determine trade flows. This table also indicates the relationship these variables are expected to have with the three basic types of trade flows we will study.

Table 2.2 reflects the basic relationships we plan to test. While it includes many of the variables that shape trade flows, some variables that appear important a priori are omitted because we could not locate data covering these areas. U.S. government regulations, export controls, and the input mix used in other countries are examples. Nonetheless, the relative completeness of our data set encourages us to proceed with the testing of relationships using our data set.

To test the general relationships discussed in this section and summarized in Table 2.2, we construct a specific model. Table 2.3 presents the most complete version of the models we will study. It employs the assumption that the independent variables which shape trade flows are related to those flows in a simple linear fashion. These functional relationships are used both in our study of imports, exports, and net imports and in our examination of trade flows that are adjusted for international direct investment flows.

Table 2.2

Industry Characteristics Which Affect Trade Flows

Industry Characteristics	Expected Relationships*		
	Imports	Exports	Net Imports
Costs			
Labor			
Labor Intensity	+	-	+
Human Capital Intensity	-	+	-
Unionisation	+	-	+
Foreign Compensation	-	+	-
R&D Intensity	+/-	+	+/-
Raw Materials			-
Nonoil Depleting Resources	+	-	+
Energy Intensity	+	-	+
Capital Intensity	-	+	-
Demand			
Industry Growth	+	-	+
Barriers to Trade Competition			
Policy Barriers			
U.S. Tariffs	+/-	NA	+/-
U.S. Nontariff barriers	+/-	NA	+/-
Foreign Tariffs	NA	+/-	+/-
Foreign Nontariff Barriers	NA	+/-	+/-
European Targeting	+	-	+
Japanese Targeting	+	-	+
Other Barriers			
Minimum Efficient Scale	-	+	-
Other Structural Characteristics			
Consumer Goods	C	C	C
Herfindahl Index	+	+/-	+/-
Localized Markets	-/C	-/C	+/-/C

*A + indicates that an increase in a variable representing the industry characteristic is expected to lead to an increase in the trade flow. A - indicates just the opposite relationship. A +/- indicates that contradictory effects are present. NA indicates the variable is not expected to affect a particular type of trade flow. C indicates that the variable is a control variable which is used to segment the sample.

Table 2.3

Equation Specification for the Full Model

Imports

$$\text{Imports} = B_0 + B_1\text{ENERGY} + B_2\text{DEPLRES} + B_3\text{LABOR} + B_4\text{CAPITAL} + B_5\text{GROWTH} + B_6\text{USTARIFF} + B_7\text{USNONTAR} + B_8\text{MES} + B_9\text{LOCAL} + B_{10}\text{JPTARG} + B_{11}\text{EURTARG} + B_{12}\text{UNION} + B_{13}\text{HERF} + B_{14}\text{FPAY} + B_{15}\text{HUMANK} + B_{16}\text{R\&D}$$

Exports

$$\text{Exports} = B_0 + B_1\text{ENERGY} + B_2\text{DEPLRES} + B_3\text{LABOR} + B_4\text{CAPITAL} + B_5\text{GROWTH} + B_6\text{FTARIFF} + B_7\text{FNONTAR} + B_8\text{MES} + B_9\text{LOCAL} + B_{10}\text{JPTARG} + B_{11}\text{EURTARG} + B_{12}\text{UNION} + B_{13}\text{HERF} + B_{14}\text{FPAY} + B_{15}\text{HUMANK} + B_{16}\text{R\&D}$$

Net Imports

$$\text{Net Imports} = B_0 + B_1\text{ENERGY} + B_2\text{DEPLRES} + B_3\text{LABOR} + B_4\text{CAPITAL} + B_5\text{GROWTH} + B_6\text{USFTARIFF} + B_7\text{USNONTAR} + B_8\text{MES} + B_9\text{LOCAL} + B_{10}\text{JPTARG} + B_{11}\text{EURTARG} + B_{12}\text{UNION} + B_{13}\text{HERF} + B_{14}\text{FPAY} + B_{15}\text{HUMANK} + B_{16}\text{ R\&D} + B_{17}\text{FNONTAR} + B_{18}\text{FTARIFF}$$

Note: All variables are discussed above and defined in Appendix A.

CHAPTER III

EMPIRICAL RESULTS

A. INTRODUCTION

In Chapter II, we drew upon the industrial organization and international trade literatures to identify industry characteristics that are likely to affect U.S. trade flows (see Table 2.2). We then specified models that relate these factors to trade flows (see Table 2.3). In this chapter, we report the results of statistical tests of the models we have specified in order to determine if there have been structural changes that explain the increased trade deficit. These tests examine the sign and significance of particular coefficients and check whether these coefficients have changed over time. In addition, we conduct a number of sensitivity tests to determine the robustness of our basic results. Before reporting our results, we discuss the data we use in our tests and the types of empirical tests we employ. Changes in industry characteristics might also lead to an increased trade deficit related to our seven "microeconomic" causes. We analyze this possibility in Chapter IV.

B. DATA USED IN EMPIRICAL TESTS

To perform the empirical analysis we report here, we assembled data on industry characteristics and trade flows during the 1975-1984 period. Data covering 360 four-digit manufacturing industries were available over the 1975-1981 period. For a sub-sample of 122 industries, trade data were also available for the additional years of 1982, 1983 and 1984.

The data set assembled for this project represents an advance over previous data sets in a number of regards. First, the data reaches into the 1980s. Most previous efforts used data sets which stopped in the mid-1970s or earlier, before the recent large trade deficits occurred. As a result, these studies can not be used to test for the existence of major shifts in the structure of U.S. trade patterns during the late 1970s and early 1980s.

Second, the four-digit level of aggregation available with several of the variables used here provides more detailed observations with less aggregation than nearly all prior studies.[67] This reduces the risk that grouping of industries together has muffled relationships and changes in relationships.

Third, as noted in the introduction, the array of foreign trade policy variables used here is considerably more complete than in previous studies. Variables on foreign nontariff barriers and European and Japanese industrial targeting are, as far as we know, presented for the first time in this study. However, time series of observations for these varaiable are not available.

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[67] Four-digit level data were not available for some variables. Where only more aggregated data were available, the four digit industries were assigned the values of the related two or three-digit level observations.

Detailed descriptions of how each variable is defined and where the data were obtained are contained in Appendix A.[68] The sources are primarily published U.S. government statistics, although some unpublished government statistics and privately-collected statistics are also used. Briefly, the variables are defined as follows: The factor intensity variables (Labor Intensity, Capital Intensity, R&D Intensity, Energy Intensity, and Human Capital Intensity) are calculated by dividing dollar values of the relevant industry input by the industry's value added.[69] Five variables are 0-1 dummy

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[68] One difficulty in using data collected by different parties is that industry definitions often do not match precisely. In such cases, use of a concordance is necessary. Appendix A notes the procedures used to build these concordances.

[69] This procedure controls for differences in industry size which may affect the statistical properties of the model by causing the error term to vary across observations (heteroscedasticity).

Others who have completed similar studies have recognized this problem (Branson and Junz (1971)). It is conventional to control for this problem, as we have done, by scaling the variables by some measure of industry size. In similar studies, economists have reported scaled and unscaled regressions. Evidently, the results do not change significantly (Branson and Monoyios (1977)). However, tests for heteroscedasticity indicate that an adjustment in the data, such as the one we employ, is appropriate.

We used value added, rather than other divisors, such as the square root of sales, because we think it has a conceptually better basis. Specifically, it measures the size of the industry fairly simply and helps place the size of the input in a proper context. For example, an important aspect of jewelry manufacture is the gem cutter's skill. Yet if the wages of the jeweler are measured relative to final value of the product, skilled labor might appear to be unimportant, given the size of raw material costs. By using value added, variables which indicate the presence of a particular industry attribute (Localized Shipments, Japanese Targeting, European Targeting, Foreign Tariff Barriers, Consumer Goods Industry, and Depleting Resource Industry). The Unionization variable indicates the percentage of U.S. production workers who are union members. The Foreign Wage variable is the hourly compensation of foreign workers. Because European and Japanese values for this variables are so highly correlated, we use Japanese hourly compensation as the Foreign Wage variable. Demand Growth reflects the percentage change in U.S. consumption between 1972 and 1981. The Herfindahl Index is the sum, taken across all firms in the industry, of the square of each firm's share in the industry. Minimum efficient scale (MES) is defined as the average share of the largest plants making up 50% of the industry output.[70] Foreign Nontariff Barriers are measured by counting the number of nontariff barriers against U.S. exports recorded by UNCTAD for Japan and the European Economic Community nations.

Because of data limitations, we were forced to assign values to some SIC's for some variables in some years. These assignments are discussed in detail in Appendix A. Basically, we had to assign two-digit SIC level values for R&D, energy intensity, foreign targeting, and international direct investment to the associated four-digit industries. Similarly, we assigned three-digit SIC values for unionization,

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we place the activities performed in the industry in the context of what the industry actual does. Others have used value added as well (Keesing (1967)). However, to facilitate comparison of our results with studies that used the square root of the value of shipments, we also report those results in Appendix D. As will become evident, the findings are not particularly sensitive to this adjustment. Moreover, it appears that the approach we use may eliminate more of the heteroscedasticity than those used by others.

[70] This is a standard way to empirically measure MES. For example, see Comanor and Wilson (1975), p. 112.

U.S. nontariff barriers and some foreign tariff barriers to the relevant four-digit industries.

An additional data limitation was the lack of time series observations for some variables. We have data for each industry for only a single point in time for the following variables; unionization, depleting natural resources, trade barriers except U.S. tariffs, foreign targeting, MES, and localized shipments. As a result, we must assume that these industry characteristics did not change significantly over the time period for these variables, that changes in these characteristics would have little effect on trade flows, or that the characteristics changed in ways contrary to the microeconomic explanations we are examining.[71] As discussed in Chapter 4, we found that the elasticities of the trade flow variables with respect these variables are small, hence trade flows are not very sensitive to less than radical changes in these variables. We also obtained supplementary information on these variables to confirm the assumption that these variables were generally stable over the period being studied.

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[71] See discussion in Section B. of Chapter IV.

C. STRUCTURE OF EMPIRICAL TESTS

The basic statistical technique that is used in our analysis of the data is multiple regression.[72] This statistical procedure allows us to obtain estimates of the coefficients in the models we proposed in Section II. Using these estimated regression coefficients, we perform statistical tests to determine the significance and stability of these relationships.

A number of different regression studies were done. These studies differ with respect to the time period that is examined, the variables that are included in the study, and the functional form of the economic relationship that is tested.

Individual regressions were run using the data for the sample industries for each year from 1975 and 1984. The resulting regression coefficients indicate how trade penetration varied with differences in industry characteristics in a particular year. We supplemented these annual cross-section regressions with regressions which are based on pooled cross-sectional data for two different years (first and last years of the data sets). Statistical tests based on this pooled data allow us to test for the existence of significant shifts in the structure between the beginning of our sample period and the end of that period. Whenever the discussion refers to changes in the structure and composition of trade, we are testing with pooled regressions that incorporate the first and last years from a span of years. Otherwise the regressions use single year cross-sectional data.

The bulk of our analysis relies on tests involving the entire sample of 360 industries for which we have data from 1975 to 1981. However, we perform some sensitivity analyses

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[72] A regression is a statistical technique used in the social sciences to estimate relationships between variables in situations in which controlled experimentation is not possible. In a multiple regression, values for the dependent variable, the trade penetration data in this case, are explained by the independent variables. See Kmenta (1971).

for the subsample of 122 industries for which we have more recent data to see if there is any evidence of shifts that occurred during the 1981-1984 period.

The regressions reported in the study also differ with respect to the types of trade flow measures that are studied. As noted above, separate regressions focus on imports, exports, and net import trade flows. A second set uses a trade measure that adjusts these trade flows for production by foreign owned firms in the U.S. and by U.S. owned firms abroad. For each of these sets of trade flow measures, we tested three different specifications of the independent variables that are believed to affect trade flows. We did this to determine the stability of the observed relationships and to facilitate comparison with previous studies.

The first specification consists of the basic variables that have been included in many empirical tests of the Hecksher-Ohlin comparative advantage model.[73] Specifically, it

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[73] As suggested above, our analysis is akin to some empirical tests of the Heckscher-Ohlin comparative advantage theory of trade, although we do not view our coefficients in this way.

In interpreting the results reported here and elsewhere, the coefficients cannot be interpreted as indicating factor abundances. A large number of conditions must be satisfied for this to be the case (Aw (1983); Anderson (1981); Leamer and Bowen (1981); Leamer(1986)). Even if these conditions hold, one needs to know the relative factor supplies abroad in order to interpret the signs of these coefficients as conclusive evidence of factor intensities, since it is relative, not absolute, factor intensity that matters. Nonetheless, the coefficients do reveal the structural characteristics of U.S. trade in manufacturing products. In particular, the regression coefficients provide measures of the relationship between trade performance (or comparative advantage) and product characteristics.

Harkness (1981) has challenged the claimed stringency of the assumptions. Central to this debate is the degree of complimentarily between factor inputs. If factors are highly includes labor intensity, physical capital intensity, human capital intensity, and research and development (R&D) intensity. We have two reasons for estimating the coefficients for this model. First, it provides a simple check on the reasonableness of the data we are using. We should find the same types of relationships as previous studies have found for the overlapping years. Second, it allows a preliminary look at stability of the trade flow relationships over time.

The second set of regressions includes all of the independent variables present in the first set of regressions and adds explicit trade policy variables, including U.S. and foreign tariff and nontariff barriers, along with the minimum efficient scale variable and the depleting natural resources variable. This specification represents a somewhat expanded, but nonetheless traditional, comparative advantage model that includes the most widely used barriers to entry variables.

The third model, shown in Tables 2.2 and 2.3, includes all of the elements in the second model plus energy intensity, growth in demand, Japanese and European government targeting, unionization, the Herfindahl index of industry concentration, a localized shipments indicator, and foreign compensation rates. This is our full model. We limit our discussion of the magnitude of the coefficients of variables to this model, since we believe that this is the appropriate specification.[74]

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complementary, it is less likely that the parameters have a simple factor abundance interpretation.

[74] We employ only direct factor inputs in our measures of factor intensities. This approach has been criticized (Baldwin (1971)). However, there are reasons for believing that our findings would not change significantly if we also included indirect factor inputs (Stern and Maskus (1981)). Moreover, there are also arguments for using our approach, especially in regression analyses (Batra and Casas (1973); Krueger (1977)).

After testing these three models on the full data set of the 1975-1981 period, additional regression studies were conducted to test the sensitivity of these basic models to other factors that might influence observed relationships. First, we tested the models using the subsample of industries for which we obtained more recent trade data. Second, we tested subsamples defined by selected industry characteristics to see if results differed. Specifically, the sample was divided into consumer and producer goods industries to see if relationships differed for these two groups of industries. We also separated the sample into nationally and internationally traded products, since the model was expected to provide a better fit for industries with extensive international trade. Third, we tested the basic trade flow equations for the possibility that key explanatory variables (R&D and Human Capital) are shaped simultaneously by trade flows. Finally, we explored whether our results are sensitive to the division of factor input levels by value added to correct for hetero-scedasticity.

D. REGRESSION ESTIMATES OBTAINED FROM BASIC UNADJUSTED MODELS

1: Simple Comparative Advantage Model

Table 3.1, contains the results for the simple comparative advantage regression model. For this fundamental trade flow model, labor intensity is positively and significantly associated with imports and net imports, but negatively related to exports.[75] U.S. imports and net imports are significantly lower and exports are significantly higher in human capital-intensive industries. These findings suggest that the U.S.'s comparative disadvantage with respect to labor intensive products results from a U.S. disadvantage with respect to unskilled labor inputs.[76]

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[75] The overall degree to which the values of the dependent variable are explained by a particular set of independent variables is measured by the R-square statistic. The degree of certainty that the whole set of independent variables are affecting the dependent variables is measured by the F-statistic. The t-statistic is used to evaluate the statistical significance of a particular explanatory variable. For all three statistics,. larger values mean greater significance. Unless otherwise stated, coefficients, which are reported as "significant" in the text, are significant at the .05 level for at least one year using a two-tailed test.

[76] We have employed a measure of human capital similar to those commonly used in the international trade literature. (See for example, Branson and Monoyios (1977); Stern and Maskus (1981); and Stern (1976).) This measure is obtained by subtracting the lowest wage for the sample from the average wage for the industry, then multiplying this difference by the labor intensity variable, and then dividing this product by one tenth. (Dividing by one tenth calculates the present value of a perpetuity with an interest rate of 10%.) Since education has also been used as a proxy for human capital, we experimented with an median education (by industry). The results were similar.

Table 3.1

The Simple Comparative Advantage Model for the U.S.

Independent Variable	Net Imports 1981	Net Imports 1975	Imports 1981	Imports 1975	Exports 1981	Exports 1975
Labor Intensity	.330*	.235*	.204*	.141*	-.126*	.094*
	(5.34)	(4.16)	(3.73)	(3.04)	(-3.58)	(-2.58)
Capital Intensity	.002	.002	.001	.001	-.001	-.001
	(.29)	(.19)	(.11)	(.10)	(.34)	(-.17)
Human Capital Intensity	-.004*	-.004*	-.002*	-.002*	.001*	.002*
	(-5.12)	(-5.14)	(-3.66)	(-3.37)	(3.32)	(3.67)
R&D Intensity	-.003+	-.004+	.002	.002	.005*	.006*
	(-1.75)	(-1.88)	(1.08)	(1.49)	(4.76)	(4.78)
Intercept	-.067	-.034	.031	.029	.098	.064
R-sq.	.137	.131	.054	.041	.146	.156
F	14.17*	13.34*	5.10*	3.80*	15.13*	16.41*
N	360	360	360	360	360	360

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.

This view is confirmed to some extent by the fact that R&D intensity, which is undoubtedly intensive in skilled labor,[77] appears to have the same relationship with the export and net imports trade flows as does human capital. However, the "product differentiation" aspect of R&D activities appears to lead to a positive, but still insignificant relationship between R&D and import penetration levels. In more comprehensive models, this positive import relationship more than compensates for the export relationship in some net import regressions.

Our statistical analysis of the core trade flow model found no statistically significant relationship between physical capital intensity and trade flows. As a result, the signs of the capital variable regression coefficients can not be given much weight.

The results reported in Table 3.1 suggest that the statistical significance of some of the relationships appears to be increasing a little over time. However, statistical tests using pooled regressions (Appendix B.1a) indicate that none of the changes in the regression coefficients is statistically significant.[78] Together, the annual cross-sectional and pooled

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[77] The high correlation (.495) between our R&D expenditures variable and the median years of education suggests that R&D is skill intensive. However, the correlation between the wage-based measure of human capital and R&D is somewhat lower (.332).

[78] The statistical significance of the change in coefficient values can not be evaluated using the results in Table 3.1. Other runs, based on the methodology suggested by Kmenta (1971), p. 373, were used for this purpose. This technique involves creating an interaction term between each variable and a year dummy variable that distinguishes the beginning of the period (1975) from the end of the period (1981) and incorporates these interaction terms in each regression. If a particular dummy variable has a significant coefficient, the change over time for that particular variable

regressions suggest that the U.S. has, and has had for some time, a comparative disadvantage in producing products that are labor intensive and a comparative advantage in producing products that use human capital and technological know-how intensively.[79]

For purposes of comparison, Tables 3.2 to 3.4 provide a summary of previous studies that explored these four trade variables. With respect to both the signs of the coefficients and the significance levels, our results are quite similar to those of previous studies, even though many of these studies covered earlier time periods. Maskus, for example, using three digit 1958 to 1976 data, found the same pattern of significant relationships for net imports, imports, and exports.[80]

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is statistically significant. Other techniques that involve pooling all data were not employed since they required more time series data than was available or add little to the analysis.

[79] The signs and significance levels in the initial comparative advantage model parallel the simple correlations for these variables. Labor intensity is positively correlated with net imports (.169) and imports (.128) and it is negatively correlated with exports (-.108). Capital intensity is weakly correlated with two dependent variables, -.046 for net imports,-.039 for imports. The correlation is .023 for exports. Human capital is negatively correlated with net imports (-.232) and imports (-.127) and it is positively correlated with exports (.219). The correlations of U.S. R&D intensity are similar to those for human capital with respect to net imports (-.185) and exports (.307). For imports, however, the correlation is negative (-.057).
Appendix C lists the correlations.

[80] We focus on Maskus' results because his book (Maskus (1981)) and article with Stern (Stern and Maskus (1981)) are among the few studies that resemble our effort to look at both trade patterns and changes in trade patterns over time.

Table 3.2

Summary of Previous Empirical Studies Net Imports*
(Studies are listed by number in parentheses. The list of studies follows on the next page.)

Sign of Coeff.**	Capital/ Labor	Capital	Total Labor Or Un-skilled Labor	Skilled Labor	Human Capital or Wages	R&D (Eng. & Scient. Or R&D Exp.)
Neg. Sig.	(9)	(9)(3)		(9)(8) (16)(17)	(1)(2) (5)(6) (7)(14)	(4)(3) (2)(9) (11)(15) (16)
Neg. Insig.		(4)(3) (1)(8)		(10)(11)	(4)(3) (2)(5) (15)	(2)(17)
Positive Insig.	(16)(17) (10)	(2)(5) (1)	(4)(3) (5)(8) (9)(10) (11)(16)		(4)	(2)(1)
Positive Sig.	(11)(14) (15)	(5)(6) (7)(2)	(4)(3) (1)(2) (5)(6) (7)			

* The literature has predominately used net exports rather than net imports. Hence the signs shown in this table have been reversed to accord with the net import penetration variable used in this study.

** Significance of the test that the coefficient equals zero at the 10 percent confidence level for a two-tailed test and at the 5 percent level for a one-tailed test.

Table 3.2--Continued

Sources: Study & Specification					
Equation Number	Author	Years in Study*	SIC Level	Type Regression	Specification
(1)	MASKUS (1981)	1958-76	3 digit	OLS	(NX/S) = f[(L,S), (K/S),(H/S)]
(2)	MASKUS (1981)	1958-76	3 digit	OLS	(NX/S) = f[(L/S), (K/S),(H/S), (R&D/S) or (ES/S)]
(3)	MASKUS (1981)	1960, 1970	3 digit	OLS	(NX/S) = f[(L,S), (K/S),(H/S), (ES/S),(T)]
(4)	MASKUS (1981)	1960, 1970	3 digit	OLS	(NX/S) = f[(L,S), (K/S),(H/S),(T), (MES),(CG),(D)]
(5)	STERN & MASKUS (1981)	1958-76	3 digit	OLS	(NX,$S^{1/2}$) = f[(S),(D $S^{1/2}$), (H,S/2),($S^{1/2}$)]
(6)	BRANSON & MONOYIOS (1977)	1963, 1976	3 digit	OLS	NX = f(K,H,L)
(7)	BRANSON & MONOYIOS (1977)	1963 1976	3 digit	OLS	(NX $S^{1/2}$) = f[(S),(K,S)$_{1/2}$ (H,S),(L,$S^{1/2}$)]
(8)	BRANSON & MONOYIOS (1977)	1963	3 digit	OLS	NX $S^{1/2}$) = f[($S^{1/2}$),(K,$S^{1/2}$), (LS $S^{1/2}$), (LU $S^{1/2}$)]
(9)	HARKNESS & KYLE (1973)	1962	3 digit non-NR	LOGIT	NXD = f[(K,L), (ES/L),(US/L), (SW/L)]
(10)	HARKNESS & KYLE (1973)	1962	3 digit	LOGIT	NXD = f[(K/L), (ES/L),(LU/L), (SW/L),NRD]

Table 3.2--Continued

Sources: Study & Specification					
Equation Number	Author	Years in Study*	SIC Level	Type Regression	Specification**
(11)	BALDWIN (1971)	1962	2 digit	OLS	[NX/(x+m)] = f[(K/L),(ES/L), (LU/L), (SLO/L), (FARM/L), (MES), (UNION)]
(14)	BRANSON & JUNZ (1971)	1964	3 digit	OLS	NX = f[(K/L), (H/L),MES, FTD]
(15)	BRANSON & JUNZ (1971)	1964	3 digit	OLS	NX = f[(K/L), (H/L),MES,FTD, R&D/VA]
(16)	HARKNESS (1978)	1958	3 digit	OLS	(NX,S) = f[(K/S), (LAND/S),(NR), (ES/S),(US/S), (SW/S)]
(17)	PUGEL (1978)	1967-70	4 digit	OLS	(NX/S) = f[(K/L), (SW),(NR), (ES/L)]

* Based on dependent variable, since some studies combine trade variables one year with independent variables for another.

** In this table X = exports in dollars; WX = world exports in dollars, M = imports in dollars; NX = (X-M); C = industry consumption calculated as (S-X-M); NXD = 1 if X=M>0 and 0 other- wise; S = industry sales in dollars; VA = value added in dollars; K = capital in dollars; H = human capital calculated by the "discount" formula $(W_{it} - W'_t)\ L_{it}/.10$ [where W_{it} = average industry wage, w'_t median wage] for all workers with 8 years or less education, and L_{it} = industry employment; W = total wages in industry; R&D = total dollar expenditures; E&S = total engineers and scientists; T = US Tariffs (import duty/import value); MES = scale economies (variously measured); CG = consumer goods ratio (variously measured); SW = skilled workers (number of foremen, professional managers and operators); LS = skilled labor (scientific, professional and technical employees or similar measure); LU = unskilled labor; F = farm workers (number of nonfarm labores and service workers or similar measure); SW = service workers; NRD = dummy variable that equals 1, if natural resource industry and otherwise; FTD = first trade date; LAND = various types of land inputs; Local = indicator of local markets; NTB = nontariff barriers; and Quota = quota.

Table 3.3

Summary of Previous Empirical Studies: Imports*
(Studies are listed by number in parentheses. The list of studies follows on the next page.)

Sign of Coeff.**	Capital/ Labor	Capital	Total Labor Or Unskilled Labor	Skilled Labor	Human Capital or Wages	R&D (Eng. & Scient. Or R&D Exp.)
Positive Significant*		(1)(3) (4)	(1)(3)		(2)	
Positive Insig-nificant*		(1)(2)	(1)(2)		(2)	(2)
Negative Insig-nificant*		(2)	(2)	(4)	(2)	(2)(4)
Negative Significant*					(1)(3)	

* Significance of the test that a coefficient equals zero at the 10 percent confidence level for a two-tailed test and at a 5 percent level for a one-tailed test.

Table 3.3--Continued

Sources: Study & Specification					
Equation Number	Author	Years in Study*	SIC Level	Type Regression	Specification**
(1)	MASKUS (1981)	1958-76	3 digit	OLS	(M/C) = f[(L/S),(K/S),(H/S)]
(2)	MASKUS (1981)	1958-76	2 digit	OLS	(M/C) = f[(L/S),(K/S),(H/S),(R&D)/S) or (E&S/S)]
(3)	BRANSON & MONOYIOS (1977)	1963	3 digit	OLS	M = f[K,H,L]
(4)	PUGEL (1978)	1967-70	4 digit	OLS	(M/S+M-X) = f[(K/L),(SW),(NRD),(ES/L),(Local),(A/S),(Profits),T,(NTB),(Quota)]

* See note for Table 3.2.

Table 3.4

Summary of Previous Empirical Studies: Exports*
(Studies are listed by number in parentheses. The list of studies follows on the next page.)

Sign of Coeff.**	Capital/ Labor	Capital	Total Labor Or Unskilled Labor	Skilled Labor	Human Capital or Wages	R&D (Eng. & Scient. Or R&D Exp.)
Positive Significant*		(1)		(7)	(1)(2)(4) (5)(6)(9)	(2)(5)(6) (7)(8)(9)
Positive Insignificant*	(7)	(1)(3)			(1)(2)(3)	(2)
Negative Insignificant*		(2)(5)	(2)			
Negative Significant*	(4)(9)	(2)	(1)(2)(3) (8)			

* Significance of the test that a coefficient equals zero at the 10 percent confidence level for a two-tailed test and at a 5 percent level for a one-tailed test.

Table 3.4--Continued

Source: Study & Specification

Equation Number	Author	Years in Study*	SIC Level	Type Regression	Specification**
(1)	MASKUS (1981)	1958-76	3 digit	OLS	(X/S) = f[(L/S),(K/S), (H/S)]
(2)	MASKUS (1981)	1958-76	2 digit	OLS	(X/S) = f[(L/S),(K/S), (H/S),(R&D)/S) or (ES/S)]
(3)	BRANSON & MONOIOS (1977)	1963	3 digit	OLS	X = f[K,H,L]
(4)	BRANSON & JUNZ (1971)	1964	3 digit	OLS	(X/X+M) = f[(K,L), (H/L),(MES), (FTD)]
(5)	LOWINGER (1975)	1968-70	2 digit	OLS	(X/WX) = f[(R&D/L), (H/L),(K/L)]
(6)	LOWINGER (1975)	1968-70	2 digit	OLS	(X/WX) + = f[(R&D/L), (W/VA),T]
(7)	PUGEL (1978)	1967-70	4 digit	OLS	(X/S) = f[(K/L),(SW), (NRD),(S/L), (Local),(A/S)]
(8)	WEISER & JAY (1972)	1960, 1967	2 digit	OLS	(X/WSX) = f[(ES/L),MES, (LU/L),(F/L), (SW)]
(9)	BRANSON (1971)	1964	3 digit	OLS	(X X+M) = f[(K/L),(H/L), MES,FTD, (R&D/VA)]

* See * note to Table 3.2.
** See ** note to Table 3.2.

Interestingly, Maskus's research also indicated an increase over time in the strength of the labor intensity relationship similar to the increase we observe in our data.[81]

We take the similarity between our findings for the initial comparative advantage model and those of previous studies to indicate that our data are consistent with trade data used in prior studies and that we can proceed with additional regression models with confidence in the reasonableness of the data.

2. U.S. Comparative Advantage Model with Entry Barriers

In Table 3.5, which adds barriers to entry to the simple comparative advantage model, the four variables from the initial model have coefficients and significance levels that are very similar to the previous results. Only the sign of the capital intensity variable changes. It is now negative for all net import and import regressions and positive for export regressions, but it remains insignificant. The barriers to entry variables, as a whole, add substantially to the explanatory power of the model and their signs are generally as expected.[82]

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[81] Maskus (1981) examines three time periods in his study of structural change: 1958-68, 1958-76, and 1968-76. He observes statistically significant (at .01 level) shifts in the labor intensity coefficient in all three time periods. Since he finds a statistically significant shift using nine years of data (1958-56), there is no reason to believe that our 1975-84, or even 1975-81, comparisons cover too short a period to pick up a continuation of the shifts he observed.

[82] F-tests that contrast the equations of Table 3.1 with the equations of Table 3.5 indicate that the additional variables in Table 3.5 significantly improve the explanatory power of all six equations (at the .05 level).

Table 3.5

U.S. Comparative Advantage Model With Entry Barriers

Independent Variable	Net Imports 1981	Net Imports 1975	Imports 1981	Imports 1975	Exports 1981	Exports 1975
Depleting Resources	.103* (3.14)	.100* (3.52)	.065# (2.27)	.043* (1.88)	-.044# (-2.33)	-.058* (3.13)
Labor Intensity	.322* (5.16)	.258* (4.33)	.214* (4.06)	.147* (3.26)	-.133* (-3.69)	-.128* (-3.30)
Capital Intensity	-.005 (-.72)	-.009 (-1.00)	-.005 (-.84)	-.006 (-.87)	.0003 (-.09)	.003 (.45)
U.S. Tariffs	-.6E-6+ (-1.74)	-.4E-6 (-1.46)	-.6E-6# (-2.03)	-.5E-6+ (-1.91)	X X	X X
U.S. Nontariff Barriers	-.0007 (-.076)	.0003 (.42)	-.0005 (-.68)	-.0001 (-.20)	X X	X X
MES	.707* (3.56)	.463* (2.58)	.884* (5.09)	.633* (4.35)	.176 (1.53)	.171 (1.47)
Human Capital Intensity	-.005* (-6.42)	-.005* (-5.91)	-.004* (-5.12)	-.003* (-4.23)	.002* (3.72)	.002* (4.10)
R&D Intensity	-.002 (-1.20)	-.003 (-1.48)	.002 (1.21)	.002 (1.28)	.004* (4.03)	.005* (4.24)
Foreign Nontariff Barriers	.8E-4 (.26)	-.0001 (-.44)	X X	X X	.8E-4 (.54)	.4E-4 (.26)
Foreign Tariffs	-.011 (-.63)	.011 (.65)	X X	X X	-.013 (-1.32)	-.026# (-2.42)
Intercept	-.49	-.039	.030	.030	.095	.076
R-sq.	.200	.180	.141	.106	.169	.195
F	8.74*	7.67*	7.21*	5.21*	8.89*	10.65*
N	360	360	360	360	360	360

Note: The figures in parentheses are t-statistics.
\+ Indicates significant at the .10 level for a two-tailed test.
\# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regression.

As was indicated in Section II, the relationship between tariff and nontariff barriers and trade flows involves potentially contradictory effects. While trade barriers clearly deter or reduce trade flows, it also is likely that they appear most frequently in industries where trade flows have been high. If trade barriers are not stringent enough to offset these flows significantly, a positive relationship between barriers and trade flows may be observed.[83] Moreover, the aggregate nature of the foreign tariff and foreign nontariff variables may allow the trade barrier variables to be high when some foreign markets are insulated, but when there are still enough large "open" markets to simultaneously absorb substantial amounts of U.S. exports.

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[83] This argument is based on the possibility that trade barriers are simultaneously determined with trade flows which implies that single equation estimation will produce biased coefficients. Since a country's trade barriers are expected to increase with its imports, this can bias the results in the observed directions. We did not have the data necessary to test this theory fully.

The statistical tests indicate that the trade deterring effect typically dominates, but levels of statistical significance are often low and sometimes are reversed by the other factors. U.S. tariff and nontariff barriers are associated with lower import levels in most years, but a very weak positive relationship between U.S. nontariff barriers and net imports is present in the first year of the period.[84] Although neither the U.S. tariff nor nontariff barriers were consistently significant, their effects have grown slightly since the beginning of the period.

Foreign tariff and nontariff barriers also appear to follow a similar mixed pattern of statistically insignificant coefficients. Foreign tariffs appear to be associated with lower trade flows (U.S. exports and net imports) for most years, but there are exceptions. And foreign nontariff

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[84] The signs and significance levels of the barriers to entry variables are less parallel to their simple correlations than were the initial comparative advantage variables. In particular, the U.S. nontariff barriers variable has a positive correlation with net imports (.073) although its regression coefficient is negative in the second comparative advantage model and in the full model ($t = -1.32$). Foreign tariffs similarly display a difference in signs between the simple correlation and multiple regression coefficients. And foreign nontariff barriers, although one of the strongest negative simple correlations with exports, has a barely negative coefficient in the regressions. These contrasts indicate that trade policy barriers to entry are not randomly distributed in the sample, but are likely to cluster with industry characteristics.

In contrast to the trade policy barriers, the coefficients for MES and the depleting natural resources variable closely accord with their simple correlations, although MES is a bit stronger in the net import regression results than the simple correlation would suggest (.052).

barrier coefficients are positive in numerous regressions.[85]

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[85] Appendix C gives the correlations between all of the independent variables. From this table, several patterns appear to link trade policies to each other and to industry characteristics. U.S. nontariff barriers are quite strongly associated with the nontariff barriers of our major trading partners (.526). This correlation is consistent with either retaliatory trade restrictions or a "common threat." The latter appears to be the most reasonable interpretation because U.S. nontariff barriers are negatively associated with the variables usually associated with strong U.S. exports: human capital (-.430) and R&D (-.294). U.S. nontariff barriers do not seem to be especially prevalent where physical capital is used intensively (-.112), in declining natural resource industries (-.166), where labor is used intensively (-.148); or where unions are stronger (-.073). Interestingly, U.S. nontariff barriers are also only weakly related to U.S. tariffs (.040) U.S. nontariff barriers appear to center on industries with old technologies that face trade challenges in both the U.S. and our major trading partners. No clear pattern is evident for U.S. tariffs. For the simple correlations, there are no strong correlations evident for U.S. tariffs. U.S. tariffs are positively related to foreign tariffs (.084) and negatively related to foreign nontariff barriers (-.058).

While U.S. tariffs and U.S. nontariff barriers appear to be very weak complements, foreign tariff and nontariff barriers appear to be substitutes. The correlation between foreign nontariff barriers and foreign tariff barriers is -.182. This contrast in the placement of foreign tariff and nontariff barriers is also evident in the correlations between these foreign trade policy variables and other explanatory variables. Opposite signs or contrasting values on the correlations of the foreign tariff and foreign nontariff barriers occur for labor intensity, capital intensity, MES, the Herfindahl index, R&D intensity, human capital intensity, foreign pay, and unionization. From these contrasting correlations, we conclude that foreign nontariff barriers, like U.S. nontariff barriers, cluster around low technology industries. Foreign tariffs, on the other hand, are more widely distributed and

Foreign tariffs, which had a pronounced negative effect on U.S. exports at the beginning of the period had a somewhat less pronounced effect by the end of the period, although the change was not statistically significant.

Minimum efficient scale appears to be positively associated with trade flows. Both imports and exports appear to be higher where there are sizeable economies of scale relative to the size of the U.S. market. This is consistent with the view that MES is associated with trade in general, rather than representing an industry characteristic that would advantage countries with large markets, such as the U.S.[86] Moreover, it suggests that industries with large scale plants may gain by diversifying the geographic extent of their markets, so that they are less vulnerable to regional downturns in demand.

As expected, the U.S. appears to be at a comparative disadvantage with respect to the non-oil depleting resource industries.[87] There is a statistically significant positive relationship between imports and these natural resource industries and a statistically significant negative relationship with exports, leading to a statistically significant positive relationship with net imports.

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include more capital intensive and more technologically sophisticated industries.

[86] This conclusion is weakened by the insignificance of the MES coefficient in some of the export equations. The 1975 MES coefficient is significant in Table 3.6, which controls for other relevant variables.

[87] We originally included a pollution control cost variable in our model, but found that it was quite collinear with a number of independent variables, particularly the depleting natural resources variable. As a result, the variable was dropped; but in assessing causality, the effects of depleting natural resources and pollution control costs are difficult to statistically separate.

Overall, the results for the second model confirm the importance and suggest the robustness of the comparative advantage variables used in the simpler model. The cross-sectional results are similar for these variables, with the coefficients having the same signs.

The pooled regressions evidence no significant changes in any regression coefficients over time. See Appendix B.1b.[88] This confirms the stability of the basic comparative advantage relationships that were examined in the simpler model. It also consistent with the proposition that there has been relatively little change in the relationships between trade barriers and trade flows, although this conclusion must be tempered by the fact that our data for most of the policy trade barriers do not track changes in these policies over time.[89]

3. Model with Barriers and Control Variables

a. Relationships Between Trade Flows and Industry Characteristics

Results for the full model specification are shown in Table 3.6a. As was true for the basic comparative advantage

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[88] As was done for the simple comparative advantage model, the statistical significance of changes was tested using an additional regression model that combined data from 1981 and 1975 and employed dummy variable interaction terms for each independent variable included, along with an individual year dummy variable. If the dummy interaction term for any of the independent variables is statistically significant, then the change in the coefficient for that independent variable over the 1975 to 1981 period is statistically significant. This test follows the approach suggested by Kmenta (1971), p. 373.

[89] Among the barrier variables, we have time series data only for the U.S. tariffs variable. As a result, it is possible that the stability is due to the nature of the data. However, we believe that the other trade variables have been fairly stable over time. See Chapter IV, Section B.

Table 3.6a

Model With Barriers and Control Variables

Independent Variable	Net Imports 1981	Net Imports 1975	Imports 1981	Imports 1975	Exports 1981	Exports 1975
Energy Intensity	.001# (2.14)	.002# (2.40)	.001# (2.44)	.002# (2.48)	-.3E-4 (-.09)	-.0005 (-.93)
Depleting Resources	.123* (3.24)	.119* (3.42)	.060+ (1.82)	.033 (1.16)	-.060* (-2.71)	-.083* (-3.69)
Labor Intensity	.319* (4.30)	.253* (3.38)	.232* (3.69)	.175* (3.12)	-.123* (-2.88)	-.102# (-2.18)
Capital Intensity	-.005 (-.77)	-.010 (-1.17)	-.006 (-.97)	-.009 (-1.18)	.0001 (.03)	.002 (.34)
Growth	.023 (1.41)	-.004 (- .28)	.034# (2.43)	.003# (2.54)	.007 (.74)	.030* (3.22)
U.S. Tariffs	-.6E-6* (-1.70)	-.4E-6 (-1.52)	-.6E-6* (-2.08)	-.5E-6* (-1.97)	X X	X X
U.S. Nontariff Barriers	-.001 (-1.32)	-.0003 (- .27)	-.001 (-1.64)	-.0008 (-1.08)	X X	X X
MES	.667# (2.55)	.396+ (1.83)	.881* (3.88)	.651* (3.72)	.167 (1.09)	.251+ (1.79)
Localized	-.011 (- .29)	.023 (.67)	-.036 (-1.08)	-.013 (- .47)	-.020 (- .90)	-.034 (-1.52)
Japan Target	.031 (1.36)	.029 (1.37)	.002 (.12)	.002 (.09)	-.021 (-1.61)	-.022 (-1.62)
Europe Target	-.025 (-1.07)	-.025 (-1.13)	-.004 (-.18)	-.007 (-.38)	.011 (.90)	.010 (.77)
Unionization	.002* (2.93)	.002* (2.78)	.002* (2.48)	.001* (2.79)	-.003 (-.68)	-.0002 (-.46)
Herfindahl	.028 (.17)	.062 (.50)	-.044 (-.32)	-.045 (-.45)	-.025 (-.26)	-.098 (-1.23)
Foreign Pay	-.062* (-2.83)	-.077* (-5.25)	-.030* (-1.65)	-.026 (-1.19)	.019 (1.44)	.042# (2.31)

(table continues)

Table 3.6a--Continued

Independent Variable	Net Imports 1981	Net Imports 1975	Imports 1981	Imports 1975	Exports 1981	Exports 1975
Human Capital Intensity	-.006*	-.005*	-.004*	-.003*	.002*	.002*
	(-5.64)	(-5.25)	(-4.48)	(-3.95)	(3.14)	(3.23)
R&D Intensity	.6E-4	.001	.002	.003	.003#	.002
	(.03)	(.57)	(1.06)	(1.33)	(2.44)	(1.58)
Foreign Nontariff Barriers	.7E-4	-.0001	X	X	.8E-4	.9E-4
	(.23)	(-.52)	X	X	(.46)	(.56)
Foreign Tariffs	-.033+	-.012	X	X	-.005	-.011
	(-1.76)	(-.66)	X	X	(- .47)	(-.97)
Intercept	.014	.031	.036	.016	.062	.006
R-sq.	.244	.223	.186	.155	.181	.240
F	6.12*	5.43*	4.90*	3.92*	4.74*	6.76*
N	360	360	360	360	360	360

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regression.

model with entry barriers, the signs of the coefficients for the four variables in the simple comparative advantage model are not affected by the inclusion of additional variables. Labor intensity continues to be strongly positively related to imports and net imports and negatively related to exports. Human capital has the same relationship with the three types of trade flows as it did in the simpler models. R&D continues to be related positively to exports and imports. The physical capital coefficient continues to have an insignificant coefficient and it is predominately negative as it was in the combined basic comparative advantage and barriers models. However, there is one noteworthy difference. The R&D coefficients' signs in the net imports regressions change from being negative and significant to being positive and insignificant.[90]

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[90] In the text, we have followed the convention of treating R&D as a unitary phenomena. However, in some industries, R&D is primarily a function of government funding, particularly in defense and aerospace industries. To explore whether the source of the R&D funds affects the relationship between R&D and trade flows, we ran regressions in which a government R&D variable was added to the regressions. When government R&D was added, total R&D, now representing only private R&D effects, became positive in most of the net imports regressions, although it was insignificant. The effect of government R&D is apparently to depress imports in particular, although exports are also negatively associated with government R&D. This, of course, may simply be due to the unique demands of the U.S. government and the inability of producers in foreign countries to supply these types of products. Private R&D, on the other hand, is associated with both higher imports and higher exports. The results for the government R&D variable suggest that although U.S. R&D behaves like an industrial policy in curtailing imports, it does not generally augment U.S. exports as a conventional set of industrial policies might strive to do. Results using the adjustments for international investment are similar to the unadjusted model except that the export effects are more significant; private R&D increases U.S. export/investment outflows, while government

For the barriers to entry variables, there also appears to be a good deal of stability across specifications, despite the lack of statistical significance of several of these variables. There are no changes in signs for the U.S. tariff barriers, foreign nontariff barriers, MES, and depleting natural resources variables. Only U.S. nontariff barriers and foreign tariff barriers in the 1975 net imports regression show a sign change and this change is statistically insignificant.

Of the eight new variables that are added to the model, four evidence statistical significance in at least some tests: energy intensity, growth in U.S. consumption, foreign compensation, and unionization.

Energy intensity is positively and significantly associated with net imports. Most of the strength of the relationship operates through a significant positive relationship with imports.

Growth in industry demand, which we believed to be associated with a reduction in the risk of entry and periods of disequilibrium in which prices exceed foreign costs, has the expected statistically significant positive relationships with imports and net imports during the period.[91] The

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R&D is associated with reduced export/investment outflows.

[91] The growth in demand variable is introduced in entry models as a condition favoring entry of new firms. As such, the predicted sign in the import equation would be positive. The actual coefficient is .034 in 1981 and the simple correlation is .062.

Growth in demand is also associated, however, with the life cycle hypothesis of comparative advantage. In this theory, American R&D creates new products that elicit increased demand for American products, especially while the technology is new. This view of growth is also consistent with the data. R&D and growth are positively correlated (.365) and growth is positively associated with exports (.150) and even more strongly associated with exports once they relationship between Growth and U.S. exports was unexpectedly positive. While the relevant coefficients typically are statistically insignificant, they are significant in 1975. The reason for this is unclear. Perhaps growth is associated with new products or production techniques where the U.S. has a comparative advantage and finds the rewards of supplying foreign consumers to exceed those of supplying additional units to the domestic market.

Foreign compensation rates are negatively associated with imports and net imports and positively associated with exports. This might be an indication that foreign wage rates are high relative to U.S. wages in some areas. Given the high and stable correlation between compensation rates across countries,[92] however, we suspect that the foreign wage variable is picking up human capital utilized in foreign production.[93] If this is the case, then the negative

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have been adjusted for U.S. investment abroad (.176).

The overall sign associated with growth in the net import regression may represents a conflict between these two effects.

[92] We found the simple correlation between U.S. compensation rates and both European and Japanese compensation rates to be approximately .67. The correlation between European and Japanese compensation rates was so high (.88) that we opted to represent foreign compensation rates using the Japanese data alone. Regressions using the European compensation rate yielded very similar results to these using the Japanese compensation rate.

[93] A major element in the U.S. human capital variable is the U.S. compensation level. By using foreign compensation, we are using a major component of foreign human capital. The correlation between foreign wages and the U.S. human capital intensity variable is between .55 and .60. This is high enough to create the kind of proxy relationship suggested, but not so high that multicolinearity problems require us to drop one of the variables from the model.

relationship serves primarily to confirm the U.S. comparative advantage in human capital intensive production.

Unionization appears to be positively and significantly related to import and net import penetration. It does not appear to have a statistically significant relationship with exports.

For the Japanese and European targeting variables, the most interesting element is the apparent divergence in the nature of the targeting that is taking place. The coefficients for these two variables have opposite signs, although neither is statistically significant.[94] The Japanese appear to be targeting different industries than the Europeans. This interpretation is also supported by the simple correlations between industry characteristics and the industries targeted by the Europeans and Japanese. Based on the simple correlations, the Japanese appear to be targeting high wage and less labor intensive industries. The Europeans are targeting industries with high labor intensity and relatively low wage rates.[95]

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[94] The t-values are slightly greater than one in both cases. To anticipate later results, they are significant in the regressions that adjust for direct international investment.

The Japanese and European targeting regression coefficients are interesting in another respect. They have opposite signs in their regressions compared to their simple correlations. In 1975, for example, the simple correlation between Japanese targeting and U.S. net imports is -.149, while its regression coefficient is positive. The simple correlation between European targeting and U.S. net imports is .066, while its regression coefficient is negative. Evidently, the process of controlling for other variables results in a major difference in the statistical effect of these two variables, making interpretation of the results particularly difficult.

[95] The correlations of the foreign compensation and labor intensity variables with the Japanese Targeting variable are .490 and -.106 (using 1981 data). This contrasts with the

The Herfindahl Index has an insignificant coefficient throughout the period. Interpretation of the Herfindahl coefficient is complicated by the high positive correlation (.654 in 1981) between the Herfindahl Index and MES. While this colinearity could make it difficult to distinguish the effects of these two variables, this potential difficulty does not seem to be overwhelming in this instance, since omission of one of the variables (the Herfindahl Index) does not alter the sign or greatly alter the significance of the remaining variable. We conclude that market concentration is not strongly associated with trade flows. To the extent that the Herfindahl Index captures concentration above and beyond that associated with economies of scale at the plant level, the insignificance of the coefficient of the Herfindahl variable suggests that concentration, that is not associated with MES, does not have much effect on trade flows.

Localized shipments have an insignificant relationship with net imports, which switches from positive to negative over the period.[96] The low significance level in the net import runs is due, in part, to contradictory effects on imports and exports. As expected, localized industries have both low imports and low exports.[97]

Table 3.6b provides insight about the magnitude of the coefficients in Table 3.6a. For each explanatory variable,

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correlations between the European targeting variable and the same two variables which are -.325 and .198. Other correlations are listed in Appendix C.

[96] This change in the sign of the coefficient is not statistically significant.

[97] The 75% test used for the localized shipments variable here garnered few industries (19) at the four digit level of aggregation we are using. One of the bifurcations presented below uses an alternative localization measure, focusing on the difference between nationally traded and internationally traded goods.

Table 3.6b

Average Changes in Import and Export Penetration
from 10% Increase in the Explanatory Variables (1975 and 1981)

Var. No.*	Mean		Import Elasticity at Mean		Change in Import Penetration		Export Elasticity at Mean		Change in Export Penetration	
	1975	1981	1975	1981	1975	1981	1975	1981	1975	1981
1.	5.83	6.52	.13	.10	.09%	.09%	-.04	-.003	-.03%	-.002%
2.	.07	.07	.03	.06	.02	.04	-.09	-.06	-.06	-.04
3.	.52	.51	1.29	1.24	.92	1.2	-.76	-.81	-.53	-.60
4.	1.03	1.10	-.12	-.07	-.09	-.07	.03	.002	.02	.002
5.	.19	.19	.08	.07	.06	.06	.08	.02	.06	.01
6.	.01	.01	-.05	-.04	-.04	-.04	x**	x	x	x
7.	5.96	5.96	-.07	-.09	-.05	-.09	x	x	x	x
8.	.03	.03	.30	.30	.21	.20	.12	.07	.08	.05
9.	.04	.04	-.01	-.02	-.01	-.02	-.02	-.01	-.01	-.01
10.	.23	.23	.005	.01	.004	.01	-.07	-.06	-.05	-.05
11.	.27	.27	-.03	-.01	-.02	-.01	.04	.04	.03	.03
12.	35.6	35.6	.70	.56	.50	.50	-.10	-.13	-.07	-.10
13.	.07	.06	-.04	-.03	-.03	-.03	-.09	-.02	-.06	-.015
14.	1.85	2.25	-.69	-.72	-.49	-.70	1.13	.55	.79	.40
15.	19.2	19.3	-.88	-.80	-.63	-.77	.60	.47	.42	.40
16.	3.60	3.87	.13	.08	.09	.08	.13	.15	.70	.10
17.	10.3	10.3	x	x	x	x	.01	.01	.01	.01
18.	.27	.27	x	x	x	x	-.04	-.02	-.03	-.01
19.	.071	.096								
20.	.070	.077								

* The variables and the units in which they are expressed are listed on the following page.
** An "x" indicates that the variable was not included in the regression.

Table 3.6b--continued

Number	Variable Name	Units
1	Energy Intensity	energy costs as % of value added.
2	Depleting Resources	dummy for depleting natural reserves.
3	Labor Intensity	proportion of labor costs to value added.
4	Capital Intensity	ratio of physical capital to value added.
5	Growth	proportionate growth in real sales.
6	U.S. Tariffs	proportion of tariff to value.
7	U.S. Nontariffs	% tariff equivalent of U.S. nontariff barriers.
8	MES	proportion of U.S. industry sales due to an MES size plant.
9	Localized	proportion of goods shipped < 100 miles.
10	Japan Target	dummy for industries targeted by Japan.
11	Eur. Target	dummy for industries targeted by Europe.
12	Unionization	% of workers unionized.
13	Herfindahl	Herfindahl Index (max = 1.0).
14	Foreign Compensation	$ real hourly Japanese compensation.
15	Human Capital	$ of human capital per annual hour worked times the proportion of value added due to labor.
16	R&D Intensity	R&D as % of value added.
17	Foreign Nontariff	number of foreign nontariff barriers procedures.
18	Foreign Tariffs	dummy for industries with high foreign tariffs.
19	Import Penetration	proportion of net imports in domestic supply.
20	Export Penetration	proportion of net exports in domestic supply.

Table 3.6b gives the mean, the units of measure for the variable, the estimated elasticity of each trade flow variable with respect to that independent variable, and the estimated change in the trade flow measure from a ten percent increase in the independent variable (expressed in percentage). The estimated elasticities and average estimated changes in trade flows are all relatively modest. The elasticities range from +8.99 to -7.74. The maximum/minimum values both occur in the net imports regressions where the mean net imports value is quite close to zero so that even the 8.99 elasticity of net imports with respect to labor intensity provides a modest estimated increase in net imports penetration of 1.6 percent in response to a ten percent increase in labor intensity. Elasticities and average changes in the cases import and export penetration are considerably smaller.

In summary, the results of the full model confirm the annual cross-sectional findings reported for the more basic models. Moreover, as Table 3.7 indicates, the results generally align with the hypotheses advanced in Chapter II. Focusing on the statistically significant findings, it appears that the U.S. has a comparative advantage in the production of technologically sophisticated products and a disadvantage in the production of labor intensive products. Natural resource limitations, local markets, and, in some cases, trade barriers have the expected restricting effects on trade flows. U.S. growth and unionization encourage imports, while high foreign wages discourage them.[98]

The experiences of individual industries also support the findings of our statistical studies. For example, consider the three industries which have experienced relatively high net import penetration: textiles, steel, and machine tools. Each of these industries contains a mix of products, some that involve state-of-the-art technological know-how and others which employ more standardized technologies. In each

[98] Only one unexpected finding is evident: Growth in the U.S. market is associated with exports, as well as having the anticipated positive relationship with imports.

Table 3.7

Expected and Observed Relationships

Industry Characteristics	Expected & Observed Relationships* Imp. Exp.	Imp. Obs.	Exprt. Exp.	Exprt. Obs.	Net Imp. Exp.	Net Imp. Obs.
Costs						
Labor						
Labor Intensity	+	+*	-	-*	+	+*
Human Capital Intensity	-	-*	+	+*	-	-*
Unionization	+	+*	-	-	+	+*
Foreign Compensation	-	-	+	+*	-	-*
R&D	+/-	+	+	+*	+/-	+
Raw Materials						
Nonoil Depleting Resources	+	+	-	-*	+	+*
Energy Intensity	+	+*	-	-	+	+*
Capital	-	-	+	+	-	-
Demand						
Industry Growth	+	+*	-	+*	+	+/-
Barriers to Import Competition						
Policy Barriers						
U.S. Tariffs	+/-	-*	NA	NA	+/-	-
U.S. Nontariff Barriers	+/-	-	NA	NA	+/-	-
Foreign Tariffs	NA	NA	+/-	-	+/-	-
Foreign Nontariff Barriers	NA	NA	+/-	+	+/-	+/-
European Targeting	+	-	-	+	+	-
Japanese Targeting	+	+	-	-	+	+
Other Barriers						
Minimum Efficient Scale	+/-	+*	+	+	+/-	+*
Other Structural Characteristics						
Consumer Goods	C	C	C	C	C	C
Herfindahl Index	+	-	+/-	-	+/-	+/-
Localised Markets	-/C	-/C	-/C	-/C	+/-/C	+/-/C

* A + indicates that an increase in a variable representing the industry characteristic is expected (observed) to lead to an increase in the trade flow. A - indicates the opposite relationship. A +/- indicates contradictory effects are present. NA indicates the variable is not expected/observed to affect a particular type of trade flow. A * indicates statistical .05 significance in at least one regression and no contrary signs were observed.
C indicates a control variable used in dividing the sample for separate regression runs.

industry, the U.S. continues to be more competitive in the more technologically sophisticated products, as the previous analysis would predict.

For example, in the textile industry, the U.S. has been a net exporter of man-made fibers and nonwoven fabrics that use evolving technologies, but has been subject to increasing imports in the apparel industry which uses more standardized technologies.[99] In the steel industry, the U.S. is a leader in specialty steel markets, even though it faces strong pressures from foreign competitors in carbon steel production.[100] In machine tool industries, net imports fell for machine tools which involve metal forming (SIC 3542), although they rose for machine tools which involve metal cutting (SIC 3541). Since the former is characterized by higher human capital

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[99] Output per hour worked has risen faster in textiles (4.4%) than in apparel (2.9%). However, productivity is growing faster in both of these industries than in overall manufacturing (2.0%). (**Economic Report of the President** (1986), p. 117.) Even in apparel, there is some evidence that new technologies may lead to a reduction in imports and an increase in U.S. exports. For example, the manufacture of dress shirts was particularly labor intensive, but technological advances recently changed this, leading to increased U.S. production. (National Research Council (1983), p. 40.) Since U.S. unions appear to be supporting research to reduce the need for unskilled labor in clothing manufacture through the Tailored Technology Clothing Corporation, additional changes of this type may occur. (Scott and Lodge (1985), p. 246.)

[100] The U.S. continues to be a leader in specialty steel, which involves substantial know-how (National Research Council (1985), pp. 4-5, 37). Even in carbon steel, U.S. minimills, which use scrap steel as an input, appear to be able to operate profitably at prices which are below the prices of foreign competitors (National Research Council (1985), p. 21). For these firms, the declining quality of U.S. iron ore reserves, which hurt some traditional U.S. producers, is less of a disadvantage.

and R&D expenditures, this change is in line with our findings about U.S. comparative advantage relationships.[101]

b. Tests for Structural Shifts in Trade Flow Relationships

As was the case for the simpler models described above, we used pooled regressions with dummy variables to test the stability of the relationship between trade flows and industry characteristics.[102] These tests revealed no statistically significant shifts in any of the regression coefficients (Appendix B.1c).[103] In addition, we tested the significance of the additional explanatory power that resulted from including all of these dummies.[104] We found that these dummies, as a group, did not add significantly to the explanatory power of the regressions, confirming the basic stability of the relationships captured by the regression model, although as noted before, many of our trade policy

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[101]

	SIC 3541	SIC 3542
Human Capital	30.05	34.80
R&D	3.76	3.97

[102] See Kmenta (1971), p. 373.

[103] The explanations advanced in the test predict a coefficient with a particular sign, indicating that a one-tailed test may be appropriate. Readers who do not believe these explanations are unambiguous because contrary predictions suggested in our discussion of some of these explanations would apply a two-tailed test. We applied a .05 one-tailed test (which is the same as a .1 two-tailed test).

[104] This test involved the construction of a test statistic with an F distribution that was derived from error statistics obtained by running pooled regressions without the dummy variables and pooled regressions with all of the dummies (Kmenta (1971), p. 370).

variables were not available in time series so we could not test for the effects of change in these variables.[105]

We interpret these results as indicating substantial stability in the structure and composition of U.S. trade flows. While our results indicate that no drastic shifts in the pattern of trade flows have occurred, we do not believe that they can be viewed as proof that no change is occurring. Indeed, shifts in trade structure may be present, if they are of an extremely gradual nature. However, even if there is gradual change in the structure of trade flows, the high level of stability we observe contradicts many of the seven explanations of the rising deficit advanced in the introductory chapter.

The stability of the labor intensity variable coefficients does not provide support for the argument that the structural relationships between labor intensity and trade flows have changed. Consequently, the results for the labor intensity variable also do not provide support for the proposition that

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[105] The tests reported in the text focus on determining whether there have been significant changes in the overall structure of trade. Evidently, there have not been particularly dramatic changes. However, we suspect that some gradual changes have occurred. To explore the nature of these changes we studied how changes in trade flows are related to industry characteristics by regressing changes in our three trade flow variables on the 1975 values for our industry characteristics variables. The results of this effort are reported in Appendix B.3. Basically, our findings suggest that U.S. is becoming a stronger exporter of goods that use human capital and R&D intensively and a weaker exporter of labor intensive products. Imports appear to be rising in depleting resource industries, R&D, and labor intensive industries but falling in industries that are protected by nontariff barriers, use capital and human capital intensively, or have high foreign wages. In sum, to the extent there has been some gradual change in trade patterns, it appears generally to be accentuating the U.S.'s traditional strengths and weaknesses.

the surge in imports and the growth in the trade deficit are due to recent increases in U.S. wage demands, as the **High Labor Cost Explanation** suggests. Similarly, the stability of the coefficients on the labor intensity and union variables contradicts the **Union Work Rule Explanation.**[106]

The **Foreign Government Trade Practices Explanation** is not supported by the stability we observe. The trade barrier coefficients are relatively stable over time, although data limitations prevent us from conclusively determining that there is no change in the relationship between some foreign trade practices and industry specific deficits.[107] Moreover, our findings suggest that, to the extent foreign governments do target particular industries for help, foreign government targeting efforts differ. This contradicts variants of this argument which suggest that foreign competitors are uniformly aided by foreign governments.

The **OPEC Cartel Explanation** is also not supported by our findings. No significant changes in the structural relationships between energy or other natural resources and trade flows were observed. Thus, while the rise in oil prices undoubtedly had a sizeable direct effect on the U.S. balance of payments, it has not had sizeable secondary effects on the

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[106] Some of the apparent stability in the relationship may be due to the relocation of industries within the U.S. to areas where unionization is less prevalent in response to the intense import competition.

[107] Because time-series data on many government policies is unavailable, we were not able to test this hypothesis as fully as we would have liked. (See Chapter IV, Section B.) Believing that trade policies have been stable at the level of aggregation we are using, and observing that the coefficients have been relatively stable, it follows that foreign trade practices cannot explain major shifts in trade flows. Since U.S. tariff barriers were available in time series we have the most confidence that U.S. tariffs have not changed sufficiently to explain changes in trade flows.

structural relationships that shaped trade patterns in the observed period.

The regression analysis does not support the **Declining R&D Explanation.** Exports remain strong in R&D intensive industries. Evidently, the drop in R&D expenditures in the mid-1970s was too small, especially with more recent increases in R&D expenditures by U.S. firms, to drastically alter the relative stocks of know-how.

Similarly, the **Inadequate Investment Explanation** is not evidenced by the regression results. No sizeable shifts in the relationship between capital intensity and trade flows were observed, such shifts would be consistent with this hypothesis.

Finally, the statistical findings do not support the **Antitrust Explanation.** Firms operating in the U.S. continue to be strong exporters in industries that involve large scale operations, suggesting that antitrust laws have not hindered their ability to compete in foreign markets. There has not been any significant shift in this relationship, or the relationship between MES and imports. Moreover, there is no evidence that the competitive position of the U.S. is stronger in more concentrated U.S. markets or that this type of relationship is developing over time.

E. MODELS ADJUSTED FOR INTERNATIONAL DIRECT INVESTMENT FLOWS

In the regression analysis discussed in the preceding section, we focused on the relationships that affect the trade positions of manufacturing operations located in the U.S. relative to those located outside the U.S. This is a traditional approach. However, in a world where there is international direct investment, it provides only a partial perspective on the competitive position of a particular country. By including the productive activities of foreign firms in the U.S., this analysis overstates the output of U.S. controlled firms. That is, direct investment in the U.S. by foreign firms may be a substitute for imports. If such substitution is happening, the simple import measures understate foreign controlled output being sold in the U.S. A measure which combines imports and foreign controlled production in the U.S. provides a better gauge of competitiveness in the sense of total foreign controlled products in the U.S. Similarly, by ignoring foreign production by U.S. firms, trade flow measures fail to recognize the possibility that U.S. controlled firms may choose to exploit their advantages through direct investment abroad, that is substitute direct investment abroad for exports from the U.S. If such substitution is taking place, total U.S. competitiveness is better measured by taking direct investment abroad into account.

As was pointed out in Chapter II, by adjusting the trade flow data for international direct investment flows, it is possible to highlight the effects that factor mobility have on trade flows. Specifically, for more mobile factors associated with U.S. competitors strengths, the negative (positive) relationship between imports (exports) and industry characteristics should be stronger when trade flows are adjusted for international direct investment flows. This would be the case if U.S. firms have exploited this advantage abroad. For immobile factors, the opposite effect should be observed, since U.S. firms may go abroad to exploit immobile factors that are less expensive abroad.

In this section, we report the results of regressions that adjust the trade flow data used in the preceding analysis for Direct Foreign Investment (DFI) and Foreign Direct Investment (FDI).[108] In these regressions, import penetration becomes imports plus an estimate of output by foreign-owned facilities in the U.S.[109] Similarly, export penetration is defined as exports plus an estimate of output by U.S. owned facilities located abroad.[110] Net import penetration is

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[108] An alternative adjustment would be to treat the international direct investment by the U.S. and foreigners as explanatory variables. However, this approach does not appear to be correct if one is operating under the assumption that direct foreign investment and trade flows are substitutes which are simultaneously determined and one does not know what variables exogenously determine the extent to which direct investment substitutes for international trade.

[109] For a particular industry, adjusted imports are equal to imports plus an appropriately scaled measure of the output produced by foreign controlled operations that are located in the U.S. Foreign controlled U.S. output is by estimating the fraction of total output produced in the U.S. that is produced by foreign controlled firms and then multiplying this fraction by total U.S. output (P). The fraction of total U.S. output produced by foreign operations located in the U.S. (FDI) was estimated by taking the ratio of employment at foreign controlled plants in the U.S. to total U.S. employment. Therefore, the equation is:
ADJUSTED IMPORTS=IMPORTS+(FDI*P).

[110] For a particular industry, adjusted exports are equal to U.S. exports plus a measure of the output produced by U.S. controlled operations that are located abroad. The output of foreign operations that are controlled by U.S. firms is calculated by multiplying an estimate of the ratio of U.S. controlled foreign produced output to total U.S. output by total U.S. output (P). The ratio of U.S. controlled foreign produced output to total U.S. output was assumed to be equal to the ratio of taxable income generated by U.S. controlled foreign operations to total taxable income

defined as the net of the revised import and export measures.[111] In this way, we obtain estimates of comparable flows controlled by the U.S. and foreign firms. While we view these estimates as crude, they are the best one we could obtain on available data.

1. Cross-Sectional Results

Tables 3.8 through 3.10 contain the results for the modified data. In contrasting Tables 3.1, 3.5, and 3.6 with Tables 3.8, 3.9, and 3.10, we observe that the results are very similar in terms of both signs and significance levels. Only three variables that are statistically significant in one functional form have a different sign in the-other.[112] Two of these variables, unionization and R&D, have differences that appear to be rooted in the adjustment of U.S. exports by DFI. The coefficient differences for the other variable, foreign pay, appear to result from the adjustment of imports by FDI.

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generated by operations located in the U.S. [DFI/(I-DFI)]. This ratio was calculated using the ratio of taxable income generated by U.S. controlled foreign operations to total income that is subject to U.S. taxes (DFI). Therefore the equation is:

ADJUSTED EXPORTS=EXPORTS+[(DFI*P)/(1-DFI)].

[111] All values are deflated by available supply, which is equal to U.S. production plus imports.

[112] The foreign targeting variables go from insignificant to very significant in the export regressions. This implies that much of the effect for these variables rests with U.S. investment abroad. The strong negative coefficient in 1975 on Japanese targeting is consistent with the idea that Japan targets industries in which U.S. firms would otherwise invest abroad. The strong positive coefficient for the European targeting variable is consistent with the idea that the European's target industries in which the U.S. has already invested abroad.

Table 3.8

The Simple Comparative Advantage Model
(Adjusted for International Investment Activity)

Independent Variable	Net Imports 1981	Net Imports 1975	Imports 1981	Imports 1975	Exports 1981	Exports 1975
Labor Intensity	.483* (3.29)	.536* (6.21)	.054 (1.02)	.032 (.70)	-.429* (-3.08)	-.504* (-6.64)
Capital Intensity	-.024 (-1.46)	-.025+ (-1.89)	.004 (.61)	.003 (.36)	.028+ (1.81)	.027# (2.37)
Human Capital Intensity	-.016* (-8.97)	-.008* (-6.72)	-.002* (-2.58)	-.002* (-2.96)	.015* (8.76)	.006* (5.84)
R&D Intensity	-.037* (-8.59)	-.015* (-5.31)	.002 (1.51)	.002 (1.53)	.039* (9.91)	.018* (6.96)
Intercept	-.033	-.180	.149	.107	.182	.287
R-sq.	.435	.307	.019	.025	.467	.342
F	68.73*	39.40*	1.73#	2.30	77.66*	46.04*
N	360	360	360	360	360	360

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.

Table 3.9

Comparative Advantage Model with Entry Barriers
(Adjusted for International Investment Activity)

Independent Variable	Net Imports 1981	Net Imports 1975	Imports 1981	Imports 1975	Exports 1981	Exports 1975
Depleting Resources	.195# (2.41)	.101# (2.32)	.065# (2.35)	.043+ (1.89)	-.144# (1.92)	-.066+ (-1.72)
Labor Intensity	.514* (3.33)	.586* (6.42)	.060 (1.18)	.035 (.77)	-.502* (-3.51)	-.585* (-7.25)
Capital Intensity	-.038# (-2.25)	-.037* (-2.73)	-.184 (.32)	-.004 (-.54)	.037# (2.35)	.033* (2.75)
U.S. Tariffs	-.9E-6 (-1.08)	-.4E-6 (-.85)	-.7E-6* (-2.35)	-.5E-6* (-1.95)	X X	X X
U.S. Non-tariff Barriers	-.004* (-8.81)	-.002 (-1.26)	-.001 (-1.43)	.0005 (.79)	X X	X X
MES	1.273* (2.59)	.822* (2.99)	.779* (4.63)	.582* (4.01)	-.513 (-1.12)	-.249 (-1.03)
Human Capital Intensity	-.020* (-9.70)	-.009* (-7.11)	-.003* (-4.34)	-.002* (-3.49)	.017* (8.77)	.006* (5.66)
R&D Intensity	-.036* (-8.22)	-.016* (-5.49)	.002 (1.60)	.002 (1.50)	.038* (9.36)	.018* (7.01)
Foreign Non-tariff Barriers	.9E-4 (.13)	.0003 (.82)	X X	X X	.0005 (.79)	-.9E-4 (.27)
Foreign Tariffs	.038 (.88)	.043+ (1.72)	X X	X X	-.067* (-1.70)	-.068* (-3.07)
Intercept	.001	-.199	.158	.101	.216	.345
R-sq.	.464	.325	.108	.086	.479	.365
F	30.20*	18.25*	5.29#	4.12*	40.32*	25.17*
N	360	360	360	360	360	360

Note: The figures in parentheses are t-statistics.
\+ Indicates significant at the .10 level for a two-tailed test.
\# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates variable was not used in the regression.

Table 3.10

Model with Barriers and Control Variables
(Adjusted for International Investment Activity)

Independent Variable	Net Imports 1981	Net Imports 1975	Imports 1981	Imports 1975	Exports 1981	Exports 1975
Energy Intensity	.007* (4.27)	.002 (1.56)	.002* (3.17)	.002* (2.80)	-.004* (-2.86)	.0008 (.95)
Depleting Resources	.463* (5.28)	.336* (7.27)	.038 (1.21)	.016 (.56)	-.449* (-5.66)	-.331* (-8.79)
Labor Intensity	.154 (.90)	.288* (2.87)	.157* (2.60)	.135# (2.42)	-.120- (-.79)	-.261* (-3.30)
Capital Intensity	-.024 (-1.51)	-.016 (-1.37)	-.006 (- .97)	-.010 (-1.36)	.020 (1.39)	.008 (.81)
Growth	-.002 (-.06)	-.035+ (-1.81)	.021 (1.56)	.025# (2.18)	.029 (.84)	.067* (4.26)
U.S. Tariffs	-.9E-6 (-1.12)	-.5E-6 (-1.32)	-.6E-6# (-2.22)	-.4E-6+ (-1.87)	X X	X X
U.S. Nontariff Barriers	-.007* (-2.75)	-.003# (-2.40)	-.001 (-1.32)	.0006 (.84)	X X	X X
MES	1.142* (1.89)	.587# (2.03)	.889* (4.09)	.699* (4.02)	-.398 (-.72)	.062 (.26)
Localized	.135 (1.54)	.046 (1.01)	-.043 (-1.36)	-.014 (-.49)	-.165# (-2.07)	-.056 (-1.48)
Japan Target	-.004 (.08)	.183* (6.49)	.009 (.47)	.004 (.24)	-.005 (- .11)	-.189* (-8.31)
Europe Target	-.199# (-2.20)	-.095* (-3.18)	-.018 (- .92)	-.021 (-1.16)	.146* (3.31)	.108* (4.94)
Unionization	-.003# (-2.06)	.003* (3.68)	.001# (1.96)	.0008* (1.69)	.005* (3.47)	-.002* (-2.77)
Herfindahl Index	-.149 (- .39)	.154 (.92)	-.037 (- .27)	-.055 (- .55)	.108 (.32)	-.253* (-1.88)

(table continues)

Table 3.10--Continued

Independent Variable	Net Imports 1981	1975	Imports 1981	1975	Exports 1981	1975
Foreign Pay	-.345*	-.410*	.008	.016	.333*	.399*
	(-6.76)	(-10.75)	(.46)	(.73)	(7.17)	(12.98)
Human Capital Intensity	-.012*	-.006*	-.004*	-.004*	.008*	.003#
	(-5.29)	(-4.48)	(-5.17)	(-4.36)	(3.69)	(2.46)
R&D Intensity	-.027*	-.003	.003	.003	.028*	.004
	(-5.39)	(- .80)	(1.47)	(1.54)	(6.27)	(1.44)
Foreign Noncariff Barriers	.0003	.5E-5	X	X	.0005	.0003
	(.38)	(.01)	X	X	(.78)	(1.17)
Foreign Tariffs	-.029	-.056#	X	X	-.003	.032
	(- .65)	(-2.34)	X	X	(- .80)	(1.66)
Intercept	.894	.474	.070	.008	-.701	-.354
R-sq.	.556	.525	.170	.145	.586	.609
F stat.	23.75*	20.97*	4.39*	3.65*	30.31*	33.33*
N	360	360	360	360	360	360

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regression.

Turning to the Unionization and R&D variables in our full model comparison (Tables 3.6 and 3.10) of the adjusted and unadjusted trade flow regressions, first, we observe that the adjustment of exports by DFI caused the associated coefficients to switch signs so that they are negative in the 1981 adjusted net import regressions. For both coefficients, this change in sign appears to be related principally to changes in the relationship that these variables have with exports (switching from negative to positive for unionization and becoming substantially more positive for R&D). One interpretation of these changes is that U.S. firms have increasingly invested abroad to take advantage of their technological know-how and to avoid U.S. unions, since adjusted exports have a stronger positive relationship with these variables than with unadjusted exports. This interpretation is consistent with the view that mobile factors, such as know-how, will move abroad when they can be advantageously coupled with other resources.

In the case of the foreign pay coefficients, it is the coefficient for the import regression which changes sign, becoming positive in the adjusted regressions. This change is consistent both with the view that foreign firms are attracted to manufacture in the U.S. when skilled labor is an important input and with the view that foreigners are discouraged with producing in their home markets when wage rates are relatively high in these markets.[113] When they

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[113] As noted earlier, the positive relationship between exports and foreign compensation could arise from either of two sources. It could occur because high foreign wages mean high foreign costs and hence an opening for U.S. exports. Or it could occur because wages are high abroad where foreign producers have to use highly skilled workers and these are just the types of industries in which the relative abundance of U.S. skilled labor gives the U.S. an advantage. Under the first hypothesis, the advantage of U.S. producers is based strictly on producing in the U.S. Producing abroad would subject them to the same wage conditions as foreign producers, so there should not be a positive association

have to rely on their own labor, they can not import effectively in high wage/skill industries. However, by producing in the U.S. they can compete successfully to serve the U.S. market. Again, the observed change in coefficients is consistent with the view that firms may move internationally to exploit relatively immobile resources.

2. Pooled Regression Results

As in our analysis of the unadjusted trade flow data, we were able to pool the adjusted trade flow data and perform statistical tests of the stability of the regression coefficients over time. While we observed substantial stability in the values of the parameters, there were some statistically significant changes (see Appendix B.1c). However, these changes in parameters evidence a strengthening of the relationships that have traditionally shaped U.S. trade flows.

T-statistics on the dummy time shift variables for the full model are reported in Table 3.11. Reports for the two simpler specifications are in Appendix B.1.

Focusing first on the variables we include in the basic model, there are no statistically significant changes in the coefficients for the labor or capital variables. While coefficients for the human capital and R&D intensity variable did change, the movement indicates increasing U.S. strength in products that involve technological know-how. The R&D intensity variable also changed in a direction consistent with strengthening U.S. traditional competitive strengths; however, this change was not statistically significant at traditional significance levels.

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between foreign compensation and production by U.S. firms abroad. But there is. Consequently, it is more useful to consider the foreign compensation variable as a foreign human capital variable where human capital technologies are somewhat transferable from the U.S. to abroad without substantial penalties.

Table 3.11

T-statistics for Dummy Time Shift Variables
Model with Barriers and Control Variables
(1975 vs. 1981)

Explanatory Variable	Net Import Penetration	International Investment Adjusted Net Import Penetration	Import Penetration	International Investment Adjusted Import Penetration	Export Penetration	International Investment Adjusted Export Penetration
Energy Intensity	-.43	2.42#	-.19	-0.3	+.63	-3.00*
Depleting Resources	.18	2.30#	.67	.56	+.65	-2.32#
Labor Intensity	.62	2.30#	.67	.15	-.39	.67
Capital Intensity	.50	-.33	.43	.62	-.12	.67
Growth	1.22	-.37	.35	-.10	-1.51	.28
U.S. Tariff	-.24	-.44	-.25	-.35	X	X
U.S. Nontariff	-.72	-.17	-.57	-1.68*	X	X
MES	.79	.82	.77	.65	-.40	-.65
Localized	-.65	1.30	.56	-.76	+.43	-1.80+
Japan Targets	.10	-2.60*	+.37	+.19	+.04	3.14*
Europe Targets	-.13	-2.07*	+.16	+.21	+.22	2.25#

(Table continues)

Table 3.11--Continued

T-statistics for Dummy Time Shift Variables
Model with Barriers and Control Variables
(1975 vs. 1981)

Explanatory Variable	Net Import Penetration	International Investment Adjusted Net Import Penetration	Import Penetration	International Investment Adjusted Import Penetration	Export Penetration	International Investment Adjusted Export Penetration
Unionization	.36	-2.74*	.11	.34	-.32	3.18*
Herfindahl	-.17	-.77	.22	.12	+.58	1.10
Foreign Pay	.31	.28	-.22	-.36	-1.15	-.24
Human Capital	-.27	-3.26*	-.44	-.50	-.02	3.43*
R&D	-.38	-1.08	-.79	-.84	-.40	.91
Foreign Nontariff	.51	-.01	X	X	-.11	-.10
Foreign Tariff	-.84	.01	X	X	+.45	-.11

+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regression.

Three trade policy variables are associated with significant changes in regression coefficients over time: Japanese industrial targeting, European industrial targeting, and U.S. nontariff barriers. Evidently, the Japanese and European targeting efforts are having less of an adverse impact on U.S. exports when DFI is included. Somewhat more perplexingly, it appears that U.S. nontariff barriers are having an increasingly negative affect on adjusted imports. Since no parallel relationship exists for unadjusted imports, we take this to mean that nontariff barriers are negatively associated with FDI. While we expected nontariff barriers to raise FDI, not decrease it, the observed relationship may still have some theoretical support. In particular, it may simply indicate that the U.S. introduces nontariff barriers in industries where U.S. based production is losing its comparative advantage.[114]

The pooled regressions also evidence changes which suggest that U.S. DFI is shifting away from natural resource intensive industries.[115] Specifically, the coefficients in the export equation (and thus the net import equation) fall for the energy intensity and depleting resource intensity variables.

The only other variables that change over time are the local market indicator and the variable which indicates the level of union activity in the industry. The coefficient for the local variable in the export equation falls over time. Evidently, the U.S. is doing more production abroad in markets in which it trades internationally. The union

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[114] As noted previously, we did not have data to test this simultaneous model of U.S. nontariff barriers.

[115] For example, U.S. firms sold Canadian affiliates in response to laws that were designed to increase the participation of local investors in the petroleum industry. Similarly, U.S. firms sold a large Australian metal manufacturing affiliate to local investors (Wichard (1983), p. 18).

coefficient changes signs over time for the adjusted net import (+ to -) and export regressions (- to +). Together, these findings suggest that the adverse effects of unions on U.S. controlled firms' international competitiveness has diminished, possibly because they have moved production overseas.

In summary, our analysis of adjusted trade-flow data complements our preceding study of unadjusted data. While the latter showed no evidence of change in trade patterns, the former provides some evidence that U.S. firms have increasingly exploited their more "mobile" competitive strengths by investing abroad. Moreover, it appears that U.S. firms have undertaken this effort, in part, to avoid some of the disadvantages of producing in the U.S. Most notably, they may have moved abroad to avoid U.S. industries that have higher levels of unionization.

Together, the analyses of adjusted and unadjusted trade flow data indicate that U.S. firms are not losing their traditional competitive strengths. Indeed, to the extent change is occurring, it appears likely that it is moving the mix of U.S. firm production toward emphasizing traditional U.S. strengths. Moreover, the structural changes that have occurred do not appear to have been dramatic enough to be consistent with the large observed increase in the U.S. balance of payments during the 1980s. As a result, there continues to be no support for the view that any of the seven hypothesized explanations is responsible for the sharp rise in U.S. trade deficits.

F. SENSITIVITY ANALYSES OF BASIC RESULTS

1. Overview

Five types of sensitivity analyses were conducted: (1) more recent data for a subsample of industries were tested to see if relationships changed after 1981; (2) subsamples of the data controlling for the local nature of the market and the extent of sales to final consumers were examined; (3) the possibility that R&D and human capital variables are simultaneously influenced by trade flows was tested; (4) alternative industry size deflators were employed; and (5) various explanatory variables were dropped from the specification to check for multicolinearity problems. The stability of coefficients under the last of these sensitivity tests has been discussed in the preceding review of the basic results. Here we will consider the updated subsample of industries. The discussion of the results of the other tests and tables reporting the results of the other tests are in Appendix D. In general, the results are robust with respect to the sensitivity tests shown in Appendix D.

2. Updated Data Subsample

For a subsample of 122 four-digit industries, we were able to obtain trade data[116] covering three additional years.

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[116] The updated data were taken from the 1985 U.S. **Industrial Outlook**, published by the Department of Commerce. Comparisons of results from regression analyses (on net imports) using this data source and a subsample of our main data files covering the same 122 industries indicate that the Commerce Department data and our main data set are similar, although not identical. The correlation between 1981 net import penetration in the two data sets is .86. No statistically significant differences occur. The largest differences are associated with the foreign nontariff barriers variable and the growth in demand variable. In the Commerce Department data for 1981, the foreign nontariff variable has a nearly significant positive coefficient while in our main

1982, 1983, and 1984. Although the main sample containing 1975 to 1981 data includes the beginning of the rise in the value of the dollar that reached its peak in early 1985, it is possible that lagged adjustments in trade could leave our main results of questionable interest for the current trade debate. To check for this possibility, we used the full regression model on the 122 industries in the new data subsample for the years 1981 to 1984. Results for different years from this new smaller data set are compared to check for changes in the regression coefficients under the assumption that changes in the results from the smaller data set are representative of the changes in the results that would be obtained if updated data were available for the larger data set.

Tables 3.12a and 3.12b contains the results for 1981-1984 using the smaller updated data set. In this data set, the import, net import and export variables are updated. However, since updated values for the explanatory variables were not available, we were forced to assume that they are the same as the 1981 values.[117] Our analysis indicates that the 1981 versus 1984 and 1975 versus 1984 coefficients are very

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data set this variable has a positive, but clearly insignificant coefficient. For the growth in demand variable, the signs are different, but both are insignificant. These differences likely arise from different industry aggregations initially used in calculating trade flows. For a description of the dependent variables used in our main data set, see Appendix A.

[117] The rankings of the industries with respect to these variables appears to be fairly stable, which makes this an acceptable methodology. See Chapter IV for a discussion of this stability.

Table 3.12a

Regression Results for the Updated Data Set Using Full Model with Barriers and Control Variables, 1984 and 1981

Independent Variable	Net Imports 1984	Net Imports 1981	Imports 1984	Imports 1981	Exports 1984	Exports 1981
Energy Intensity	-.0003 (-.20)	.0002 (.11)	-.0005 (-.35)	-.4E-4 (-.03)	.7E-4 (.08)	-.0002 (-.20)
Depleting Resources	.223* (3.66)	.227* (4.01)	.114* (1.92)	.080* (1.67)	-.112* (-3.08)	-.147* (-3.40)
Labor Intensity	.332* (3.15)	.278* (2.84)	.266* (2.60)	.244* (2.95)	-.067 (-1.06)	-.027 (-.36)
Capital Intensity	.004 (.35)	.005 (.49)	.012 (1.06)	.010 (1.15)	.007 (.98)	.004 (.49)
Growth	-.002 (-.09)	-.038 (-1.63)	.039 (1.59)	.027 (1.34)	.036* (2.42)	.062* (3.48)
U.S. Tariffs	.7E-6 (1.08)	.2E-6 (.35)	.9E-8 (.01)	-.3E-6 (-.70)	X X	X X
U.S. Non-tariff Barriers	.003 (1.41)	.002 (1.15)	.003 (1.72)	.001 (.86)	X X	X X
MES	.470 (.75)	.664 (1.14)	1.599* (2.66)	1.561* (3.23)	.993* (2.70)	.819* (1.87)
Localized	-.035 (-.43)	.0009 (.01)	-.085 (-1.08)	-.063 (-1.00)	-.041 (-.86)	-.060 (-1.06)
Japan Target	.018 (.61)	.037 (1.36)	.009 (.33)	.004 (.20)	.008 (.44)	-.020 (-.95)
Europe Target	.002 (.06)	-.026 (-.92)	.013 (.44)	.006 (.26)	-.008 (-.43)	.011 (.55)
Unionization	-.0007 (-.73)	.0002 (.29)	-.001 (-1.21)	-.0004 (-.52)	.6E-4 (.11)	-.0004 (-.63)
Herfindahl Index	.304 (1.05)	.199 (.74)	-.126 (-.45)	-.147 (-.66)	-.385* (-2.22)	-.331 (-1.61)

(table continues)

Table 3.12a--Continued

Independent Variable	Net Imports 1984	Net Imports 1981	Imports 1984	Imports 1981	Exports 1984	Exports 1981
Foreign Pay	-.030	-.038	-.002	-.004	.015	.031
	(- .89)	(-1.22)	(- .07)	(- .16)	(.73)	(1.30)
Human Capital Intensity	-.002	-.003*	-.0003	-.001	.002*	.003*
	(-1.58)	(-2.54)	(- .22)	(- .84)	(2.37)	(2.82)
R&D Intensity	-.007*	-.003*	-.006*	-.004*	.002	-.5E-5
	(-2.49)	(-1.23)	(-2.17)	(1.87)	(1.32)	(-.002)
Foreign Non-tariff Barriers	.0003	.0004	X	X	.6E-4	-.0001
	(.65)	(1.02)	X	X	(.25)	(-.41)
Foreign Tariffs	-.002	-.006	X	X	-.022	-.017
	(- .87)	(- .24)	X	X	(-1.41)	(- .95)
Intercept	-.023	-.042	-.032	-.039	.009	-.012
R-sq.	.456	.462	.292	.289	.443	.430
F stat.	4.79*	4.91*	2.71*	2.67*	5.22*	4.96*
N	122	122	122	122	122	122

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regressions.

Table 3.12b

Regression Results for the Updated Data Set Using the Model with Barriers and Control Variables, 1983 and 1982

Independent Variable	Net Imports 1983	Net Imports 1982	Imports 1983	Imports 1982	Exports 1983	Exports 1982
Energy	-.0007	.0004	-.0008	-.0002	-.0001	-.0007
Intensity	(-.46)	(.32)	(-.64)	(-.14)	(-.15)	(-.63)
Depleting	.225*	.259*	.109#	.099#	-.115*	-.157*
Resources	(3.94)	(4.63)	(2.18)	(2.11)	(-2.90)	(-3.56)
Labor	.292*	.324*	.219#	.228*	-.067	.098
Intensity	(2.97)	(3.36)	(2.54)	(2.81)	(-.99)	(-1.17)
Capital	.007	.005	.011	.009	.004	.003
Intensity	(.60)	(.45)	(1.18)	(.96)	(.48)	(.32)
Growth	-.017	-.023	.026	.022	.040#	.043#
	(-.73)	(-1.00)	(1.28)	(1.13)	(2.49)	(2.36)
U.S. Tariffs	.5E-6	.4E-6	-.1E-6	-.2E-6	X	X
	(.79)	(.73)	(-.24)	(-.37)	X	X
U.S. Nontariff	.003	.003*	.002	.001	X	X
Barriers	(1.45)	(1.81)	(1.22)	(1.22)	X	X
MES	.593	.836	1.552*	1.520*	.859*	.547
	(1.01)	(1.46)	(3.07)	(3.20)	(2.15)	(1.23)
Localized	-.016	-.0003	-.068	-.063	-.050	-.063
	(-.21)	(-.01)	(-1.04)	(-1.02)	(-.96)	(-1.09)
Japan Target	.022	.046+	.004	.007	-.005	-.024
	(.81)	(1.69)	(.18)	(.29)	(-.26)	(-1.14)
Europe Target	-.007	-.016	.015	.014	.004	.011
	(-.24)	(-.59)	(.63)	(.63)	(.19)	(.54)
Unionization	-.0006	-.0006	-.0008	-.0005	-.8E-4	.0002
	(-.67)	(-.72)	(-1.16)	(-.79)	(-.13)	(.36)
Herfindahl	.269	.179	-.188	-.136	-.434#	-.280
Index	(.99)	(.67)	(-.80)	(-.62)	(-2.30)	(-1.33)
Foreign Pay	-.026	-.029	-.002	-.1E-4	.020	.025
	(-.83)	(-.96)	(-.09)	(-.6E-3)	(.93)	(1.04)

(table continues)

Table 3.12b--Continued

Independent Variable	Net Imports 1983	Net Imports 1982	Imports 1983	Imports 1982	Exports 1983	Exports 1982
Human Capital Intensity	-.003+	-.004*	-.0004	-.006	.002*	.003*
	(-1.87)	(-2.75	(- .35)	(- .56)	(2.69)	(3.37)
R&D Intensity	-.006#	-.004	-.005#	-.004#	.002	.0006
	(-2.16)	(-1.60)	(-2.09)	(-2.03)	(.95)	(.31)
Foreign Non-tariff Barriers	.0003	(-1.60)	X	X	-.5E-4	-.002
	(.71)	(.61)	X	X	(- .18)	(- .53)
Foreign Tariff	-.007	.001	X	X	(- .016)	(-.027)
	(- .29)	(.06)	X	X	(- .98)	(-1.46)
Intercept	-.039	-.063	-.017	-.040	.010	.010
R-sq.	.451	.493	.306	.315	.413	.411
F stat.	4.70*	5.57*	2.90*	3.02*	4.61*	4.58*
N	122	122	122	122	122	122

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regression.

similar.[118] Moreover, there are no statistically significant changes in the coefficients over time.[119]

In sum, these tests confirm the basic findings for the larger data set. Specifically, it appears that the determinants of trade have not changed radically over the course of the early 1980s.

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[118] Only two differences are observed. In the import regressions, U.S. nontariff barriers are becoming a stronger deterrent to imports. In the export regressions, foreign compensation is becoming more positively associated with exports.

[119] As noted previously, statistical differences in the coefficients over time can be assessed by using dummy interaction variables with data from the end points of the period--1981 and 1984 in this case.

G. SUMMARY OF EMPIRICAL FINDINGS

The empirical results largely confirm the hypothesized relationships between industry characteristics and trade flows that are summarized in Table 3.3. Moreover, the results indicate that the structural relationships which shape U.S. trade flows have not changed significantly over the last decade. However, the relative advantages of U.S. controlled firms appear to have changed somewhat. Importantly, U.S. firms appear to have an increasing advantage in industries where know-how is a particularly important input and have found that producing abroad avoids the comparative disadvantages associated with unionized production in the U.S. However, these shifts have not been so dramatic that they have altered the traditional structure of U.S. trade flows.

1. Cross-Sectional Results

a. Advantages of Manufacturing In The U.S.

As was anticipated, the U.S.'s comparative strength is in manufacturing products that use skilled labor and technological know-how intensively, while its relative weakness is in the manufacture of products that employ proportionately more unskilled labor.[120] Capital intensity does not appear to be a particularly significant industry characteristic, perhaps because of the international mobility of capital.

Our examination of trade barriers is consistent with the common view that trade barriers reduce trade flows. However, the relationships do not appear to be as simple as

[120] As was anticipated, the relationship of U.S. net imports and imports to R&D intensity is insignificant due to contradictory effects. The product differentiation effect of R&D suggests a positive relationship, while the expected strength of the U.S. in producing these products predicts a negative relationship. R&D was always positively associated with U.S. exports, perhaps because these two forces both support higher U.S. export levels.

analysts often assume they are. Since trade barriers probably are erected in markets where imports are a significant threat, there may be a simultaneous relationship between trade flows and trade barriers. As a result, higher trade barriers may be observed where higher levels of imports are present, even though imports are lower than they would be absent the trade barriers.

A number of market characteristics appear to be associated with higher import levels: energy intensity, depleting resource intensity, growth, MES, and unionization. Each of these relationships was anticipated. Perhaps the only surprise in the cross-sectional results is the observation that the Europeans and Japanese are targeting different industries. Based on simple correlations between these two explanatory variables and other explanatory variables, it appears that the Japanese are targeting human capital intensive industries, while the Europeans are targeting more traditional labor intensive industries.

Generally, the results appear to be quite robust to changes in specification. Variables can be deleted without having particularly significant impacts on the signs of remaining variables, although for some variables the evidence is weaker than for others. Subsamples appear to have similar properties.[121] Tests of models that recognize that R&D and human capital may be simultaneously determined and affected by trade flows indicated that these considerations are not statistically significant. Alternative heteroscedasticity corrections have minimal effects.

b. Strengths of U.S. Controlled Corporations

The results for the cross-sectional trade flow models which are adjusted for international direct investment are very similar to those for the unadjusted model. The only

[121] The local/internationally traded segmentation of the sample improved the statistical significance of the results. The consumer/producer goods bifurcation did not improve the fit and suggested that additional work in this area is needed.

coefficients that have a sign that differs significantly at least once across models are the coefficients for the unionization, R&D, and foreign pay variables. The sign differences involving the first two of these variables are consistent with the view that U.S. controlled firms are investing in foreign manufacturing operations to avoid unions and to exploit their R&D advantages. The sign difference for the third of these variables may result because foreign firms are attracted to invest in the U.S. when the industry intensively employs skilled (higher wage) labor.

2. Pooled Regression Results

The pooled regressions evidence substantial stability in the structural relationships that shape trade flows. Evidently, the basic relationships that encourage firms to produce in the U.S. have not changed significantly, although gradual changes may be occurring.

The regressions that analyze trade flows that are adjusted to reflect international direct investment flows do evidence some statistically significant shifts in the structural relationships over time. However, the changes in regression coefficients are limited in number and often reinforce existing structural relationships, rather than indicating an erosion of these relationships. For example, among the variables we include in the basic model, there are no statistically significant changes in the coefficients for the labor intensity or capital intensity variables. While coefficients for the Human Capital and R&D intensity variables did change in some of our pooled regressions, the movement in both cases indicates increasing U.S. strength in products that involve technological know-how relative to many other nations.[122]

Other changes in the regression coefficients over time are consistent with the hypothesis that U.S. nontariff barriers to trade may be having a more significant prohibitory impact on imports, while Japanese and European

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[122] See footnotes 35 and 123.

targeting efforts appear to be having less of an adverse impact on U.S. exports. And the pooled regressions suggest that the adverse effects of unions on U.S. controlled firms' competitiveness have diminished over time, since they have moved production overseas.

The analyses of adjusted and unadjusted trade flow data indicate that U.S. industries are not losing their traditional competitive strengths relative to other U.S. industries. Changes in trade structure, to the extent they are occurring, appear to be leading U.S. producers to exploit their historical strengths and avoid their traditional disadvantages by investing abroad. Yet, direct foreign investment has not been so significant that it has altered the basic structure of trade flows. No evidence of dramatic changes of the type suggested by the seven explanations for the growth in the trade deficit is apparent.

CHAPTER IV

CHANGE IN THE PERFORMANCE OF U.S. INDUSTRIES

A. INTRODUCTION

Factors associated with U.S. competitiveness in trade appear to have been relatively stable throughout the 1970s and early 1980s. As the empirical results reported in Chapter III indicate, manufacturing operations located in the U.S. retain their traditional competitive advantage in production that requires sophisticated know-how and continue to experience a competitive disadvantage in production that uses unskilled labor intensively. Moreover, it appears that, to the extent change has occurred, these relationships have strengthened over time.[123] Yet, as others have pointed out, the competitive performance of many U.S. industries appears to have declined.[124] Can these two observations be consistent?

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[123]This finding reflects an analysis that considers numerous manufacturing industries and trade with all countries. Particular industries or trade patterns with individual countries may have diverged somewhat from these average relationships. For a discussion of particular product markets, see the various studies of the National Research Council (1982-85). And for a discussion of shifts in trade competitiveness with Japan, see Marston (1987).

[124] Landau and Rosenberg (1986) and various industry studies by the National Research Council (1982-1985).

Our earlier empirical findings may be quite consistent with the observed rise in the trade deficit, since the competitive performance of U.S. industries can decline because of changes that do not affect the relationships between trade flows and the industry characteristics included in our previous analysis. Two possibilities are the focus of our attention in this chapter.[125] First, the characteristics of particular industries, such as their factor intensities, may have changed so that net imports increased. For example, we found in the last chapter that higher unionization is associated with more imports, thus if unionization increased and this relationship remained stable, then unionization could be one cause of increased imports. Second, it is possible that variables not included in our analysis, including economy-wide variables, such as exchange rates, may have changed, causing the rise in net imports.

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[125] There is also the possibility that the failure to observe significant shifts in the structural relationships captured by our model is due to measurement error. In particular, as noted in Chapter III, we are forced to assume that some variables do not change over time, when they may change somewhat. However, given the stability in the structure of trade evidenced in the preceding section, as well as stability in the explanatory variables that can be traced over time (covered in this chapter), it seems unlikely that this is the case.

B. CHANGES IN INDUSTRY CHARACTERISTICS THAT AFFECT INTERNATIONAL COMPETITIVENESS

Shifts in the relative competitiveness of an individual industry may reflect adjustments in the characteristics of the industry, within the context of stable comparative advantage relationships. For example, if strong research and development efforts are associated with strong exports, but industries reduce their research and development expenditures, export performance would be expected to decline even though the relationship between exports and research and development was stable. Put slightly differently, when relative factor abundancies are stable, changes in industrial input requirements will be reflected in shifts in the trade balance of particular U.S. industries.

While it is theoretically possible that changes in the characteristics of U.S. industries underlie the observed rise in U.S. trade deficits, available empirical evidence suggests that this is not the case. Our sample of 360 industries accounts for most U.S. manufacturing industries and evidences an increase in the merchandise deficit much like that which the entire economy experienced.[126] Yet, we observe considerable stability in the characteristics of the industries within our sample.

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[126] For our sample manufacturing industries, net imports increased by $50 billion or 9.4% of total trade between 1975 and 1981. This figure differs from the change shown in Table 1.1, $19.1 billion, because unprocessed U.S. agricultural exports are included in the merchandise trade balance, but not in our sample. Similarly oil imports are not included in our sample, but are included in the merchandise trade accounts.

Interestingly, our net import penetration ratios do not change much. The average import penetration ratio moves from .00117 to .00123. This implies that many of the most dramatic increases in net imports have occurred in large industries.

Four tests were performed to evaluate the stability of the industry characteristics we used in our empirical tests. First, we examined the stability of the rankings of industries with respect to their net import levels. Second, we looked at the stability of industry characteristics across time, for those industry characteristics for which we have data that change over time. Third, we related the changes in the trade flow variables to changes in the industry characteristics to see how much of the observed change in trade flows is explained by changes in the industry characteristics. Fourth, we evaluated the sensitivity of trade flows to changes in variables that could be observed at only one point in time. The first three measure whether these characteristics have changed enough to have significantly affect trade flows. The fourth checks whether any change in the characteristics, regardless of how large, could result in significant changes in imports and exports.

The rankings of industries with respect to their trade flows have been quite stable. While there have been some shifts in position during the last decade, statistical tests indicate that the shifting has not been substantial. The rank order of manufacturing industries by the level of net imports in 1975 is highly correlated with the rank order which existed in 1984. This correlation is .87, based on our updated (smaller) sample. For our larger sample, which covers the 1975-1981 period, the correlation is .90. Both of these correlations are statistically significant.

Industry characteristics available in time series have also been quite stable. As Table 4.1 reports, the values for industry characteristics in 1975 are highly correlated with their values in 1981. Indeed, none of the eight explanatory variables that vary across time in our sample have a correlation that is below .80. This indicates that industries with high values for an explanatory variable in 1975 are very likely to have high values in 1981. Moreover, the changes in mean values for these variables are relatively small, especially for the variables that are most directly related to the seven proposed explanations of the trade deficits that we analyze. The variables available in time series include the primary variables used in traditional trade models.

Table 4.1

Correlation of Explanatory Variables Over Time
(1975 and 1981)

Explanatory Variable	Correlation Coefficient	% Change in Mean
Labor Intensity	.81	- 1.3
Capital Intensity	.91	7.1
U.S. Tariffs	.81	-10.8
Herfindahl Index	.84	-1.5
Foreign Pay	.99	21.8
Human Capital	.91	.8
R&D Intensity	.96	7.5
Energy Intensity	.98	11.8

To determine how changes in the explanatory variables are related to changes in the trade flows, we regressed the 1975-1981 changes in eight explanatory variables on the changes in the trade flow variables over the same time period. The results are reported in Table 4.2. The results in Table 4.2 show little evidence that input requirements or other industry characteristics changed in ways that would cause a sharp rise in the trade deficit.[127] Specifically, it is

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[127] Consistent with our earlier finding that changes have taken place in characteristics associated with trade flows adjusted for international direct investment, a number of changes in explanatory variables are significantly related to changes in the adjusted trade flows. The U.S. tariffs variable is the only significant explanatory factor for the adjusted imports regression and the explanatory power of the model is correspondingly small (less than 4%). It is positively related to changes in U.S. tariffs. In contrast, four changes in explanatory variables are significant in explaining changes in adjusted exports. By far the most important explanatory factor is the change in R&D intensity. Increases in R&D intensity are relatively important in explaining increases in adjusted export penetration. Increases in foreign compensation and human capital also are positively related to adjusted export activity. Increases in labor intensity are negatively related to changes in adjusted export activity. These four changes in industry characteristics account for 15.6% of the change in adjusted export penetration. In the net imports equation, all five variables discussed above are significant in the expected directions. The model accounts for 17% of the change in adjusted net imports. The coefficients are shown in Appendix B.4.

Table 4.2

Results for Regressions Relating Changes in Industry Characteristics to Changes in Trade Flows

Change Variable	Coefficients of Changes in Penetration of		
	Net Imports	Imports	Exports
Labor Intensity	-.127+	-.073	.111
Capital Intensity	.014	-.007	-.030
U.S. Tariffs	-.079	-.098+	xxx
Herfindahl Index	.045	-.007	-.079
Foreign Pay	-.040	-.191*	-.167*
Human Capital	.010	.059	.056
R&D Intensity	.040	-.001	-.064
Energy Intensity	-.055	.037	.131#
Intercept	.022	.044	.022
R-Square	.030	.045	.056
F	1.352	2.390#	2.991*

+ Indicates significant at the 10% level for a two-tailed test.
# Indicates significant at the .05% level for a two-tailed test.
* Indicates significant at the .01% level for a two-tailed test.
xxx Indicates that the variable is not used in the particular model specification.

clear that those changes that did occur account for relatively little of the change in trade flows.[128] The highest degree of explanatory power is achieved in the export equation where the R-square is 5.6%, indicting that changes in the independent variables explain little of the rise in the trade deficit.[129]

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[128] Within the overall stability of the independent and dependent variables there are a few industries for which trade flows change significantly and there is a corresponding shift in these industries' characteristics. For example, in the press control instruments and lenses industry (SIC 3823), net imports increased and the industry's position in the ranking of industries by net imports changed by over 100 positions between 1975 and 1981. Yet the gap between the actual and predicted net imports was narrower in 1981 than it was in 1975. The regression equation appears to have been able to predict the increase in net imports because the industry shifted toward much less human capital intensive production over the 1975-1981 period.

[129] Given the significance of market characteristics in predicting trade flows, one might expect that changes in these characteristics would be significantly related to changes in trade flows. However, this need not be the case. Other variables may be responsible for changes in trade flows across time, despite the fact that market characteristics often do not vary appreciably across time, so it is frequently the case that industry characteristics do not explain much of the intertemporal variation. In contrast, macroeconomic variables often vary substantially across time, and thus frequently explain intertemporal variations in economic variables such as trade flows.

Given the stability of the coefficients that relate market characteristics to trade flows, one might also expect to observe the same slope coefficients in the regression that relates changes in market characteristics to changes in trade flows as one observes in regressions that study the structure of trade flows in a particular year. However, this expecta-

Although we have data on changes in industry characteristics on the main comparative advantage variables, we do not have time series for all of the variables we use in our regressions. Consequently, questions could remain about the degree to which increased trade deficits are explained by changes in the variables that were not available in time series form.

In order to explore these questions, we examined the elasticities of the variables in the 1975 regressions and sought qualitative information on the stability or direction of changes in the explanatory variables with only a single period of observation across time. These elasticities are reported in Table 3.6b. The cases of greatest concern are those in which the elasticities of trade flows were relatively large. If elasticities for a particular characteristic are small, there is relatively little chance that changes in this characteristic (unless they were drastic) account for much of the increase in the trade deficit. In only two cases would an increase of 10% in one of these explanatory variable produce so much as .1% increase in import penetration (or a .1% decrease in export penetration). Those variables are MES and Unionization.[130]

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tion is in error because relationships between omitted variables and independent variables included in the regressions may cause the slope coefficients to differ (Kmenta (1971), pp. 392-395). Two types of omitted variables that will have this effect are likely to be present. First, the regressions that study changes in trade flows exclude some variables that were included in regressions that analyzed trade flow levels. Second, there may be variables that are excluded from both types of regressions that are only correlated, or correlated in a different way, with changes in market characteristics that are included in the regressions which focus on changes in trade flows.

[130] Increases in the level of U.S. wages do not appear to have been significantly associated with the growth of net imports. Changes in U.S. wages are strongly reflected in our human capital measure. This measure has a low import

In the case of MES, we believe that there has been little shift over time because MES is imbedded in the nation's capital stock which changes only slowly.[131] Similarly, Unionization has been relatively stable, and to the extent it has changed, it has gradually declined.[132] Given the positive coefficient on this variable in the import regressions and negative coefficient in the export regressions, the reduction in unionization should have reduced, not increased the trade deficit.

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penetration elasticity (-.883) and has a small change in the mean of less than 1% over the 1975 to 1981 period. In the regressions in which changes in human capital were used to explain changes in trade flows, the change in human capital variable was not statistically significant.

More directly, the average change in relative U.S. wages involved a small decrease over the 1975 to 1981 period with wage gains abroad generally outstripping U.S. wage gains despite the rise in the value of the dollar in 1980 and 1981. Although they remained higher than foreign wages, U.S. wages fell by 8% relative to the increase in Europe and by 15.8% relative to the increase in Japan. Since the wage coefficient in the proposed hypothesis is positive, this decline should have reduced the net imports and the trade deficit rather than increased them.

[131] Consistent with our belief, examination of MES changes over the period 1972 to 1977, using FTC line of business industries, shows that MES changed by roughly 11%. Moreover, this change was a decrease, not an increase. This would have led to a decrease in the trade deficit rather than to an increase, given the positive sign on the net imports regression coefficient.

[132] See Gifford (1983).

Although the trade policy variables were among those with small coefficients, we did some additional exploration of the stability of these variables because they might change more quickly and dramatically than the technology related variables. We found that most policy variables appear to be quite stable. While others may have changed considerably, and therefore probably contribute to the variance that our models do not explain, the small size of their elasticities makes it unlikely that they could account for much of the increase in the trade deficit.

The policy variables that are not available in time series are foreign targeting, foreign tariff and nontariff barriers, and U.S. nontariff barriers. Foreign targeting in our model represents a stock of foreign government interventions over several years. Hence year to year decisions would not change the variable to a great extent. Our foreign tariff and nontariff data are from recent compilations and include actions taken during the 1980s by our major trading partners. Foreign tariff and nontariff barriers were fairly stable over the observed period (U.S. Dept. of Commerce (1985), p. 48). The apparent continuity of interventions by these governments probably occurs because the coalitions that support such policies are often stable. Over much of the main period of observation, foreign tariffs were stable because of "stand still" agreements initiated in 1973 as part of the Tokyo round of tariff negotiations that concluded in 1979. Between 1979 and 1983, tariff levels were adjusting, but since tariff changes were often across the board, relative tariff levels were stable. The simple correlations over time in CCN Japanese and European tariffs from 1979 to 1983 were .51 and .95 respectively (conversations with World Bank staff, January 1987).

Having recent data on foreign tariff and nontariff barriers does not obviate the possibility of errors in variables, but recent data has the advantage of avoiding the possibility that the most recent regression coefficients are insignificant only because the data is dated.

The measures of U.S. nontariff barriers are by far the most outdated data in our data set. It is believed, however, that U.S. nontariff barriers have been expanded rather than contracted ((Deardorf and Stern (1985)), so changes in this variable are likely to have reduced rather than expanded trade penetration. Recent studies of trade policy have continued to focus on U.S. nontariff barriers to imports of textiles, apparel, and metals (Zysman and Tyson (1983)) which also featured prominently in the nontariff barriers to entry data set that we use.

In sum, there is no evidence of the massive shifts in the characteristics of individual industries that would be necessary to produce the sizeable increases in trade deficits which have occurred recently. Indeed, both the independent and dependent variables appear to be fairly stable. Moreover, the changes in the independent variables that are observed do not explain much of the observed change in trade flows.

C. CHANGES IN OMITTED VARIABLES

Since the relationships that explanatory variables have with trade flows have not changed significantly and changes in explanatory variables do not appear to explain much of the change in trade flows, it must be that changes in omitted variables underlie the recent rise in U.S. trade deficits. The behavior of the intercept term in the import and net import regressions is consistent with this view. Specifically, regressions that pool 1975 and 1981 data and include a single dummy variable to indicate the year along with the complete set of explanatory variables indicate that the intercept increases over time in the net import and import regressions.[133] Evidently, omitted variables that affect many of the industries in our study simultaneously have changed over time in ways that lead to trade deficits.

Here, we discuss omitted microeconomic and macroeconomic variables separately. Our evidence suggests that omitted microeconomic variables may be important in explaining trade patterns for some industries where our model did the poorest job of predicting these patterns. However, as was suggested in the introductory chapter, it appears likely that changes in macroeconomic variables explain much of the rise in net imports.

We examine two macroeconomic variables: exchange rates and aggregate demand. These variables are selected because they are believed to be closely associated with the simple macroeconomic explanations of recent trade deficits. Specifically, the relationship between exchange rates and

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[133] As noted earlier, when dummy variables for the slope regressions are added, these intercept dummies become insignificant individually. All of the dummies are insignificant as a group.

The change in the intercept of the export equation was not statistically significant. However, it was fairly large (it would have been significant at the .25 level) and did move in a direction that suggest a decline in U.S. exports over time.

trade deficits is explored because, in most macroeconomic theories, they provide the crucial link between recent inflows of foreign capital and trade deficits. And the relationship between aggregate demand is studied because it is key to the theory that macroeconomic forces caused the U.S. demand for imports to rise relative to the foreign demand for U.S. exports.

Our examination of the relationship between these two macroeconomic variables and trade deficits confirms the view that the recent rise in the balance of payments deficits is associated with macroeconomic forces. We conclude that while omitted microeconomic variables may be the key to changes in trade flows in some markets, macroeconomic variables have a larger and more widespread effect.

1. Omitted Microeconomic Changes That Appear To Affect Trade Flows

Econometric studies rarely contain all of the explanatory variables that affect the associated dependent variable. As a result, they normally are unable to explain a substantial portion of the total variation in the independent variable.[134] In our study, we were forced to omit some theoretically plausible explanatory microeconomic variables because of data constraints. As a result, we were not surprised to observe that our statistical models only approximate actual trade flows and that our R-square levels are generally limited to the .15 to .60 range.[135] To get an idea of what types of omitted microeconomic variables might be important, we examined observations for which the model made the worst predictions.

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[134] Some of the variation may also be due to random noise and errors in measurement of the variables included in the study.

[135] For cross-section regressions using disaggregated data, this is not unusually low. For example, Maskus (1981), reports similar, and typically lower, R-square values.

Table 4.3 identifies the twenty-seven industries for which the predicted value of net import penetration differed from the actual value by more than 25% of domestic new supply (U.S. output plus imports) in the industry. For these larger outliers, we are able to get some idea of the types of relationships that are omitted from the regression study, but which may be important. Three industries (SIC 3483, SIC 3721, and SIC 3795) involve products with military applications. U.S. government support of the military and national defense considerations which are not captured by our model probably account for the fact that the model overestimates the level of net imports. For six other industries, production involves the use of natural resources, which the U.S. may have in more abundant supply (SIC 2874, SIC 2044) or less abundant supply (SIC 2429, SIC 2911, SIC 3333, SIC 3915) than our model indicates.[136] Product differentiation, based on historical reputations for product quality, may explain the relatively high level of imports in four industries. Widely

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[136] The U.S. historically has had particularly large deposits of phosphorous in Florida, which gives the U.S. a comparative advantage in the production of fertilizers (SIC 2874). Similarly, the U.S.'s abundant supply of arable land gives it a comparative advantage in rice production that, in combination with relatively low U.S. demand for rice, leads to exports of milled rice (SIC 2044). While it would appear that the U.S. has a comparative advantage in the production of wood that is used by sawmills (SIC 2429), there are some specialty woods (such as teak and ebony) that are not in abundant supply. It is the milling of these woods that probably explains the behavior of SIC 2429. U.S. dependence on foreign oil, zinc, and gems explain the remaining three raw material outliers (SIC 2911, SIC 3333, and SIC 3915).

While the steel industry does not appear to be as large an outlier as the industries we include in Table 4.3, its position appears to be similar to that of some of the other industries which rely heavily on natural resources. U.S. iron-ore reserves have declined, which caused U.S. raw material input costs to rise relative to the costs foreign producers face.

TABLE 4.3

Net Import Outliers*

Industry Name	SIC Code	1975 Error	1981 Error
Rice Milling	2044	-.60	-.64
Wines, Brandy, & Brandy Spirits	2084	+.21	+.26
Distilled Liquor, Except Brandy	2279	+.22	+.38
Carpets & Rugs, Nec	2279	+.22	+.38
Cordage & Twine	2298	+.26	+.14
Textile Goods, Nec	2299	+.55	+.38
Raincoats & Other Waterproof Outer Garments	2395	+.27	+.15
Leather & Sheep Lined Clothing	2386	+.25	+.26
Special Product Sawmills, Nec	2429	+.12	+.26
Phosphatic Fertilizers	2874	-.15	-.26
Petroleum Refining	2911	+.24	+.25
Rubber & Plastics Footware	3021	+.29	+.45

TABLE 4.3--Continued

Industry Name	SIC Code	1975 Error	1981 Error
Footware, except Rubber, Nec	3149	+.40	+.44
Fine Earthenware Food Utensils	3263	+.27	+.41
Primary zinc	3333	+.25	+.39
Ammunition, excluding Small Arms, Nec	3483	-.26	-.22
Construction Machinery	3531	-.31	-.25
Calculating, Accounting Machines	3574	+.27	+.21
Sewing Machines	3636	+.25	+.13
Motor Vehicles & Car Bodies	3711	+.15	+.31
Aircraft	3721	-.27	-.21
Motorcycles, Bicycles, & Parts	3751	+.52	+.46
Tanks & Tank Components	3795	-.60	-.50
Watches, Clocks, Clockwork Operated Devices, & Parts	3873	+.16	+.35
Jewelers' Findings & Materials, & Lapidary Work	3915	+.59	+.67

TABLE 4.3--Continued

Industry Name	SIC Code	1975 Error	1981 Error
Dolls	3942	+.11	+.27
Feathers, Plums & Artificial Trees & Flowers	3962	+.31	+.41

* Outliers are defined here as observations for which the predicted value from either the 1975 or 1981 full model regressions differ from the observed value by an absolute value of more than .25. Figures shown are actual net imports less predicted net imports.

recognized foreign brand names are prominent suppliers in these industries (SIC 2084 wine, SIC 2085 liquor, SIC 3263 china, SIC 3873 clocks and watches). In twelve other industries, it is probable that unskilled labor inputs are more important in producing the product (or the versions of the product which are imported) than the labor intensity of competing U.S. manufacturers indicates (SIC 2298, SIC 2299, SIC 2385, SIC 2386, SIC 3021, SIC 3149, SIC 3574, SIC 3636, SIC 3751, SIC 3962, SIC 2279, SIC 3942).[137] Construction machinery (SIC 3531) and motor vehicles (SIC 3711) are the two industries not included in the previous categories.[138]

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[137] This possibility is not only evident in the characteristics of the imported products (consider jute mats, SIC 2279), but is evident in the unusually high labor intensity of U.S. manufacturers (SIC 2386, SIC 3021, SIC 3483, SIC 3636, SIC 3751).

[138] The U.S. does surprisingly well in the construction machinery industry, having unusually high exports.

In the case of the motor vehicles industry, imports are higher than expected and exports are lower. The error appears to relate to the unexpected growth in the small car market brought about by the oil shock. U.S. manufacturers evidently responded more slowly or were less well positioned for the shift in demand for small cars. U.S. firms do not appear to be at a physical technological disadvantage, since they have access to the same technology as the Japanese automobile manufacturers (National Research Council (1982), p. 101), although perhaps not the same organizational and management techniques. Indeed, the U.S. plants tend to be more capital intensive than the Japanese plants (National Research Council (1982), p. 5). Another possible source of error in prediction is that U.S. auto workers won unusually large pay concessions during the 1970s without a comparable accompanying increase in productivity. Auto industry compensation rates were 30% above the manufacturing average in 1970, but rose to 50% above the industry average by 1981. Yet, productivity did not rise proportionately (**Economic Report of the President** (1985), p. 92). To the extent that wage increases are usually tied to productivity

In summary, the differences between predicted values and observed values suggest that a variety of microeconomic explanatory variables have been omitted.[139] Examination of these errors suggests that some of the omitted variables capture characteristics of particular industries. However, it appears unlikely that changes in these microeconomic variables explain all of the changes in the structure of trade flows that have occurred, since most of these variables probably did not change significantly over the last decade. Given that finding substantial structural changes in trade flows is a prerequisite for concluding that microeconomic changes caused the increase in the trade deficit and given that we have found little change in the structure of U.S. trade flows, we now turn to a brief examination of evidence that changes in macroeconomic variables are consistent with the recent rise in U.S. trade deficits.

2. *Omitted Macroeconomic Variables That Appear To Affect Trade Flows*

As is noted above, simple macroeconomic relationships suggest that the rise in the deficit is likely to be associated with changes in macroeconomic variables. If this is true, then one would expect that many industries experienced a rise in their trade deficits.[140] Consistent with this predic-

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increases, but were not in this instance, our model would predict a stronger competitive position for U.S. auto makers, because wages have such a significant effect on the human capital variable, even though their competitiveness was actually reduced.

[139] Besides the variables discussed in the text, we suspect that the following variables probably are important: U.S. government regulations, export controls, and foreign industry characteristics.

[140] Although all industries are affected somewhat by changes in macroeconomic variables, some industries may be affected more than others. For example, changes in the

tion, nearly all U.S. industries experienced declining international competitiveness to some degree between 1981 and 1984. Of the 122 industries in our updated sample, 84% had increases in net import penetration.[141]

In addition to this general confirmation of the macroeconomic explanations for trade deficits, there is direct support for the view that recent inflows of foreign capital, attracted by relatively high U.S. interest rates, and increases in U.S. aggregate demand relative to foreign aggregate demand are responsible for recent trade deficits. Specifically, exchange rates appear to have risen and led to an increase in net imports, as the macroeconomic theory of international financial flows predicts. Also there appears to be a positive association between recent increases in U.S. aggregate demand and net imports, as the aggregate demand theory suggests.

a. Exchange Rates

According to the macroeconomic theory of international financial flows, higher U.S. interest rates will attract foreign

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exchange rate, which alter the relative prices of U.S. imports and exports, will affect industries differently, depending on the price elasticity of demand for imports and exports. Similarly, the effect of an increase in U.S. aggregate demand relative to foreign aggregate demand on a particular industry will depend on the income elasticities of U.S. imports and exports. While differences in income and price elasticities are expected to cause some shifting in the relative positions of industries when they are ranked according to their net import levels, these changes do not reflect changes in the underlying comparative advantage relationships. Instead, they reflect transitory changes due to the ebb and flow of macroeconomic forces that affect relative price and income levels.

[141] In contrast, during the 1975-1981 period, 57% had increases in net import penetration. From 1975 to 1984, 75% experienced increased net import penetration.

capital. Since U.S. financial assets are denominated in dollars, this will lead to an increase in the demand for the dollar. Because increases in the value of the dollar make U.S. goods more expensive relative to foreign goods, there will be a reduction in the international competitiveness of U.S. manufacturers. This decrease in competitiveness is expected to be reflected in higher net imports, causing the trade deficit to equal the surplus on the capital account.[142]

There is empirical support for this argument. U.S. industries appear to have been under severe competitive pressure because of the relatively high value of the dollar. For example, in the automobile industry, it has been argued that about $700 of the roughly $2000 cost disadvantage of U.S. automobile manufacturers in 1983 was due to the unusually high exchange rate.[143] Similarly, in steel, machine tools, textiles, and many other industries, analysts have pointed to exchange rates as an important source of the U.S. competitive disadvantage.[144] As a result, it is not too surprising that the increase in the value of the dollar between 1980 and 1985 was associated with a decline in the U.S. trade balance (Figure 4.1).[145]

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[142]As was pointed out in the introduction, there is a balance of payments accounting identity that requires that the U.S.'s current account (real trade deficit) equal its surplus on the capital account.

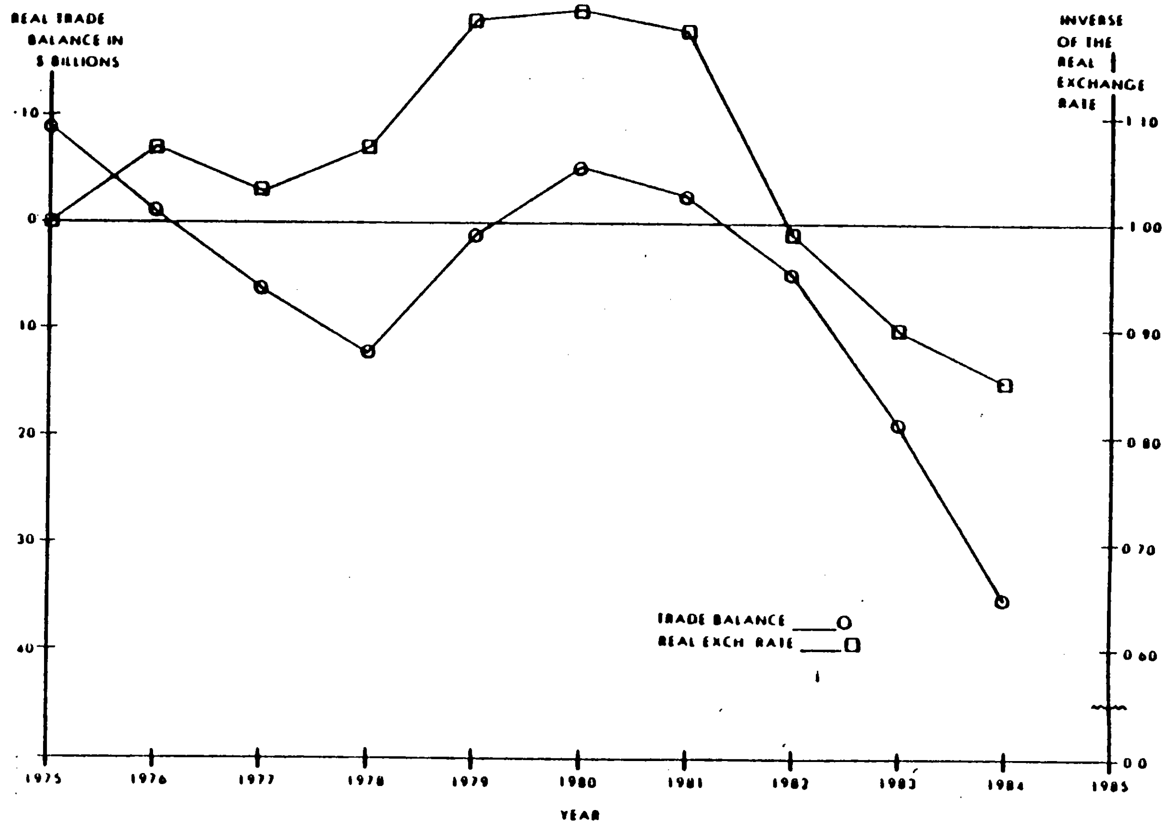
[143] "Detroit Battle: The Cost Gap," New York Times, May 28, 1983, pp. 35, 37.

[144] National Research Council (1985), National Research Council (1983b), and National Research Council (1983a).

[145] The dollar increased in real value by 65% between 1980 and the close of 1984 (**Economic Report of the President** (1985), p. 103). Statistical tests predict that a 1% real appreciation in the dollar adds $2 billion to the deficit, after a sufficient lag to allow the appreciation to have its full effect (**Economic Report of the President** (1984), pp. 46-7).

Figure 4 1

Real Exchange Rate Versus the Real Net Merchandise Trade Balance (Agricultural Exports and Petroleum Imports Removed)



Source Economic Report of the President

While the adverse effect of the increased value of the dollar on the competitive position of U.S. industries seems to have been quite widespread, the effect has been larger in some industries than others. In particular, it appears likely that the effect will be largest for products where the demand for U.S. exports and imports was quite elastic, since these products are most sensitive to changes in relative prices. For example, estimates of price elasticities by Baldwin (1976) indicate that these elasticities are particularly large (between 3.20 and 4.4) in the case of metal working machinery and office/computing machines. Our data indicate sizeable increases in net import penetration in Metal-Cutting Machine Tools (11.6%) and Office Machines, Typewriters, Etc. (26.7%).[146]

b. Changes in Relative Aggregate Demand

According to macroeconomic theory, imports are likely to vary positively with the level of aggregate demand, other things being equal. Specifically, as U.S. incomes rise, the U.S. demand for imports is likely to rise. Moreover, if U.S. incomes rise relative to foreign incomes, the U.S. demand for imports should rise relative to the foreign demand for U.S. exports.[147] As a result, macroeconomic theory predicts that,

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[146] Of the 62 industries for which export elasticities were available, only three had elasticities below one. These were glass and glass products, primary nonferrous metals, and heating and plumbing products (Baldwin (1976)).

Of the 62 products for which import price elasticities were estimated, only 6 had price elasticities which were below one. These industries were: livestock and products, other agricultural products, forestry/fishery products, agricultural/forestry/fishery services, ordnance and accessories, and household appliances (Baldwin (1976)).

[147] The foreign share of U.S. sales will increase either if income elasticities for foreign output in an industry exceeds the income elasticity for domestically produced goods or if U.S. supply is less price elastic than foreign supply.

during these periods, U.S. demand for imports will rise relative to foreign demand for U.S. exports and growing trade deficits are more likely.

Available data are generally consistent with this theory.[148] As Figure 4.2 indicates, when U.S. growth picks up relative to the growth of its trading partners, U.S. trade deficits rise.[149] Consider the recent experience. At the end of 1982, the U.S. balance of payments deficit appears to have been reduced by aggregate demand effects, since the U.S. demand was falling relative to foreign demand. However, in 1983 and 1984 the U.S. economy grew relative to the

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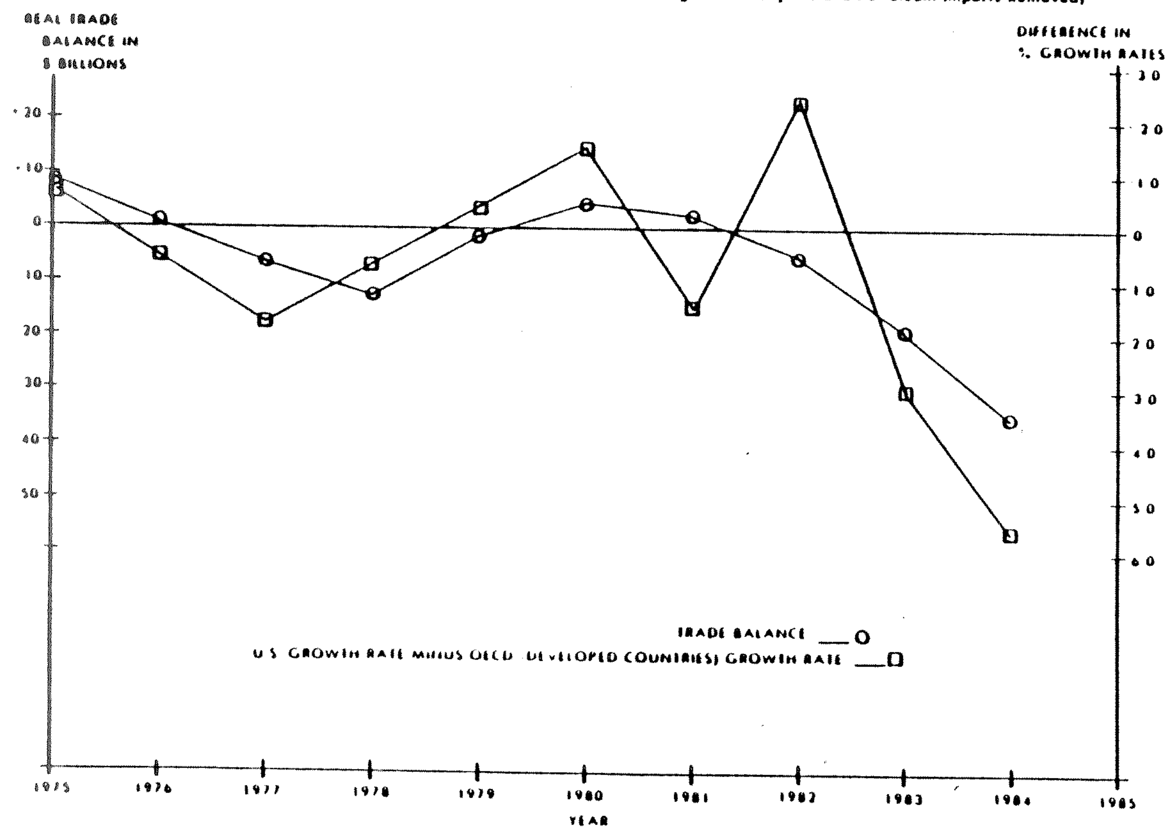
[148] Even if foreign demand was synchronized with U.S. demand so that U.S. aggregate demand rose proportionally with world aggregate demand, increases in aggregate demand could affect the U.S. differently. For example, the U.S. income elasticity of demand for imports could be higher than foreign income elasticities, which would make it more sensitive to swings in demand. This difference in the elasticity of demand appears to be present, since the U.S. trade balance tends to move toward surplus in world ressions and toward deficit in world expansions. See the **Economic Report of the President** (1984), p. 48.

[149] Moreover, LDCs have been experiencing financial difficulties (partially due to the OPEC oil shock) in meeting their debts. This has led them to place strict limitations on their imports during much of the recent past. Since many of these LDCs are Latin American countries with whom the U.S. has done a substantial amount of trade, U.S. exports have suffered disproportionately. In the early 1980s, this effect may have worsened the U.S. trade balance by $10-$20 billion dollars (**Economic Report of the President** (1983), p. 75). During 1984, this problem was reduced (**Economic Report of the President** (1985), p. 103). However, it is possible that some countries, such as Mexico, may again face additional difficulties, since they have invested in oil and its price has fallen.

Figure 4.2

Relative U.S. Growth Rates Versus the Real Net Merchandise Trade Balance (Agriculture Exports and Petroleum Imports Removed)



Source: Economic Report of the President economies of its trading partners.[150] The relatively strong U.S. recovery, and the general world-wide recession, was associated with a sharp rise in the U.S. trade deficit.[151]

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[150] In 1983, the growth rate for real U.S. GNP was 3.5%, while it was 3.3% in Japan and only 1.2% for the European Economic Community. For 1984, the U.S. growth rate was 6.5%, when the Japanese growth rate was 3.2% and the E.E.C. growth rate was 2.1% (**Economic Report of the President** (1986), p. 378).

[151] Estimates suggest that perhaps as much as 25% ($8.5 billion) of the increase in the deficit after 1980 is due to this change in relative levels of aggregate demand. **Economic Report of the President** (1985), p. 103.

D. CONCLUSION

There is no conflict between the observation that U.S. trade deficits are rising and our finding that U.S. comparative advantage relationships have been relatively stable over the last decade. Evidently, there have been shifts in macroeconomic variables that have increased the level of imports in most industries, without shifting trade patterns across industries significantly. While other types of changes, such as shifts in omitted microeconomic variables or changes in the magnitudes of included variables, would also make the two observations consistent, available data suggest that these alternative explanations are not as important. Moreover, simple macroeconomic theories and available empirical evidence suggest strongly that macroeconomic forces underlie recent trade deficits.

Changes in most microeconomic variables have either been gradual or narrowly focused. As a result, they are unlikely to generate the large deficits that are observed. Only the changes in international capital flows (with associated changes in exchange rates) and, for part of the period, changes in the relative levels of aggregate demand, have been large enough and sharp enough to explain the sudden rise in net imports.

APPENDIX A

DESCRIPTIONS OF DATA

This appendix contains descriptions of the variables used in the multiple regression models as well as information about the sources of the data. The dependent variables are described first. The independent variables are described in the order presented in Table 2.2. A summary table is shown at the conclusion of the section.

Dependent Variables

Net Import Penetration

Net import penetration is calculated as the ratio (Imports - Exports)/(U.S. Production + Imports).

The import data used in the study were gathered for the Department of Labor's Trade Monitoring System (U.S. Bureau of Labor Statistics, Office of Productivity and Technology, Division of Foreign Labor Statistics and Trade). The export data were assembled directly from a four- and five-digit concordance linking SIC classifications to trade data collected on the basis of the Tariff Schedule of the United States Annotated (TSUSA) classes. All of these component measures were recorded in millions of dollars.

The Trade Monitoring System utilizes import based SIC definitions which differ for some industries from the output SIC basis on which other data were available. As a result, it was necessary to develop a concordance to bring the Trade Monitoring Data onto the same basis. This was done using the following rules: (1) When an import SIC in the Trade Monitoring data is identical to the output SIC, a one to one correspondence is used; (2) When an import SIC applies to two or more complete output SIC's, the import penetration ratio from the import SIC is assigned to all of the component output SIC's; (3) When an import SIC applies to a predominance of an output SIC, the import SIC ratio is assigned to that output SIC; and (4) When no predominant relationship between an output SIC and an import SIC can be determined, the output SIC is dropped.

For approximately 70 or our 360 four-digit industries, the U.S. shipments data for the import data set did not match the U.S. shipments data for the export data set. Most of these mismatches were corrected by shifting five-digit component industries from one four-digit industry to another to replicate the placement of five-digit industries in the import data set. For the remaining industries, U.S. shipments in the export data set were adjusted to match the shipments in the import data set. The export level was changed in proportion to this adjustment to U.S. shipments in the export data set.

Import Penetration

Import penetration is calculated as the ratio (Imports) / (U.S. Production + Imports). It uses the import data as described above.

Export Penetration

Export Penetration is calculated as the ratio (Exports) / (U.S. Production + Imports). It uses the export data as described above.

Foreign Direct Investment

Foreign direct investment in the United States is measured as the proportion of all employed persons in a two-digit industry who are employed by a foreign-owned firm. Only firms with 50 or more employees are included in the sample. Foreign ownership is defined as foreign control of 10% or more of the voting stock. For two industries (tobacco and furniture), data on employment was unavailable. Here, establishment data was used to estimate the relative importance of foreign direct investment in the industry. Data was obtained from the Bureau of the Census publication, **Selected Characteristics of Foreign-Owned U.S. Firms** for 1975, 1976, 1978, 1979, 1980, and 1981.

Direct Foreign Investment

Direct Foreign Investment by the United States is measured at the two-digit SIC level using the ratio: taxable income (income subject to tax) earned by U.S.-based firms from foreign sources divided by the U.S. taxable incomes. Information on the total taxable income from foreign sources was obtained from the IRS publications **Statistics of Income, International Income and Taxes**, 1974 and 1976-1979 and the **Statistics of Income Bulletin**, Summer 1984. Information on "Income subject to tax" was obtained from the IRS publication **Corporation Income Tax Returns** 1974, 1976 and 1980.

Independent Variables

Human Capital Intensity

Human capital (HUMANK) is calculated as average hourly compensation in the industry minus the minimum wage, multiplied by one over the interest rate (.10), multiplied by labor intensity. Industry compensation data came from the U.S. Bureau of Labor Statistics, Office of Productivity and Technology, Division of Foreign Labor Statistics and Trade as did the labor intensity data. The minimum wage is the lowest average compensation figure from the average compensation data set. Average industry compensation and average minimum compensation are both expressed in dollars.

Labor Intensity

Labor intensity (LABOR) of U.S. manufacturing firms is defined as the ratio total worker compensation in the industry divided by value added, both expressed in millions of dollars. This figure includes consideration of salaried and non-salaried workers and includes wages and fringe benefits. Value added is used in the denominator to match the operations carried out by the firms in the industry category separate from the value added by their suppliers.

Data were available at the four-digit level in most instances. In approximately 10% of the sample, four-digit output SIC data had been amalgamated to calculate the values in the data source. In these instances, labor intensity values for the aggregate were calculated and then assigned to the component four digit output SIC industries. Data for labor intensity were made available by the U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology. The data were originally taken from BLS publications and from materials gathered by the Office of Productivity and Technology.

Foreign Compensation

Real hourly compensation rates (FPAY) by industry for Japanese workers are used in the regressions. These data were obtained from the U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology. Observations at the two- and three-digit level were assigned to the component four-digit industries. Observations are expressed in dollar equivalents. Our composite European compensation figure, the average figure for West Germany and Great Britain, proved to be too highly correlated with the Japanese compensation figure to be included separately.

Unionization

Unionization rates (UNION) were obtained directly from R. Freeman and J. Medoff's article, "New Estimates of Private Sector Unionism in the United States", **Industrial Labor Relations Review** 32 (January 1979), pages 155-188. For three-digit industries, the authors calculated the percentage of production workers in the industry that are union members. These three-digit level data were then assigned to the four-digit level industries.

Research and Development Intensity

The research and development variable (R&D) is defined as the intensity of total research and developmental expenditures as a percent of value added. Two digit level data for this variable were taken from the annual **National Patterns of Science and Technology** published by the National Science Foundation (Table 38 and 41). Four-digit industries were assigned the values of the related two-digit entries. Conversion from the R&D over sales figures in this publication to R&D over value added was accomplished by multiplying R&D over sales from NSF by sales over value added from the Department of Labor data. Both sales and value added in the D.O.L. data are in millions of dollars.

Government R&D Intensity

Government R&D is defined as the intensity of R&D efforts financed by the U.S. government. This data was also taken from **National Patterns of Science and Technology** and calculated as the difference between total R&D intensity and corporate R&D intensity. As in the total R&D variable, four-digit assignments were made from the two-digit data and converted to value added intensities.

Depleting Natural Resource Industries

To create the depleting natural resources dummy variable (DEPLRES), the natural resources industries identified in Baldwin (1971) were divided on the basis of whether the natural resource was renewable or not. The renewable resources industries were defined to include the food, lumber, paper and tobacco industries. The depleting natural resource industries group includes the remainder of Baldwin's natural resource industries with the exception of petroleum processing, which is accounted for by the energy intensity variable.

Energy Intensity

The energy intensity variable (ENERGY) is defined as the dollar value of energy used by the industry divided by the value added, both expressed in millions of dollars. The source of the data on energy use was the U.S. Department of Commerce, Office of Research Analysis and Statistics in the Bureau of Industrial Economics. The data tape contains unpublished data primarily at the two-digit level with additional detail in a few instances. Data were available for the years 1975 to 1977, hence the 1978 through 1981 values for this variable repeat the 1977 observations. The value added information from BLS at the four-digit level was aggregated to the two-digit level in order to calculate the value added observations used to calculate the variable. The two-digit values were reassigned to the component four-digit industries under a homogeneity assumption.

Net Capital Stock Intensity

The net plant and equipment stock estimates (CAPITAL) are from the Office of Business Analysis at the Department of Commerce. These estimates are made by adjusting nominal capital assets for wear and loss of efficiency in production by assigning rental prices to each type of asset. The net capital plant and equipment assets from OBA are divided by value added figures for the same industry groups. Both are expressed in the same units. The mixed three- and four-digit ratios are then assigned to the component four-digit industries.

Documentation of the techniques used in creating the capital stock estimates can be obtained from OBA. A description appears in the Bureau of Labor Statistic's Bulletin 2178, "Trends in Multifactor Productivity 1948-1981" (1983) at Appendix C, pp. 39-65.

Growth in Demand

The growth in demand variable (GROWTH) is the proportional change in U.S. consumption from 1972 to 1981. It is calculated as (U.S. Production + Imports - Exports for 1981) - (U.S. Production + Imports - Exports for 1972) / (U.S. Production + Imports - Exports for 1972), using the same data sources as the dependent variables at the four-digit level. The growth variable is introduced as a proxy for the expected profitability of entry into the industry. Empirical models of entry have generally found that growth is quite strongly associated with successful entry of new firms and foreign competitors.

U.S. Tariffs

The tariff variable (USTARIFF) used in the modeling is the effective tariff rate. It is the ratio of import duties (in dollars) to the value of imports (in millions of dollars) for the four-digit industries.

Data on duties was organized and aggregated to the four-digit level based on a seven-digit level concordance to TSUSA data. Access to the data was through the TRADENET data system maintained by the Departments of Labor and Commerce. The import data used in calculating the variable is from the Department of Labor's Trade Monitoring System.

U.S. Nontariff Barriers

Estimates for nontariff barriers (USNONTAR) are taken from Robert Baldwin's 1970 Brookings publication **Nontariff Distortions of International Trade.** Since this data was gathered during the 60's, it must be used under the somewhat strong assumption that there has been continuity in U.S. nontariff barriers. U.S. Nontariff Barriers are expressed as a percentage equivalent tariff.

Foreign Tariffs

The foreign tariffs variable (FTARIFF) is a dummy variable which designates industries in which a substantial foreign tariff on imports from the U.S. was reported for one of our primary trade partners in the **1985 Annual Report on National Trade Estimates**, Office of the United States Trade Representative, Washington, D.C., 1985. This report, which is required by the Trade and Tariff Act of 1984, discusses what are believed to be "significant" trade barriers to U.S. exports. Tariff barriers reported in this publication are assumed to be of long standing and thus applicable to earlier years. The publication provides descriptions of the industries involved and the dummy variable assignments are constructed as narrowly as possible from these descriptions.

Foreign Nontariff Barriers

This variable (FNONTAR) is a count, by industry, of major trade protection actions taken by Japan or members of the EEC against U.S. exports. The data set was obtained from UNCTAD and is based on their four-digit tabulations.

A description of the data is contained in "Protectionism and Structural Adjustment" a report by the UNCTAD Secretariat, February 2, 1983.

European Targeting

A dummy variable indicating industrial policy targeting undertaken by European governments (EURTARG) was created to control for the effects of these policies. In this dummy variable, a one is used if the industry was the subject of European government subsidization apparently aimed at increasing exports by these countries. The dummy is based on the U.S. International Trade Commission's publication **Foreign Industrial Targeting and Its Effects on U.S. Industries Phase II: The European Community and Member States**, 1984. Pages 17, 129, and 137 contain the charts and text used in constructing the variable. The information is largely available at the two-digit level with more specific details available in a few instances. The two-digit level findings are assigned to the related four digit industries.

By its nature, targeting efforts are at least somewhat ambiguous. Help for particular industries may be primarily a regional development effort with only minor implications for international trade. Alternatively, general small business aid, for example, may be primarily directed toward particular industries with substantial export potential without making these links very visible. The ITC publication makes an effort to unscramble some of these ambiguities, but the reader is cautioned that this a very complex classification problem with strong incentives for governments to obscure what is the real intent or result of particular industrial aid policies.

A further complication is the possibility that the variable is really capturing how countries decide to target rather than the effects of their targeting. For example, a country might target those industries that seem to be approaching take-off on their own. If this is the case, targeting would be associated with increased U.S. imports not because targeting was particularly successful but rather because targeting efforts are originated in industries that already show evidence of being able to penetrate U.S. markets.

Japanese Targeting

The design and qualifications of the European targeting variable are repeated for the Japanese targeting variable (JPTARG). The source for the Japanese targeting variable is the U.S.I.T.C.'s publication **Foreign Industrial Targeting and Its Effects on U.S. Industries Phase I, Japan.** The chart containing targeting information is on page F-2.

Minimum Efficient Scale

The Minimum Efficient Scale variable (MES) for this data set is defined as the average proportion of the market served by the largest plants making up 50% of industry output. The data is derived from the Bureau of the Census', **1977 Census of Manufacturing.** MES data were calculated at the four-digit level by the staff of the FTC's Line of Business Program.

Localized Shipments

The localized shipments variable (LOCAL) used in the study is a dummy variable set at 1 for industries in which the proportion of goods produced by U.S. firms that are shipped less than 100 miles was greater than 75 percent. The statistic appears in the U.S. **Census of Transportation** (1972) as Table 2, "Percent Distribution of Commodities by Distance of Shipments." This four-digit level variable is meant to reflect the focus in the industrial organization literature on shipment patterns as a test for localized markets. High levels of extremely localized shipments are interpreted in this literature as an indication that markets are localized.

Industry Structure

Industry structure (HERF) is represented by the Herfindahl index based on EIS data. EIS estimates were available for the years 1974, 1976, 1977, 1978, and 1979. Observations for other years are based on the mean of the surrounding years or on the closest previous year. EIS data is available on the four-digit level and in it, market share is expressed as the proportion of the market served by a particular firm.

In addition to the variables used in the principal regression models, median years of education, proportion of workers who are black, skill characteristics of workers, and three technology dummy variables were used in the simultaneous equations models discussed in Chapter III. The education, skill, and race variables were taken from the 1980 population census (Department of Commerce, 1984). The industry technology dummy variables were supplied by F. M. Scherer. The data are described in Scherer's 1965 article "Firm Size, Market Structure, Opportunity, and Output of Patented Inventions", **American Economic Review**, 55:5 (December, 1965), pp. 1097-1125.

Table A.1
Summary of Characteristics of the Data

Variable Name	Aggregation Level	Frequency of Observation	Primary Source of Data
Net Import Penet.	4	yearly	D. of Labor
Import Penetration	4	yearly	D. of Labor
Export Penetration	4	yearly	D. of Commerce
Foreign Direct Investment	2	yearly (not 1977)	D. of Commerce
Direct Foreign Investment	2	1974,76,80	D. of Commerce
Human Capital	4	yearly	D. of Labor
Labor Intensity	4	yearly	D. of Labor
Foreign Compensation	2-4	yearly	D. of Labor
Unionization	3	1 year (mid 1970s)	Freeman
R&D Intensity	2	yearly	N.S.F.
Depleting Natural Resources	2	once covering 1960s	Baldwin
Energy	2	1975,76,77	D. of Commerce
Capital Intensity	4	yearly	D. of Commerce
U.S. Tariffs	4	yearly	D. of Commerce
U.S. Nontariff Bar.	3	once covering 1960s	Baldwin
Foreign Tariffs	3-4	once covering 1980s	U.S. Trade Rep.
Foreign Nontariff	4	once covering 1980s	U.N.C.T.A.D.
European Targeting	2	once up to 1980s	I.T.C.
Japanese Targeting	2	once up to 1980s	I.T.C.
Min. Efficient Sc.	4	1 year (1977)	D. of Commerce
Localized Shipments	4	1 year (1972)	D. of Commerce
Herfindahl Index	4	1974,76,77, 78,79	EIS

APPENDIX B.1a

T-statistics for Dummy Time Shift Variables
Simple Model Comparative Advantage

Explanatory Variable	Net Import Penetration	Investment Adjusted Net Imports Penetration	Import Penetration	Investment Adjusted Import Penetration	Export Penetration	Investment Adjusted Export Penetration
Labor Intensity	1.12	.16	.81	.21	-.69	-.09
Capital Intensity	-.02	.27	.09	.20	.16	-.21
Human Capital Intensity	.24	-4.88*	-.24	.38	-.72	5.41*
R&D Intensity	-.14	-1.53	-.80	-.61	-.88	1.39

* Indicates significant at the 10% level, two-tailed. Figures in parentheses are t-statistics.

APPENDIX B.1b

T-statistics for Dummy Time Shift Variables
Simple Comparative Advantage Model with Barriers to Entry
(1975 vs. 1981)

Explanat. Variable	Net Import Penetr.	International Investment Adjusted Net Imports Penetration	Import Penetration	International Investment Adjusted Import Penetration	Export Penetration	International Investment Adjusted Export Penetration
Depleting Resources	.05	1.87*	.54	.56	.50	-1.82*
Labor Intensity	.75	.08	.86	.26	-.18	.04
Capital Intensity	.30	.26	.21	.30	-.12	.13
U.S. Tariff		-.45	-.82	-.26	-.42	X X
U.S. Nontarrif	-.87	-.16	-.39	-1.64	X	X
MES	.94	.51	1.12	.91	.01	-.14
Human Capital	-.23	-5.21*	-.67	-.56	-.65	5.70*

APPENDIX B.1b--Continued

Explanat. Variable	Net Import Penetr.	International Investment Adjusted Net Imports Penetration	Import Penetration	International Investment Adjusted Import Penetration	Export Penetration	International Investment Adjusted Export Penetration
R&D	.18	-1.07	-.67	-.46	-1.1	41.02
Foreign Nontariff	+ 50	-.65	X	X	-.19	.74
Foreign Tariff	-.85	-.41	X	X	.82	-.13

+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates variable not used in the regression.

APPENDIX B.2

Model with Barriers and Control Variables
Regression Results for 1976-1980

Indep. Variable	Net Imports 1980	1979	1978	1977	1976
Energy Intensity	.001# (2.03)	.001# (2.14)	.001# (2.31)	.002# (2.50)	.002# (2.36)
Depleting Resources	.089# (2.34)	.081# (2.30)	.113* (3.06)	.112* (3.14)	.117* (3.33)
Labor Intensity	.378* (5.30)	.325* (4.43)	.294* (3.76)	.302* (3.95)	.260* (3.38)
Capital Intensity	-.005 (-.55)	-.013 (-1.26)	-.006 (-.67)	-.006 (-.69)	-.013 (-1.44)
Growth	.017 (1.03)	.009 (.56)	.010 (.62)	.009 (.59)	.008 (.56)
U.S. Tariffs	-.6E-6# (-2.03)	-.7E-6# (-2.17)	-.6E-6# (-2.08)	-.5E-6+ (-1.70)	-.5E-6 (-1.62)
U.S. Nontariff Barriers	-.001 (-.88)	-.001 (-1.34)	-.002 (-1.52)	-.001 (-1.19)	-.001 (-.71)
MES	.571# (2.18)	.668* (2.70)	.562# (2.31)	.529# (2.37)	.539# (2.44)
Localized	-.013 (-.35)	-.032 (-.91)	.013 (.37)	.017 (.48)	.017 (.49)
Japan Target	.024 (1.04)	.024 (1.10)	.203 (1.04)	.028 (1.29)	.028 (1.29)
Europe Target	-.034 (-1.47)	-.021 (-.94)	-.019 (-.83)	-.020 (-.89)	-.020 (-.88)
Unionization	.002* (2.66)	.002* (2.93)	.002* (3.09)	.002* (2.75)	.002* (2.90)

(Table continues.)

APPENDIX B.2--Continued

Independent Variable	Net Imports 1980	1979	1978	1977	1976
Herfindahl Index	.046 (.28)	-.020 (-.13)	.055 (.34)	.055 (.42)	.107 (.84)
Foreign Pay	-.055# (-2.44)	-.043# (-2.16)	-.048# (-2.48)	-.061# (-2.44)	-.073* (-2.59)
Human Capital Intensity	-.005* (-5.36)	-.005* (-5.62)	-.006* (-5.66)	-.006* (-5.83)	-.006* (-5.80)
R&D Intensity	.4E-3 (.14)	-.001 (-.48)	.8E-4 (.03)	-.3E-3 (-.11)	-.2E-3 (-.07)
Foreign Nontariff Barriers	.4E-4 (.13)	-.3E-4 (-.11)	-.5E-4 (-.16)	-.2E-3 (-.57)	-.1E-3 (-.37)
Foreign Tariffs	-.022 (-1.18)	-.017 (-.95)	-.021 (-1.17)	-.016 (-.92)	-.019 (-1.06)
Intercept	-.039 (-.61)	-.008 (-.13)	.029 (.42)	.017 (.24)	.032 (.48)
R-sq	.230	.245	.250	.238	.248
F stat	5.67	6.15	6.31	5.93	6.25
N	360	360	360	360	360

+ Indicates significant at the .10 level for a two-tailed test.
\# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.

APPENDIX B.3

Coefficients of Industrial Characteristics Associated with Changes in Trade Flows Between 1975 to 1981

Variable	Change in Net Import Penetration	Change in Import Penetration	Change in Export Penetration
Energy Intensity	.060	.120#	.070
Depleting Resources	.100	.219*	.101
Labor Intensity	.243*	.315*	-.155#
Capital Intensity	-.089	-.154*	-.037
Growth	.204*	.008	-.320*
U.S. Tariffs	.026	.022	x
U.S. Nontariff Barriers	-.253*	-.176#	x
MES	.172*	.216*	-.022
Localized Shipments	-.044	-.028	.051
Japan Target	.098	.108	-.017
Europe Target	-.105	-.121	.045
Unionization	.093	.092	.040
Herfindahl Index	-.024	-.011	.012
Foreign Compensation	-.183+	-.242#	-.158
Human Capital Intensity	-.229*	-.425*	-.125
R&D Intensity	.056	.175#	.158#
Foreign Nontariff Barriers	.071	x	.001
Foreign Tariffs	-.146#	x	-.008
R^2	.195	.208	.158
F	4.587*	5.615*	4.313*

+ Indicates significant at the .10% level for a two-tailed test.
# Indicates significant at the .05% level for a two-tailed test.
* Indicates significant at the .01% level for a two-tailed test.
Change equals the 1981 value of the trade flow variable less the 1975 value.
x Indicates variable not used in regression.

APPENDIX B.4

Coefficient of Changes in Industry Characteristics
Associated with Changes in Trade Flows
Adjusted for International Direct Investment

Change Variable	Coefficients of Changes in Penetration of Net Imports	Imports	Exports
Labor Intensity	-.1812#	.0067	-.0065
Capital Intensity	.0680	-.0789	.0579
U.S. Tariffs	.1285#	-.0874+	--
Herfindahl Index	.0148	.0090	-.0477
Foreign Pay	-.0240	-.1286#	-.1163#
Human Capital	.1555#	.0876	.0209
R&D Intensity	.1829*	.0159	.1399#
Energy Intensity	.0301	-.0405	-.0180
Intercept	6.928	16.757	16.964
R-Square	.0621	.0364	.0330
F	2.907*	1.899+	2.004#

+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.

APPENDIX B.5

Poll Results on Causes of the U.S. Trade Deficit

Q For each of the listed items, say whether you think it is a major cause of the U.S. trade deficit, a minor cause, or not a cause at all.

Item	Major Cause	Minor Cause	Not a Cause	Do Not Know
a. High salaries and benefits for U.S. workers compared to foreign workers.	64%	22%	7%	7%
b. Restrictions by foreign governments on imports of American goods.	61	26	4	9
c. The high value of the U.S. dollar.	57	26	5	12
d. Better management at foreign companies.	39	36	10	15
e. The U.S. budget deficit.	60	21	6	13
f. Better quality foreign goods.	49	33	9	9
g. American government trade policies.	48	31	5	16

Source: Washington Post, October 2, 1985, p. A23.

APPENDIX C.1
1981 Simple Correlations

	1	2	3	4	5	6	7	8	9	10	11
1. Export Penetration	X										
2. Labor Intensity	-.108	X									
3. Energy Intensity	.047	-.135	X								
4. Net Import Penetration	-.535	.169	-.011	X							
5. Capital Intensity	.023	.032	.145	-.046	X						
6. Import Penetration	.041	.128	.019	.822	-.039	X					
7. U.S. Tariffs	.013	-.082	-.062	-.091	.021	-.099	X				
8. R&D Intensity	.307	.045	-.045	-.185	-.057	-.011	.005	X			
9. Herfindahl Index	.169	-.161	.008	-.044	.087	.061	.032	.177	X		
10. Foreign Nontariff Barriers	-.065	.047	-.028	.118	-.099	.096	-.058	-.121	-.109	X	
11. European Targeting	.019	.198	-.070	.066	-.121	.091	-.010	.191	.032	.407	X
12. U.S. Consumption Growth	.150	-.192	-.046	-.033	-.090	.062	.049	.365	.048	-.008	.052

APPENDIX C.1 (Continued)

	1	2	3	4	5	6	7	8	9	10	11
13. U.S. Nontariff Barriers	-.118	-.148	.127	.073	-.112	.007	.040	-.294	-.133	.526	.460
14. Japanese Targeting	.078	-.106	.219	-.149	.025	-.124	-.056	.208	-.010	-.091	-.020
15. Minimum Efficient Scale	.151	-.007	-.028	.087	.135	.204	.023	.156	.654	-.098	.070
16. Unionization	-.023	.150	.188	.053	.267	.047	-.036	-.185	.170	-.096	-.121
17. Depleting Resources	-.078	.184	.164	.080	.307	.042	-.070	-.118	.018	-.074	-.050
18. Foreign Tariffs	-.006	-.233	-.059	-.105	-.003	-.128	.084	.019	.174	-.182	-.048
19. Human Capital Intensity	.219	.369	.146	-.232	.228	-.127	-.072	.332	.258	-.284	-.111
20. Localized Shipments	-.094	.102	-.044	-.017	-.022	-.083	-.039	-.103	-.108	-.071	-.128
21. Foreign Compensation	.185	-.045	.387	-.222	.290	-.138	-.066	.232	.108	-.293	-.325
22. Adjusted Import Penetration	.080	.002	.140	.765	-.002	.959	-.110	.018	.086	.049	-.014
23. Adjusted Export Penetration	.515	.042	.099	-.390	.164	-.114	-.002	.526	.209	-.144	.035
24. Adjusted Net Import Penetration	-.466	-.039	-.057	.573	-.156	.363	-.027	-.493	-.175	.149	-.037

APPENDIX C.1 (Continued)

	12	13	14	15	16	17	18	19	20	21	22	23
12. U.S. Consumption Growth	X											
13. U.S. Nontariff Barriers	-.006	X										
14. Japanese Targeting	.170	-.222	X									
15. Minimum Efficient Scale	.032	-.130	-.114	X								
16. Unionization	-.228	-.073	-.036	.091	X							
17. Depleting Resources	-.101	-.166	-.024	.052	.429	X						
18. Foreign Tariffs	-.059	-.020	.014	.006	.095	-.145	X					
19. Human Capital	-.036	-.430	.231	.195	.433	.392	-.072	X				
20. Localized Shipments	.010	-.070	.152	-.098	-.073	-.005	-.001	.046	X			
21. Foreign Compensation	.098	-.421	.490	.045	.294	.466	-.180	.592	.021	X		
22. Adjusted Import Penetration	.070	-.044	-.008	.208	.042	.053	-.128	-.102	-.100	.038	X	
23. Adjusted Export Penetration	.176	-.221	.334	.113	.212	.068	-.027	.538	-.119	.548	-.066	X
24. Adjusted Net Import Penetration	-.148	.198	-.319	-.052	-.190	-.051	-.008	-.537	.086	-.509	.328	-.964

APPENDIX C.2
1975 Simple Correlations

	1	2	3	4	5	6	7	8	9	10	11
1. Export Penetration	X										
2. Labor Intensity	-.061	X									
3. Energy Intensity	.011	-.216	X								
4. Net Import Penetration	-.628	.108	.053	X							
5. Capital Intensity	.050	-.043	.226	-.062	X						
6. Import Penetration	.039	.096	.060	.754	-.038	X					
7. U.S. Tariffs	-.010	-.017	-.067	-.061	-.035	-.086	X				
8. R&D Intensity	.347	.048	-.067	-.228	-.035	.001	-.022	X			
9. Herfindahl Index	.129	-.188	.005	-.047	.095	.049	.077	.223	X		
10. Foreign Nontariff Barriers	-.089	.105	-.024	.119	-.108	.077	-.093	-.129	-.116	X	
11. European Targeting	-.011	.266	-.047	.079	-.102	.092	-.067	.230	.030	.407	X
12. U.S. Consumption Growth	.267	-.084	-.052	-.111	-.092	.083	.004	.368	.096	-.008	.052

APPENDIX C.2 (Continued)

	1	2	3	4	5	6	7	8	9	10	11
13. U.S. Nontariff Barriers	-.181	-.082	.117	.148	-.114	.037	-.014	-.314	-.155	.526	.457
14. Japanese Targeting	.118	-.166	.203	-.162	.041	-.109	-.077	.220	.007	-.091	-.020
15. Minimum Efficient Scale	.159	.021	-.036	.040	.128	.185	.042	.186	.576	-.098	.070
16. Unionization	-.035	.038	.237	.075	.280	.066	-.008	-.203	.129	-.096	-.121
17. Depleting Resources	-.079	.112	.221	.078	.312	.033	-.062	-.100	.021	-.074	-.050
18. Foreign Tariffs	-.061	-.374	-.043	-.036	-.021	-.089	.065	.047	.118	-.182	-.048
19. Human Capital Intensity	.273	.370	.055	-.268	.184	-.114	-.036	.379	.184	-.288	-.083
20. Localized Shipments	-.089	.076	-.044	-.003	-.038	-.078	-.038	-.092	-.094	-.071	-.128
21. Foreign Compensation	.234	-.132	.364	-.235	.365	-.105	-.073	.257	.139	-.326	-.343
22. Adjusted Import Penetration	.060	-.029	.165	.724	-.013	.971	-.091	.003	.054	.070	.032
23. Adjusted Export Penetration	.629	-.107	.214	-.473	.191	-.076	-.026	.421	.138	-.170	-.071
24. Adjusted Net Import Penetration	-.546	.165	-.124	.763	-.178	.506	-.017	-.379	-.101	.185	.078

APPENDIX C.2 (Continued)

	12	13	14	15	16	17	18	19	20	21	22	23
12. U.S. Consumption Growth	X											
13. U.S. Nontariff Barriers	-.006	X										
14. Japanese Targeting	-.170	-.222	X									
15. Minimum Efficient Scale	.032	-.130	-.114	X								
16. Unionization	-.228	-.073	-.036	.001	X							
17. Depleting Resources	-.101	-.166	-.024	.052	.429	X						
18. Foreign Tariffs	-.069	-.020	.014	.006	.095	-.145	X					
19. Human Capital	.053	-.434	.240	.198	.328	.334	-.143	X				
20. Localized Shipments	.010	-.070	.152	-.098	-.073	-.005	-.001	.111	X			
21. Foreign Compensation	.081	-.481	.484	.055	.344	.506	-.133	.573	.011	X		
22. Adjusted Import Penetration	.105	.080	-.028	.173	.038	.030	-.084	-.135	-.085	.003	X	
23. Adjusted Export Penetration	.282	-.153	.101	.091	.027	.034	-.009	.348	-.121	.575	.021	X
24. Adjusted Net Import Penetration	-.208	.174	-.185	-.004	-.007	-.018	-.030	-.875	.072	-.518	.431	-.893

APPENDIX D.

ADDITIONAL SENSITIVITY TESTS

This appendix contains discussions and tables of results for three sets of sensitivity tests: subsamples of industries for consumer/producer goods and native/ international shipment patterns, simultaneous equations models, and alternative heteroscedasticity adjustments.

1. Subsamples

a. Consumer versus Producer Goods Industries

We split the sample according to whether products of the industry are directly used by consumers.[152] We expected the comparative advantage relationships to be clearer for producer goods, since we hypothesized that taste differences are less likely to vary internationally in this segment.

Industries were included in the consumer goods subsample if they sell more than 50% of their output directly for consumer use. Industries below this cutoff are termed producer goods industries and make up the other subsample in this bifurcation. This division of industries has been used in industrial organization studies because it is believed that the information and information search conditions in consumer goods industries are likely to be quite different than in producer goods industries.[153]

Tables D.1a and D.1b contain the results for this division of the sample. The fit for consumer goods industries appears to be better than that for producer goods industries,

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[152] Industries were classified on the basis of the consumer goods variable in the Department of Commerce's 1972 input-output tables. We are grateful to Robert Brogan for making the data available to us (Brogan (1985), p. 22).

[153] Comanor and Wilson (1975).

Table D.1a

1975 Consumer versus Producer Goods
Full Model Regression Results

Independent Variable	Net Imports Consumer Goods	Net Imports Producer Goods	Imports Consumer Goods	Imports Producer Goods	Exports Consumer Goods	Exports Producer Goods
Energy Intensity	.022# (2.23)	.002# (2.42)	.004 (.34)	.001# (2.13)	-.003 (- .96)	-.0008 (-1.31)
Depleting Resources	X X	.135* (3.64)	X X	.041 (1.54)	X X	-.090* (-3.22)
Labor Intensity	.310 (2.06)	.175 (1.99)	.486 (3.60)	.031 (.51)	-.063 (-1.14)	-.144 (-2.24)
Capital Intensity	-.029 (- .77)	-.003 (- .35)	-.057 (-1.55)	-.003 (- .43)	.002 (.14)	-.002 (-.22)
Growth	.033 (1.06)	-.013 (- .81)	.081# (2.53)	.017 (1.43)	.043* (3.86)	.030# (2.46)
U.S. Tariffs	-.3E-6 (- .75)	-.4E-6 (- .99)	-.5E-6 (-1.05)	-.4E-6 (-1.35)	X X	X X
U.S. Non-tariff Barriers	.003 (1.05)	-.8E-4 (- .07)	-.002 (- .69)	-.0002 (- .31)	X X	X X
MES	-.291 (- .66)	.180 (.71)	.397 (.90)	.530 (2.87)	.259 (1.62)	.335 (1.74)*
Localized	-.028 (- .45)	.047 (1.18)	-.077 (-1.20)	.015 (.51)	-.020 (- .86)	-.030 (-1.01)
Japan Target	-.111 (-1.54)	.020 (.89)	-.103 (-1.37)	.001 (.09)	-.003 (- .12)	-.018 (-1.04)
Europe Target	-.088 (-1.14)	-.006 (- .23)	.010 (.15)	.019 (1.07)	-.013 (- .58)	.011 (.67)
Unionization	.004# (2.37)	.001 (1.45)	.002 (1.28)	.001# (2.27)	-.0003 (- .49)	.0002 (.36)
Herfindahl Index	.106 (.43)	.057 (.40)	.028 (.11)	-.049 (- .47)	-.061 (- .69)	-.100 (- .95)

(table continues)

Table D.1a -- Continued

Independent Variable	Net Imports Consumer Goods	Net Imports Producer Goods	Imports Consumer Goods	Imports Producer Goods	Exports Consumer Goods	Exports Producer Goods
Foreign Pay	.119 (1.13)	-.071# (-2.23)	.152 (1.41)	-.031 (-1.41)	0003 (007)	.039 (1.63)
Human Capital Intensity	-.002 (-.98)	-.004* (-3.08)	-.002 (-1.04)	-.002# (-2.28)	.0008 (1.05)	.002# (2.14)
R&D Intensity	.006 (.62)	.001 (.52)	-.009 (-1.17)	.003 (1.41)	.006 (1.84)	.002 (1.00)
Foreign Non-tariff Barriers	-.0004 (-1.30)	.0005 (1.02)	X X	X X	.9E-4 (78)	.0002 (.60)
Foreign Tariffs	-.186* (-3.27)	.009 (.43)	X X	X X	-.006 (- 32)	- 007 (- 43)
Intercept	-.367	.026	-.374	.068	055	034
R-sq.	.423	.191	336	.137	402	.201
F stat.	3.71*	3.10*	2.96*	2.37*	3.95*	3.76*
N	104	256	104	256	104	256

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regression.

Table D.1b

1981 Consumer versus Producer Goods
Full Model Regression Results

Indepen. Variable	Net Imports Consumer Goods	Net Imports Producer Goods	Imports Consumer Goods	Imports Producer Goods	Exports Consumer Goods	Exports Producer Goods
Energy Intensity	.025# (2.33)	.011# (2.23)	-.0009 (-0.09)	.001# (2.28)	-.003 (-.090)	-.0002 (-0.55)
Depleting Resouces	X X	.121* (3.17)	X X	.057# (1.83)	X X	-.061* (-2.28)
Labor Intensity	.152 (1.07)	.301* (3.45)	.405# (2.49)	.098 (1.39)	-.044 (-0.85)	-.205* (-3.37)
Capital Intensity	-.010 (-0.26)	.0007 (0.10)	-.071+ (-1.88)	-.0006 (-0.11)	-.002 (-0.17)	-.002 (-0.42)
Growth	.086# (2.36)	.007 (0.40)	.097# (2.49)	.011 (0.78)	.009 (0.71)	.006 (0.46)
U.S. Tariffs	-.3E-6 (-0.57)	-.6E-6 (-1.53)	-.7E-6 (-1.24)	-.6E-6+ (-1.74)	X X	X X
U.S. Nontariff Barriers	.0004 (0.13)	-.0009 (-0.73)	-.006# (-1.96)	-.0007 (-0.75)	X X	X X
MES	-.805 (-1.46)	.613# (2.06)	.132 (0.23)	.777* (3.23)	.359+ (1.81)	.158 (0.75)
Localised	-.0001 (-0.002)	.004 (0.09)	-.086 (-1.11)	-.001 (-0.04)	-.035 (-1.31)	-.003 (-0.10)
Japan Target	-.099 (-1.23)	.018 (0.79)	-.115 (-1.33)	.002 (0.09)	-.029 (-1.00)	-.016 (-0.98)
Europe Target	-.137 (-1.65)	-.003 (-0.13)	.050 (0.65)	.017 (0.88)	.007 (0.33)	.010 (0.65)
Unionization	.008* (3.81)	.0006 (0.84)	.005# (2.43)	.0007 (1.15)	-.0008 (-1.09)	.001 (0.27)
Herfindahl Index	.0398 (1.20)	-0.85 (-0.47)	.095 (0.27)	-.065 (0.45)	-.154 (-1.27)	.018 (0.14)

(table continued)

Table D.1b -- Continued

Independent Variable	Net Imports Consumer Goods	Net Imports Producer Goods	Imports Consumer Goods	Imports Producer Goods	Exports Consumer Goods	Exports Producer Goods
Foreign Pay	.014 (0.16)	-.040+ (-1.68)	.096 (1.05)	-.025 (-1.41)	-.020 (0.63)	.012 (0.70)
Human Capital Intensity	-.005+ (-1.86)	-.004* (-3.33)	-.006# (-2.20)	-.002# (-2.02)	.0008 (0.92)	.002# (2.55)
R&D Intensity	.014 (1.47)	.0002 (0.09)	-.010 (-1.23)	.002 (1.42)	.005 (1.54)	.003* (1.76)
Foreign Nontariff Barriers	-.0002 (-0.64)	.000 (0.88)	X X	X X	.5E-4 (0.35)	.0003 (0.82)
Foreign Tariffs	-.313* (-4.95)	-.002 (-0.11)	X X	X X	.008 (0.41)	.004 (0.25)
Intercept	-.186	-.051	-.249	.059	.049	.109
R-sq.	.504	.177	.356	.137	.297	.164
F stat.	5.14*	2.84*	3.25*	2.37*	2.48*	2.93*
N	104	256	104	256	104	256

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.
X Indicates that the variable was not used in the regression.

contrary to our initial hypothesis.[154] Turning to the coefficients, there are numerous minor differences in coefficients between the subsamples, and a few major differences. Variables where differences do not appear to be significant include the U.S. tariff variable, European targeting, and human capital. Differences in signs, where one or both of the sample coefficients are significant or nearly significant in both 1981 and 1975, include Japanese targeting, foreign compensation, and foreign nontariff barriers in the net import regressions. Large differences in coefficients also occur with the foreign tariffs variable.[155] Although there is no apparent difference in the

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[154] As the table below shows, the fit for consumer goods is superior to the fit for producer goods industries and the fit for the undivided sample.

Adjusted R-Square
1981

	Full Sample	Consumer Goods	Producer Goods
Imports	.150	.246	.082
Exports	.143	.177	.108
Net Imports	.204	.406	.115

F-tests indicate that there are statistically significant differences between the two subsamples for imports and net imports, but not for exports. For a discussion of the methodology underlying the statistical test employed, see Kmenta (1971), p. 373.

[155] In Tables D.1a and D.1b, although the foreign tariff variable shows significant differences between consumer and producer goods for the 1975 and 1981 net import regressions, there is no parallel differences evident in the export regressions. Since any significant result in the net import regression should be reflected in either the import or export equations (or both), logic necessitates that the difference in

net import equation for the R&D variable, R&D has opposite, although insignificant, signs in the import runs.

The variables for which coefficients appear to differ between consumer and producer goods industries fall into two categories: trade policies (Japanese targeting, foreign tariffs, and foreign nontariff barriers) and technological sophistication (R&D and foreign compensation, interpreting foreign compensation as foreign human capital). For the trade policy variables, the producer goods industries evidence results that are consistent with the more traditional hypothesis that a nation's barriers reduce its import penetration levels. That is, the coefficients for the foreign trade barriers are positive and the coefficients for U.S. barriers are negative in the net import equations. The consumer goods subsample produces the opposite signs suggesting that the "common threat" or retaliation explanations apply to trade in consumer products.

For the technology variables, a priori predictions that the U.S. has an advantage in technology intensive goods are to a limited extent realized for the producer goods subsample, but are violated for the consumer goods subsample. That is, the technology variables tend to be somewhat more negatively associated with net imports for producer goods than for the consumer goods. However, these relationships are not particulary strong and are not always evident. Nonetheless, the findings are consistent with the idea that R&D in consumer products produces a substantial degree of product differentiation, which would encourage two-way trade flows.

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the relationships between foreign tariffs and net imports in the two subsamples must stem from difference in the relationships between foreign tariffs and U.S. imports in producer and consumer goods. We excluded foreign tariffs from the U.S. import equation because no direct linkages were expected. Evidently, there may be indirect links.

b. National versus International Geographic Markets

The second bifurcation we explored divides the sample according to the level of international trade in the market. If traded goods (imports plus exports) account for more than 5% of total production available for U.S. consumption, then the industry is viewed as international. Otherwise, the industry is classified as national.[156] Tables D.2a and D.2b contain the results for the regressions on these two sub-samples. As noted above, we expected national industries to introduce "noise" into the relationship, since production levels are less directly related to factors that affect international trade flows. By removing them from the sample, we hoped to improve the fit of the regressions.

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[156] We recognize that this division is somewhat crude and that a more detailed geographic market analysis might lead to a different treatment of some industries.

Table D.2a

1975 National versus International Shipments Full Model Regression Results

Independent Variable	Net Imports National	Net Imports Inter.	Imports National	Exports Inter.	National	Inter.
Energy Intensity	.0008* (2.79)	.002# (2.09)	.0005* (2.82)	.001+ (1.69)	-.0004+ (-1.75)	-.0009 (-1.56)
Depleting Resources	.011 (1.25)	.139* (3.00)	.0008 (.14)	.052 (1.47)	-.010 (-1.52)	-.083* (-3.01)
Labor Intensity	.039# (2.35)	.338* (3.21)	.011 (1.03)	.179# (2.45)	-.031* (-2.73)	-.150# (-2.44)
Capital Intensity	-.008 (-1.64)	-.007 (-.66)	-.005 (-1.57)	-.010 (-1.23)	.005 (1.56)	-.004 (- .54)
Growth	.001 (.18)	.002 (.09)	.003 (.72)	.029# (2.11)	.002 (.35)	.027# (2.45)
U.S. Tariffs	-.6E-7 (-1.05)	-.7E-6+ (-1.78)	-.6E-7 (-1.53)	-.7E-6# (-2.13)	X X	X X
U.S. Non-tariff Barriers	-.0002 (- .81)	-.0004 (- .29)	-.0004# (-2.22)	-.001 (-1.10)	X X	X X
MES	.013 (.22)	.393 (1.35)	.052 (1.37)	.610* (2.74)	.037 (.91)	.222 (1.28)
Japan Target	.005 (.94)	.024 (.77)	-.003 (- .90)	.028 (1.16)	-.005 (-1.36)	.006 (.31)
Europe Target	-.019* (-2.87)	-.024 (- .82)	-.005 (-1.22)	-.023 (-1.02)	.010# (2.32)	-.002 (- .14)
Unionization	.1E-4 (.08)	.002# (2.48)	-.3E-4 (- .33)	.002# (2.43)	.3E-4 (.26)	-.0005 (-1.00)
Herfindahl	-.032 (-1.31)	.122 (.67)	-.012 (- .77)	-.015 (- .11)	.019 (1.12)	-.132 (-1.20)

(table continues)

Table D.2a -- Continued

Independent Variable	Net Imports National	Net Imports Inter.	Imports National	Imports Inter.	Exports National	Exports Inter.
Foreign Pay	-.025*	-.083#	-.008+6	-.050+	.014*	.033
	(-3.39)	(-2.16)	(-1.74)	(-1.76)	(2.60)	(1.44)
Human Capital	-.0003	-.007*	-.0002+	-.004*	-.8E-5	.003*
	(-1.18)	(-5.06)	(-1.67)	(-3.50)	(- .05)	(3.92)
R&D Intensity	.0002	.002	.5E-4	.0009	.0001	-.0003
	(.17)	(.52)	(.08)	(.38)	(.16)	(-.17)
Foreign Non-tariff Barriers	-.9E-4	-.0002	X	X	.8E-4	.4E-4
	(- .77)	(- .72)	X	X	(1.09)	(.20)
Foreign Tariffs	-.004	-.0009	X	X	-.001	-.001
	(- .92)	(- .03)	X	X	(- .36)	(- .08)
Intercept	.036	.017	.028	.096	-.002	.073
R-sq.	.396	.275	.262	.173	.349	.264
F stat.	3.32*	5.28*	2.11*	3.32*	3.18*	5.73*
N	105	255	105	255	105	255

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the 10% level for a two-tailed test.
# Indicates significant at the .05% level for a two-tailed test.
* Indicates significant at the .01% level for a two-tailed test.
X Indicates that the variable was not used in the regression.

Table D.2b

1981 National versus International
Shipments Full Model Regression Results

Independent Variable	New Imports National	New Imports Inter.	Imports National	Imports Inter.	Exports National	Exports Inter.
Energy Intensity	.0003 (.65)	.002# (2.13)	.0001 (.48)	.001+ (1.93)	-.9E-4 (- .37)	-.0004 (- .87)
Depleting Resources	-.0009 (- .08)	.138* (2.97)	-.007 (- .98)	.069+ (1.79)	-.005 (- .64)	-.069* (-2.72)
Labor Intensity	.023 (1.26)	.413* (4.29)	-.016 (-1.33)	.281 (3.59)	-.041* (-3.36)	-.160* (-3.08)
Capital Intensity	.002 (.38)	-.002 (.28)	.004 (1.49)	-.005 (- .82)	.003 (.98)	-.003 (- .63)
Growth	.013* (1.65)	.027 (1.41)	.0009 (.17)	.030+ (1.93)	-.012# (-2.27)	.001 (.12)
U.S. Tariffs	-.5E-7 (- .86)	-.8E-6+ (-1.81)	 (-1.73)	-.7E-7+ (-1.81)	- E-6+ X	X X X
U.S. Non-tariffs Barriers	.4E-4 (.12)	-.003+ (-1.87)	-.2E-4 (- .09)	-.002# (-2.00)	X X	X X
MES	.009 (.10)	.651+ (2.10)	-.009 (- .16)	.795* (3.10)	-.007 (- .11)	.090 (.55)
Japan Target	.0006 (.10)	.043 (1.37)	-.002 (- .62)	.044+ (1.68)	-.0007 (- .17)	-.0003 (- .02)
Europe Target	-.007 (- .74)	-.018 (- .64)	-.005 (- .96)	-.021 (- .91)	-.002 (- .33)	-.002 (- .15)
Unionization	.0003 (1.55)	.002# (2.29)	.2E-5 (.02)	.001# (2.04)	-.0003+ (-1.93)	-.0004 (- .82)
Herfindahl	.001 (.03)	.069 (.34)	.010 (.36)	.014 (.09)	.001 (.03)	-.015 (- .13)

(table continues)

Table D.2b -- Continued

Independent Variable	Net Imports National	Net Imports Inter.	Imports National	Imports Inter.	Exports National	Exports Inter.
Foreign Pay	-.006 (-.78)	-.070+ (-2.56)	-.002 (-.47)	-.046# (-2.06)	.001 (.23)	.017 (1.16)
Human Capital Intensity	.1E-4 (.05)	-.007* (-5.48)	.0002 (.84)	-.005 (-4.39)	.0001 (.70)	.002* (3.41)
R&D Intensity	-.001 (-1.64)	-.0008 (-.31)	-.0006 (-1.24)	.0004 (.18)	.0009 (1.53)	.002 (1.22)
Foreign Non-tariffs Barriers	-.9E-4 (-.40)	.2E-4 (.05)	X X	X X	.0002 (1.23)	.6E-4 (.33)
Foreign Tariffs	-.002 (-.31)	-.033 (-1.33)	X X	X X	-.002 (-.43)	.007 (.51)
Intercept	-.011	-.010	.017	.086	.034	.106
R-sq.	.275	.282	.195	.198	.402	.201
F stat.	1.34	6.11*	1.00	4.37*	2.77*	4.47*
N	78	282	78	282	78	282

Note: The figures in parentheses are t-statistics.
+ Indicates significant at the 10% level for a two-tailed test.
# Indicates significant at the .05% level for a two-tailed test.
* Indicates significant at the .01% level for a two-tailed test.
X Indicates that the variable was not used in the regression.

The results are consistent with our basic hypothesis.[157] The fit is better for our international regression than it is for the full sample regression.[158] Moreover, except for the export equation, the fit is worse for the local goods sample than it is for the full sample.

While the overall fit improves in moving from the whole sample to the internationally-traded subsample, the differences in the individual coefficients are each relatively small.[159] Only a few coefficients have different signs.[160]

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[157] We dropped the variable "local" from these regressions due to singularity problems. For the national subsamples, there was no variation in this variable across observations.

[158]

Adjusted R-Square 1981

	Full Sample	Local Goods	Nonlocal Goods
Imports	.150	.0003	.153
Exports	.143	.257	.159
Net Imports	.204	.070	.236

F-tests indicate that there are statistically significant differences between the subsamples for the import and net import equations, but not the export equation. For a discussion of the methodology which we used for this statistical test, see Kmenta, (1971), p. 373.

[159] We expected to see more significant sign differences for the coefficients in the national data subset than we actually found. Perhaps some of these national markets are sufficiently linked to international markets to allow the same model fit.

However, none of these differences are statistically significant.[161]

2. Simultaneous Equation Tests

Our basic model assumes that trade flows are shaped by the characteristics of the industry, but that the characteristics of the industry are not affected by trade flows. This assumption, which has been made in most previous analyses of trade flows, may not be valid. We conducted a number of statistical tests to see if the data indicated that this assumption should be rejected.

We tested the possibility that R&D and human capital are simultaneously determined with trade flows. These two industry characteristics were chosen for the simultaneity tests because they are particularly important to our findings and because, based on theory, it is possible that simultaneity might be important in these cases. With respect to R&D, the availability of an export market (proxied by the level of exports) may mean that the returns from R&D are larger, which should encourage research and development. Imports may also influence R&D expenditures. If increased competitive pressure leads to more R&D, as it might since R&D is one form of competitive endeavor, then increased import competition could lead to higher R&D.

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[160] For 1975, only coefficients in the export regression have different signs in the nonlocal sample than in the full sample. The variables for which there is a difference include: Japanese targeting, European targeting, and R&D intensity. For 1981, there were different signs in the full and nonlocal regressions for all three trade flow models. In the net import regression, capital intensity and R&D intensity coefficients change. In the import equation, capital intensity and the Herfindahl index coefficients change. And in the export regressions, the capital intensity, Japanese targeting, European targeting, and foreign tariff coefficients change.

[161] This was determined by using the test suggested by Kmenta (1971), p. 373.

We also suspected that human capital might be endogenous. Since our measure of human capital is based on a measure of U.S. wages, we suspected that import competition might affect the value of human capital in particular industries. Specifically, higher import competition might be expected to lower the value of human capital in the industry, since import competition may lower the wages of U.S. workers in an industry.

To test for the presence of these simultaneous relationships, we developed two simultaneous equation models. In one, R&D was the only endogenous variable. In the other, both R&D and human capital were treated as endogenous variables. The R&D equation hypothesized that R&D is a linear function of net imports, unionization, technological opportunity (as captured by electrical, traditional, and chemical industry dummies), industry concentration, and industry growth rate. The human capital equation hypothesized that human capital is a function of median education, race, sex, unionization, industry concentration, capital intensity, R&D intensity, and net import penetration. Results are in Table D.3.

After obtaining the simultaneous equation estimates of the coefficients for the trade flow equations, we tested for the presence of a statistically significant simultaneous relationship using a Hausman Test.[162] None of the Hausman tests indicated that the results were significantly different. As a result, we focus on the simpler OLS results in the report.

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[162] Hausman (1978). Our application of this test involved the following steps. First, we used a complete specification of both of these equations, applying two-stage least squares estimation. Second, the coefficients from these runs were compared to the OLS results reported earlier to see if the results were significantly different. This comparison involved the use of a chi-square test. See Appendix B.3 for regression results incorporating the two simultaneous equation models.

Table D.3

Simultaneous Equations Models with Barriers and Control Variables, 1981
(Dependent Variable = Net Import Penetration)

Independent Variable	Models: With R&D Equation	Models: With R&D and Human Capital Equations
Energy Intensity	.001#	.001#
	(2.08)	(2.09)
Depleting Resources	.094+	.108#
	(1.85)	(2.22)
Labor Intensity	.311*	.357*
	(4.13)	(3.35)
Capital Intensity	-.005	-.005
	(-.75)	(-.76)
Growth	.036	.030
	(1.59)	(1.43)
U.S. Tariffs	-.6E-6+	-.6E-6+
	(-1.66)	(-1.70)
U.S. Nontariff Barriers	-.002	-.002
	(-1.54)	(-1.49)
MES	.658#	.663*
	(2.50)	(2.52)
Localized	-.023	-.015
	(-.57)	(-.37)
Japan Target	.024	.027
	(.99)	(1.14)

Table D.3-- Continued

Simultaneous Equations Models with Barriers and Control Variables, 1981
(Dependent Variable = Net Import Penetration)

Independent Variable	Models	
	With R&D Equation	With R&D and Human Capital Equations
Europe Target	-.4E-3 (-.01)	-.010 (-.28)
Unionization	.002# (1.96)	.002# (2.19)
Herfindahl Index	.037 (.22)	.078 (.43)
Foreign Pay	-.048+ (-1.71)	-.044 (-1.40)
Human Capital Intensity	-.005* (-3.47)	-.007# (-2.41)
R&D Intensity	-.006 (-.78)	-.003 (-.45)
Foreign Nontariff	1.0E-4 (.33)	.5E-4 (.14)
Foreign Tariff	-.002 (-1.00)	-.027 (-1.22)
N	366	360

+ Indicates significant at the .10 level for a two-tailed test.
# Indicates significant at the .05 level for a two-tailed test.
* Indicates significant at the .01 level for a two-tailed test.

4. *Alternative Heteroscedasticity Adjustments*

We divide the appropriate explanatory variables by value added both because we think the resulting variables are sensible and easily interpreted measures of the relationships we are studying and because this adjustment reduces the likelihood that heteroscendasticity is present.[163]

While some researchers have also followed this approach, others have deflated variables by the square root of sales. This approach produces coefficients that are somewhat harder to interpret. Nonetheless, we tested this approach.[164] Our tests indicated that it did not remove heteroscedasticity as well as the value added deflator which we used.[165] The results from these runs are reported in Table D.3, so that our findings can be compared to earlier studies which used this adjustment.

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[163] Heteroscedasticity occurs when the variance of the error term differs across observations, violating a standard assumption of ordinary least squares regression. Tests we performed indicated that heteroscedasticity was present when unadjusted regressions were run.

[164] We used the tests described in Judge et al. (1982), pp. 416-420. See note (?) for a further discussion of these tests.

[165] The square root of sales deflator, which seems to have been the most commonly used method to reduce heteroscedasticity problems in previous studies, does not completely remove the heteroscedasticity present in the data. Indeed, our tests suggest that more heteroscedasticity remains when explanatory variables are adjusted using the square root of sales than when value added is used, as we do here.

As is evident in Table D.4, the choice of deflator does not appear to make a substantial difference.[166] However, a few differences were observed. The coefficient for labor, human capital intensity, and MES became insignificant while R&D intensity became significantly negative at the ten percent level.

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[166] Besides using the hetroscedasticity-related adjustments discussed in the text, we also experimented with making additional adjustments, as suggested in Judge et al. (1982), pp. 416-420. These additional adjustments do not produce major changes in signs or significance levels in most cases. No instances occur in which a significant or nearly significant coefficient changes signs. The most frequently observed changes occur for the R&D and growth variables, however there is no consistent weakening or strengthening of the significance of these variables. Since heteroscedasticity affects the efficiency of the estimates and does not lead to biased estimates and because the coefficients are fairly stable across a variety of adjustments to the explanatory variables (dividing inputs by sales, square root of sales, and new supply) for heteroscedasticity, we conclude that our use of value added as the deflator is reasonable. Given the relative directness of interpreting the results using the value added deflator, since the resulting ratios appear to be sensible variables for analysis, we think the focus on the variables that are deflated by value added is appropriate.

Table D.4

Model with Barriers and Control Variables Deflated by the Square Root of Industry Sales Rather than Value Added

Independent Variable	Net Imports 1975	1981	1984
Energy Intensity	.001*	.001⁻	.003#
	(1.65)	(1.35)	(2.28)
Depleting Resources	5.069#	8.658*	19.710*
	(2.44)	(2.64)	(3.67)
Labor Intensity	.016	-.027	-.052
	(.42)	(-.63)	(-.85)
Capital Intensity	-.003	-.006	-.003
	(-.39)	(-.86)	(-.42)
Growth	1.061	4.740*	-1.013
	(1.20)	(3.20)	(-.44)
U.S. Tariffs	-.2E-4	-.3E-4	.1E-3*
	(-1.23)	(-.15)	(1.88)
U.S. Nontariff Barriers	.074	-.072	.076
	(1.29)	(-.78)	(.45)
MES	-7.794	-25.379	-34.578
	(-.58)	(-1.06)	(-.16)
Localized	1.904	2.998	3.604
	(.88)	(.85)	(.44)
Japan Target	-.100	.756	-.278
	(-.08)	(.37)	(-.10)

(Table continues.)

TABLE D.4 -- Continued

Independent Variable	Net Imports 1975	1981	1984
Europe Target	.093	1.902	3.992
	(.08)	(.99)	(1.55)
Unionisation	.059	.155#	.095
	(1.56)	(2.51)	(1.14)
Herfindahl Index	9.488	13.852	-14.803
	(1.29)	(.97)	(-.56)
Foreign Pay	-1.929	-3.766#	-3.568
	(-1.30)	(-2.17)	(-1.30)
Human Capital Intensity	-.001	-.2E-3	-.3E-3
	(-1.24)	(-.33)	(-.36)
R&D	-.002+	-.002	-.002
	(-1.71)	(-1.52)	(-1.22)
Foreign Nontariff Barriers	-.001	.020	.051
	(-.08)	(.73)	(1.18)
Foreign Tariffs	.393	-1.843	-3.493
	(.40)	(-1.13)	(-1.40)
Intercept	1.070	5.274	10.256
	(.36)	(1.18)	(1.27)
R-sq	.148	.132	.531
F-stat	3.30*	2.89*	6.49*
N	360	360	122

+ Indicates significant at the .10% level for a two-tailed test.
# Indicates significant at the .05% level for a two-tailed test.
* Indicates significant at the .01% level for a two-tailed test.

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APPENDIX B.1a

T-statistics for Dummy Time Shift Variables
Simple Model Comparative Advantage

Explanatory Variable	Net Import Penetration	Investment Adjusted Net Imports Penetration	Import Penetration	Investment Adjusted Import Penetration	Export Penetration	Investment Adjusted Export Penetration
Labor Intensity	1.12	.16	.81	.21	-.69	-.09
Capital Intensity	-.02	.27	.09	.20	.16	-.21
Human Capital Intensity	.24	-4.88*	-.24	.38	-.72	5.41*
R&D Intensity	-.14	-1.53	-.80	-.61	-.88	1.39

* Indicates significant at the 10% level, two-tailed. Figures in parentheses are t-statistics.