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Real Exchange Rates and Protectionism in Industrial Countries

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Summary

This paper investigates empirically some aspects of the relation between real exchange rate movements and the rise of protectionism in industrial countries. While the term "protectionism" is generally used to refer to any governmental measures that have the effect of restricting the access of goods and services from abroad to the domestic market, the focus of this paper is on nontariff trade barriers.

This paper focuses on a two-step process by which real exchange rate fluctuations can lead to increased protectionism. First, the paper surveys evidence from other empirical studies that suggests there is a relationship running from rising import penetration to increased protectionism. Second, the paper specifies and tests the hypothesis that import penetration in specific industries is related to movements in real exchange rates. For the statistical tests, indices of industry-level real exchange rates for textiles, clothing, iron and steel, and transport equipment have been derived for three countries: the United States, the Federal Republic of Germany, and the United Kingdom. The empirical work suggests that when the real exchange rate of a given domestic industry begins to appreciate, the result is likely to be a rise in imports of the types of goods produced by that industry. Of course, it is to be expected that, over time, the level of import penetration will rise in sectors where domestic producers are relatively less efficient than foreign producers, as international trade expands in response to the forces of comparative advantage. But the estimates in this paper suggest that an appreciating real exchange rate is associated with increases in import penetration beyond what can be accounted for by the secular growth of international trade.

This paper also shows how the empirical results can be used to estimate some of the economic effects of trade restrictions. A

1/ The author would like to acknowledge numerous helpful comments that were provided by J.M. Boughton, J. Ha, J. Horne, M.D. Knight, and A.K. McGuirk. The author is grateful to A. Turner and T. Walter for research assistance. The author, is, of course, responsible for any remaining errors.

quantitative illustration is developed to show how a policy to restrict import penetration into markets served by a given domestic industry will lead to measurable increases in economic rents for domestic producers in the form of a depreciation of the "shadow" real exchange rate for that industry.

I. Introduction

Protectionist pressures increased significantly in the industrial countries from 1974 onwards, following the first international oil price shock and the beginning of a sharp economic recession in the major industrial countries. 1/ While the term "protectionism" is generally used to refer to any governmental measures that have the effect of restricting the access of goods and services from abroad to the domestic market, the focus of this paper is on nontariff trade barriers (NTBs). In recent years, governments have frequently imposed NTBs in response to demands for protection. The recent emphasis on NTBs rather than tariffs as a means of affording protection to specific domestic industries is the result of a number of factors of which two are of particular significance: (1) several rounds of multilateral trade negotiations, most recently the Tokyo Round, have led to commitments to reduce tariffs on most manufactures to modest levels by the late 1980s; (2) NTBs can be arranged so as to provide an increasing degree of protection if the home country's real exchange rate continues to appreciate.

The causes and effects of the current trend toward increased recourse to NTBs have been widely analyzed and discussed. Recently the focus of much of the attention, especially in the popular press, has been on the role of real exchange rate movements in the rise of protectionist pressures. 2/ In this view, large movements in exchange rates between industrial countries may at times alter the competitive positions of specific industries so much that they result in strong protectionist pressures from both management and unions. To the extent that such demands are satisfied through the imposition of tariff or nontariff trade barriers, movements in real exchange rates lead indirectly to increased protectionism. In spite of the popularity of this view, however, only a small amount of research attention has been paid to it, and virtually no empirical evidence has been forthcoming. 3/

Since protectionism, whatever its form, tends to reduce international trade and the resulting welfare gains from specialization along the lines of comparative advantage, it is important to gain as many empirical insights as possible into its causes. This paper investigates empirically the role of movements of real exchange rates in the increased recourse to NTBs by industrial countries. 4/ For the statistical tests carried out in this paper, industry-level real exchange rates have been derived for textiles, clothing, iron and steel, and transport equipment in the United

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1/ See Nowzad et al. (1978) for details on the rise in protectionism.

2/ See, for example, The New York Times, August 5, 1984.

3/ For examples of works on this topic see Bergsten and Williamson (1983) and Corden (1984).

4/ The measurement of the real exchange rate is discussed in Section III of this paper. Unless otherwise noted, the term exchange rate refers to the effective exchange rate, that is the price of domestic currency in terms of a weighted basket of foreign currencies.

States, the Federal Republic of Germany, and the United Kingdom. The analysis focuses on a two-step process by which real exchange rate fluctuations can lead to increased protectionism. First, we survey some evidence from other empirical studies that suggests there is a relationship between import penetration and protectionism. Second, we specify and test the hypothesis that import penetration in specific industries is related to movements in real exchange rates. The empirical tests show that when the real exchange rate of a given industry begins to appreciate, the result is likely to be a rise in the penetration of imports of the goods produced by that industry into the domestic market. Of course, it is to be expected that as international trade expands in response to the forces of comparative advantage, the level of import penetration will rise in sectors where domestic producers are relatively less efficient than foreign producers. But the empirical estimates presented in this paper suggest that an appreciating real exchange rate is associated with increases in import penetration beyond what can be accounted for by the secular growth of international trade. Thus the linkage between real exchange rates and protectionism is indirect, operating through import penetration. 1/

The plan of this paper is as follows. Section II surveys some of the recent literature on the determinants of protectionism. Section III discusses the countries and industries that are used in the empirical portion of this study, describes the hypothesized relationship between the import penetration ratio and the real exchange rate, outlines the empirical tests used, and reviews the empirical results. Section IV discusses some implications of these empirical results and shows how they can be used to assess some of the economic effects of trade restrictions. A quantitative illustration is developed to show how a policy to restrict import penetration into an industry will lead to measurable increases in economic rents for domestic producers in the form of a depreciation of the "shadow" real exchange rate for that industry. The final section contains a summary and some concluding remarks.

II. The Determinants of Protectionism

In conducting an investigation of the determinants of protectionism, it is first necessary to distinguish between "the pressure for protectionism" and "protectionism" per se. 2/ Industries may press for government action to protect themselves without necessarily achieving much success. Protectionism may be defined, in general, as governmental measures that have the effect of restricting the access of goods and

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1/ The relation between real exchange rates and import penetration may also be asymmetric. While an appreciating real exchange rate may lead to a rise in import penetration and thus to the introduction of NTBs, a depreciating real exchange rate will not necessarily lead to a reduction in the degree of nontariff protection afforded to domestic producers.

2/ This observation is from Takacs (1981).

services from abroad to the domestic market, thereby limiting the degree to which they can compete with domestically produced goods. Protectionist measures can be implemented either through traditional forms of commercial policy such as tariffs and subsidies, or via a very wide variety of other types of measures. As noted above, currently the major trade restrictions in place in the industrial countries are NTBs. 1/ Consequently, the discussion of protectionism in this paper is focused on NTBs and, more specifically, on quantitative restrictions such as quotas and voluntary export restraints.

Recently, the pressure for nontariff protection has originated primarily in those sectors where employers and employees believe that they are being adversely affected by imports, rather than from policymakers concerned about maintaining overall external balance. 2/ That the introduction of a system of flexible exchange rates would be likely to lead to a decrease in the pressure for protection was predicted by *Friedman* (1953) *and Johnson* (1974), *among others*. Their argument was that flexible exchange rates would ensure that the balance of payments would automatically adjust to its equilibrium level, and hence that there would be no need for policymakers to resort to trade barriers as a means of restoring external equilibrium. However, the payments balances of the major industrial countries have not always adjusted automatically to equilibrium since the advent of greater exchange rate flexibility in the early 1970s, and real exchange rates have fluctuated widely. Nevertheless, it does appear that in the industrial countries, policymakers' use of protectionist measures for the specific purpose of maintaining or restoring external balance has diminished somewhat since the advent of generalized floating. At the same time, it has frequently been noted that since 1974 the industrial countries have increasingly resorted to trade barriers to protect certain domestic industries. 3/ The fact that the pressure for protection recently has tended to arise at the level of specific industries suggests that it is appropriate to investigate the determinants of protection at the disaggregated sectoral level.

Cline (1984) recently examined the determinants of protection via nontariff quantitative restrictions at the individual industry level in five major industrial countries. He used logit analysis to test statistically an equation that specified the probability of the occurrence of nontariff trade barriers as a function of the level of import penetration,

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1/ For details see Cline (1984), U.S. Trade Representative (1984) and Anjaria et al. (1982).

2/ See Nowzad et al. (1978) and Anjaria et al. (1982) for details on recent actions to protect specific industrial sectors. See Witte (1984) for a discussion of the distinction between measures to improve the balance of payments and actions to protect specific industries.

3/ See, for example, Page (1981). Measures that have recently been taken to protect the specific industries examined in this paper are reviewed in the next section.

comparative advantage, export dependence, the political importance of the industry, the concentration of the industry, public "sympathy" for the industry, and the cost of adjustment to imports.

Cline's approach involves a reduced form specification, since it gives the equilibrium probability that protectionist measures will be introduced, based on the interaction between the "demand" for protection by market participants and the "supply" of protection by domestic policymakers. Cline described the import penetration ratio as one of the arguments in the protection demand function. He hypothesized that the potential economic rents from protection grow as the level of import penetration into the domestic market increases. Cline further hypothesized that employers and employees are "rent seekers" and that the increase in potential rents available leads them to demand more government action to restrict imports so as to raise their share of the domestic market. Therefore, the demand for protection is a positive function of the import penetration ratio. In contrast, he described the authorities' supply function for protection as being independent of the import penetration ratio. 1/ Thus, he was able to derive a reduced-form equation in which the equilibrium probability of protection increases as the import penetration ratio rises.

To estimate his equation, Cline used cross-section data on 80 industries in five major industrial countries. He relied on cross-section data in part because time series are not available for many of the independent variables. In addition, it is difficult to use time series to estimate a function for the amount of protection because in many cases the imposition of a protective measure in an industry provides only a single shift in a dummy variable representing the policy regime. From such a single observation it is not normally possible to determine the factors that triggered the protectionist response. Using his cross-section data to circumvent this difficulty, Cline estimated protection functions for the United States, Canada, the United Kingdom, Germany, and France. He concluded that, based on the similarity of the coefficients in the individual country equations, the protection process is relatively similar in all five countries. He further concluded that, in general, the import penetration ratio is the key variable triggering protection, with its influence moderated to the extent that the home country is also an exporter of goods in the same industrial category. Cline's "best estimates" of the protection functions for the Federal Republic of Germany, the United Kingdom, and the United States included the import penetration ratio and the industry's share of the total manufacturing labor force as major explanatory variables. 2/

1/ Cline hypothesized that the supply of protection is a function of the political importance of the affected industry, public sympathy for the industry, and adjustment costs.

2/ Cline defined "best estimates" as the set of explanatory variables for each equation that produces the highest percentage explanation of protectionism.

The Cline study also contains an extensive survey of other studies on the determinants of protectionism. The studies that he reviewed suggest that, in addition to the import penetration ratio, the important explanatory variables of protectionism are the size of employment in the industry, the industry wage rate, the industry's use of unskilled labor, and industry concentration. Two other recent studies, Takacs (1981) and Lavergne (1983), also found import penetration to be an important determinant of protectionism.

In contrast to the evidence relating increases in import penetration to protectionism, little hard empirical evidence exists linking increased protectionism to a country's real exchange rate. Such a state of affairs seems somewhat surprising in light of the widespread interest in the interplay of exchange rate movements and protectionism and the vast number of assertions in the popular press that these factors are linked. In part, the dearth of empirical evidence may be due to what Bergsten and Williamson (1983) referred to as the "bifurcation between money and trade, at both the analytical and policy levels."

Studies of the determinants of protectionism usually discuss separately the impact of import penetration and real exchange rate movements. This dichotomy is somewhat natural because these two variables can exert different influences on trade policy. For example, the effects of real exchange rate movements on protectionism can involve more than just an overvalued currency hurting the import-competing sectors; an overvalued currency can obviously harm the export sectors as well. In addition, some authors have hypothesized that exchange rate volatility may itself lead to protectionist pressure. 1/ Thus, in theory at least, real exchange rate movements can have a much broader impact on commercial policy than just that due to their effects on import-competing industries. Nevertheless, as Bergsten and Cline (1983) and Witte (1984) have noted, most recent protectionist measures have been introduced to protect domestic industries from import competition. Thus it seems that, in practice, much of the protectionist sentiment caused by real exchange rate changes is the more or less direct result of increases in the degree of import penetration.

While recent studies have shown that increasing import penetration is a very important determinant of protectionism, few have directly explored the variables that might lead to increases in the import penetration ratio itself. 2/ Obviously, many factors might influence the penetration of imports into a given country's domestic market: the general openness of the economy, changes in tastes, shifts in comparative advantage, and technological change, to name only a few. But standard trade theory would also lead us to conclude that the price of domestically produced goods relative to their imported substitutes should play a key role in determining the share of imports in domestic consumption. This relative price is, of course, the real exchange rate for these goods.

1/ See Bergsten and Cline (1983), p. 85, for example. This issue is explored in greater detail in Section IV.

2/ Of course, this issue is addressed indirectly by empirical studies of import demand functions.

Thus the approach of this paper involves the assumption that a real exchange rate appreciation can result in increased protection in a two-stage process. First, the appreciating real exchange rate leads to increases in import penetration beyond what would occur from the normal growth of international trade. Second, rising import penetration leads to increased demands for protection. This process is asymmetric in the sense that a depreciating real exchange rate is unlikely to lead to a decline in protectionism. 1/ The previously cited studies by Cline and others have established empirically the second stage of the process described above. The following section of this paper attempts to establish empirically the occurrence of the first stage, by estimating industry-level import penetration ratios as functions of industry-level real exchange rates and the level of a country's aggregate international trade.

III. Empirical Analysis

1. Countries and manufacturing industries examined

In order to examine empirically the determinants of the import penetration ratio, quarterly data from four manufacturing industries in three major industrial countries over the period 1963 to 1980 are used. 2/ The countries are the United States, the United Kingdom and the Federal Republic of Germany. These countries were chosen both because of their importance in international trade and because they experienced relatively large movements in their real exchange rates over this period, as measured by exchange rate-adjusted relative normalized unit labor costs in manufacturing. 3/ In addition, in all of these countries there has been an upsurge in protectionist sentiment over the past several years. 4/ The specific industries in the manufacturing sector that are considered in this paper are: transport equipment, textiles, clothing, and iron and steel. 5/ These industrial categories accounted for about 40 percent of world trade in manufactures in 1980 and have all been subject to protectionist pressures over the past decade. 6/

Charts 1 to 3 present annual data on industry import penetration ratios and real exchange rates. The data sources and the derivation of

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1/ *See Bergsten and Williamson (1983) and Corden (1984) for a discussion* of this issue, and Section IV below.

2/ Slightly shorter time periods are used for the U.K. iron and steel sector (1963-79), and the U.K. transport equipment sector (1963-75). For details see the Appendix.

3/ See Artus and Knight (1984), p. 11.

4/ See Cline (1983) for a discussion of recent developments in commercial policy.

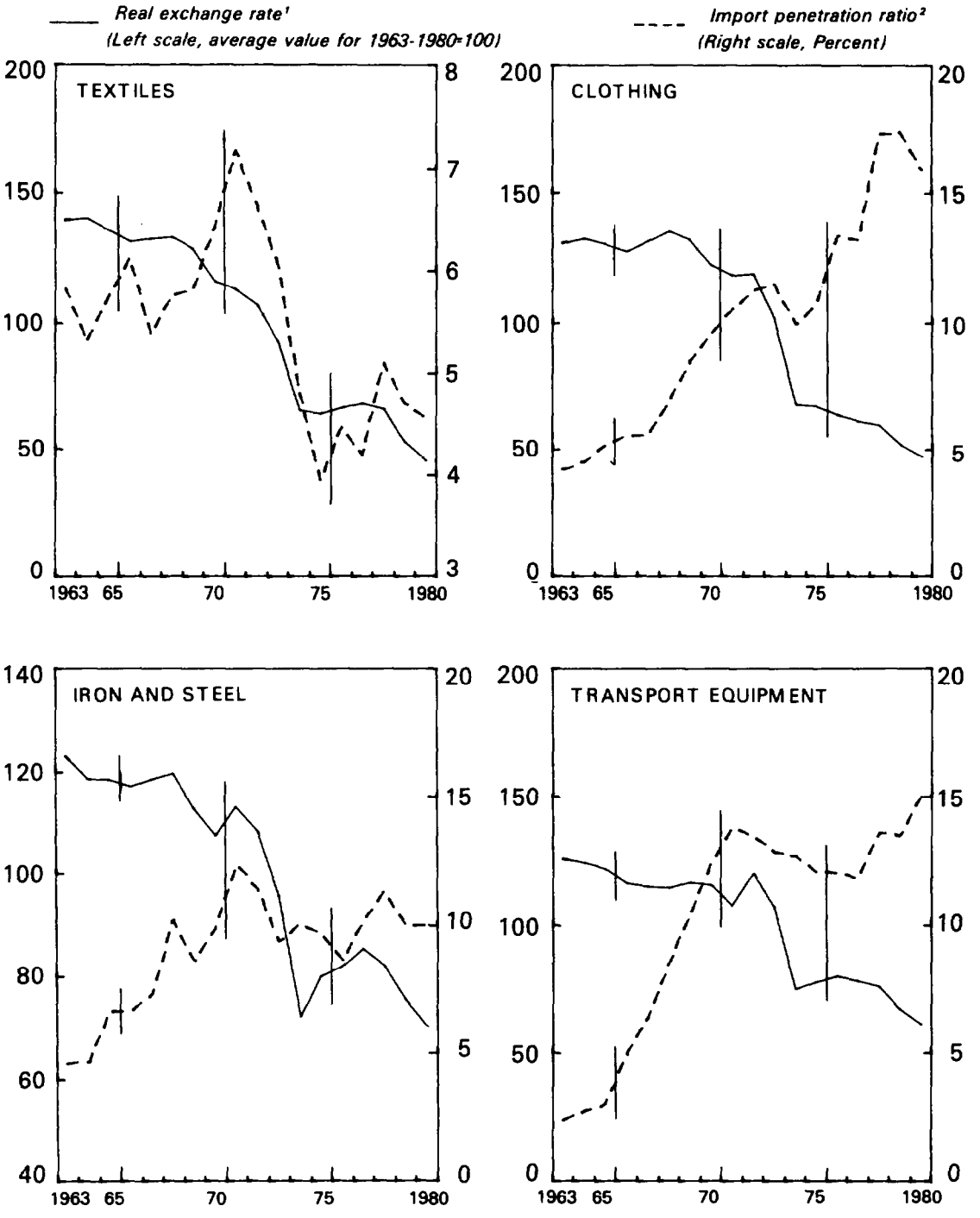
5/ These sectors are as defined at the 2-digit Standard International Trade Classification (SITC) level and the 3-digit International Standard Industrial Classification (ISIC) level.

6/ See Anjaria et al. (1982).

CHART 1

UNITED STATES

IMPORT PENETRATION RATIOS AND REAL EXCHANGE RATES BY INDUSTRY, 1963-80



Source: Staff estimates. See the appendix for notes on the data in this graph.

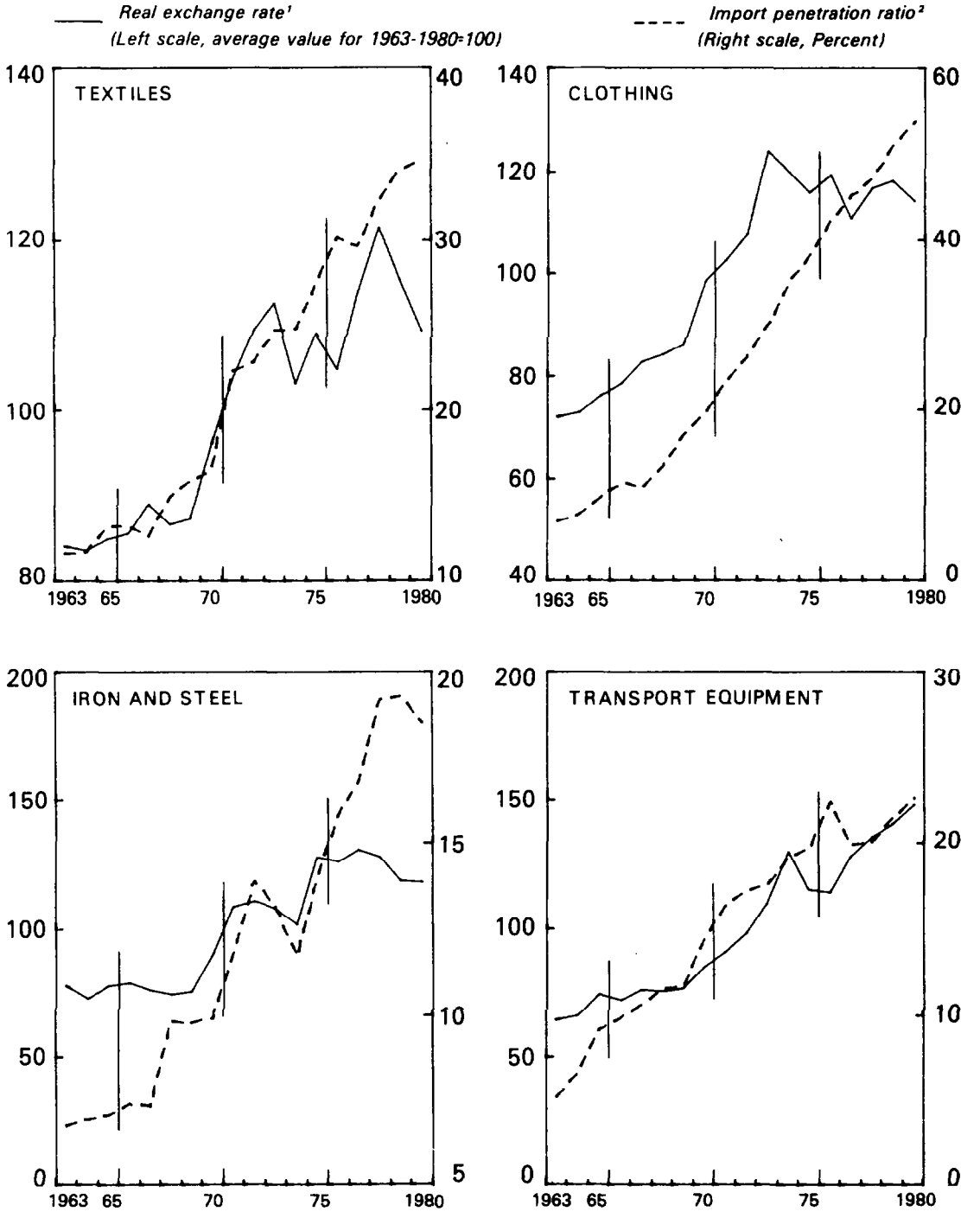
[1]The real exchange rates are defined as an index of the labor cost of a unit of domestic gross output in the industry divided by an index of the unit value of imports of those goods with all values converted to domestic currency. An increase thus represents a real appreciation.

[2]Import penetration ratios are real imports divided by apparent real consumption.

CHART 2

FEDERAL REPUBLIC OF GERMANY

IMPORT PENETRATION RATIOS AND REAL EXCHANGE RATES BY INDUSTRY, 1963-80



Source: Staff estimates. See the appendix for notes on the data in this graph.

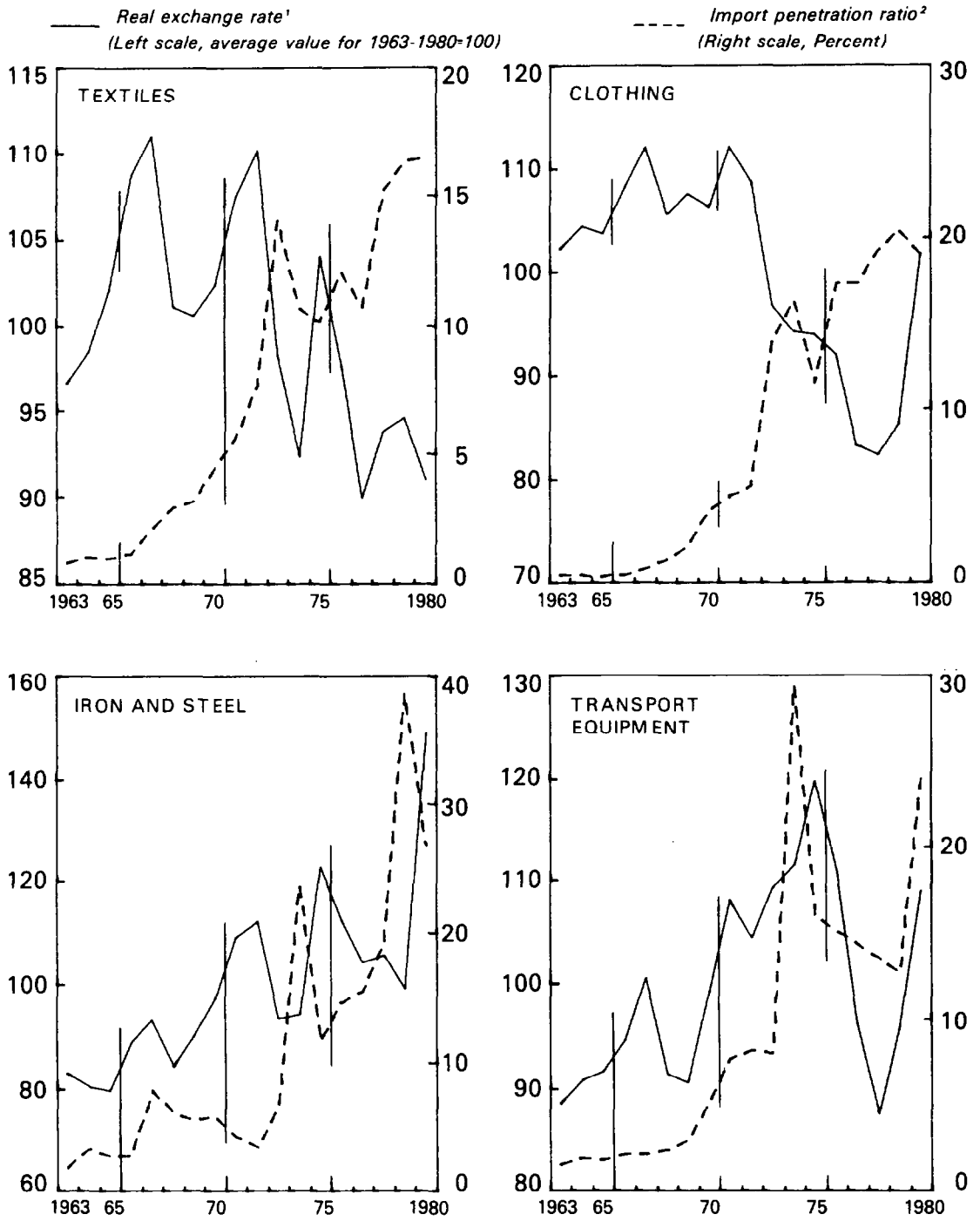
[1]The real exchange rates are defined as an index of the labor cost of a unit of domestic gross output in the industry divided by an index of the unit value of imports of those goods with all values converted to domestic currency. An increase thus represents a real appreciation.

[2]Import penetration ratios are real imports divided by apparent real consumption.

CHART 3

UNITED KINGDOM

IMPORT PENETRATION RATIOS AND REAL EXCHANGE RATES BY INDUSTRY, 1963-80



Source: Staff estimates. See the appendix for notes on the data in this graph.

[1]The real exchange rates are defined as an index of the labor cost of a unit of domestic gross output in the industry divided by an index of the unit value of imports of those goods with all values converted to domestic currency. An increase thus represents a real appreciation.

[2]Import penetration ratios are real imports divided by apparent real consumption.

the variables used in these charts are described in detail in the Appendix. In brief, industry-level real exchange rate indicators are defined as an index of the labor cost of a unit of gross output in the relevant domestic industry divided by an index of the unit value of imports of those goods, with all values converted into the domestic currency. Thus, a decline in the solid line of Charts 1 to 3 indicates a depreciation of the home country's real exchange rate for the relevant industry. The import penetration ratios used are equal to real imports in each sector divided by apparent real consumption, which is defined as gross production plus imports minus exports. The import penetration ratios are in real terms so that changes in the ratios represent changes in the volume of consumption accounted for by imports, and not just changes in the price of imports.

For all of the countries considered, import penetration ratios were generally increasing over this period, with the U.S. textile industry the only exception. As regards the measures of industry-level real exchange rates, the indicators for the United States were generally depreciating over the 1968-1980 period while those for Germany were generally appreciating. The real exchange rate measures for the United Kingdom fluctuated widely over this period but appear to have shown relatively less change on balance than in the other two countries.

Chart 4 and Table 1 present information on restrictions on international trade adopted by the United States, the United Kingdom, and Germany, in the industries under consideration during 1968-83. Casual inspection of the data on real exchange rates and import penetration ratios in Charts 1 to 3 and the information on NTBs in Chart 4 is not sufficient to arrive at a conclusion about the relationship between import penetration and protectionism. As noted in the preceding section, however, Cline (1984) and other studies have provided more formal evidence linking increases in the import penetration ratio with the implementation of protectionist measures. The next subsection of this paper develops a formal model linking movements in import penetration ratios to changes in indicators of real exchange rates at the industry level.

2. Estimates of the import penetration ratio and the real exchange rate

This subsection describes the hypothesized relationship between the real exchange rate and the import penetration ratio. It is assumed that the partial equilibrium level of the import penetration ratio for each industry, IP_j^*, is a function of the industry real exchange rate and the aggregate level of the country's international trade. Consumers in each country--including both final consumers and sectors that use the goods as intermediate inputs--are assumed to purchase one product, C_j, from each industry, j. Apparent consumption, C_j, consists of goods produced by foreign and domestic manufacturers as the goods M_j and D_j, respectively, where D_j is domestic production minus exports, or

$$C_j = D_j + M_j \text{ where } D_j = P_j - E_j. \qquad (1)$$

Table 1. List of Selected Restrictive Trade Actions of the United States, European Community, Germany, and the United Kingdom

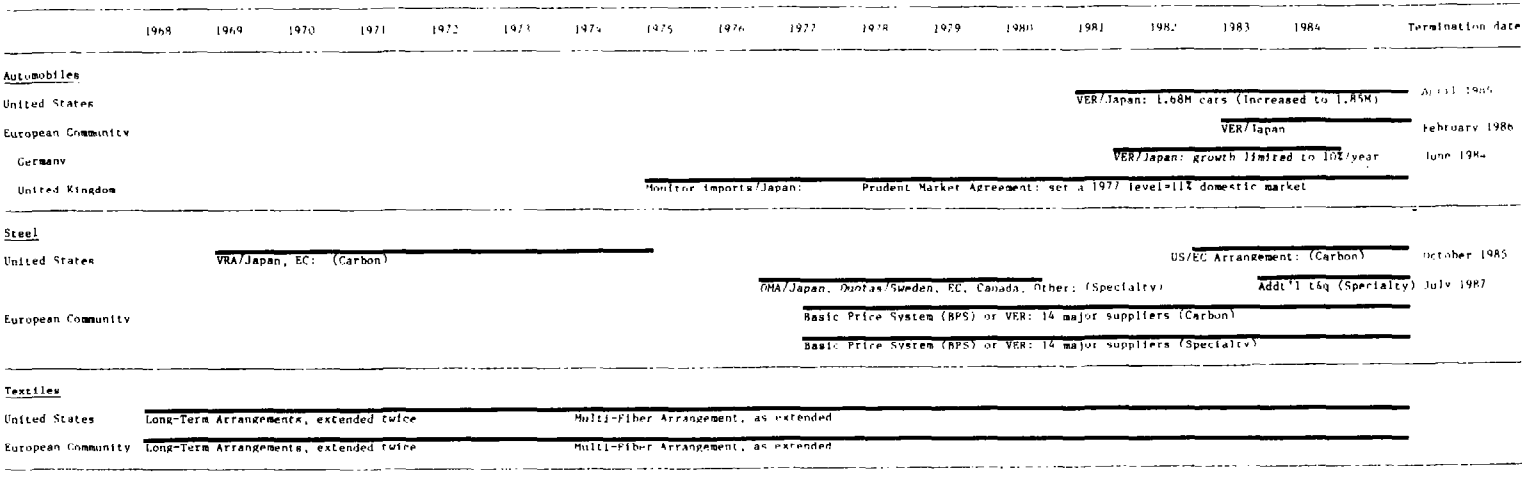
Products	Type of Action
(Actions in effect in 1980)	
United States	
Textiles and clothing	Bilateral quotas
High carbon ferrochromium	Safeguard 1/
Lag bolts, nuts, screws of iron or steel	Safeguard 1/
Specialty steel	Orderly marketing agreement/Bilateral quotas
European Community	
Textiles and clothing	Bilateral quotas
Steel	Voluntary export restraint
United Kingdom	
Automobiles	Voluntary export restraint
Yarn of synthetic fibers	Safeguard 1/
(Actions implemented from 1981-83)	
United States	
Automobiles	Voluntary export restraint
Certain steel products	Voluntary export restraint
Motorcyles	Safeguard 1/
Specialty steel	Safeguard 1/
European Community	
Steel (Korean)	Voluntary export restraint
Light commercial vehicles	Voluntary export restraint
Automobiles	Voluntary export restraint
Motorcycles	Voluntary export restraint
Forklift trucks	Voluntary export restraint
Germany	
Automobiles	Voluntary export restraint

Source: Annual Report of the President of the United States on the Trade Agreements Program, 1983, Table B-1.

1/ GATT Article XIX authorizes contracting parties to raise tariffs or impose other restrictions on imports of a product if the imports are in such increased quantitities or under such conditions as to cause or threaten serious injury to domestic producers. See Anjaria et al. (1982) for details.

CHART 4

SELECTED IMPORT RESTRICTIONS IN THE UNITED STATES, EUROPEAN COMMUNITY, GERMANY, AND THE UNITED KINGDOM



Key: BPS - Basic Price System
OMA - Orderly Marketing Agreement
t&q - tariffs and quotas
VER - Voluntary Export Restraint
VRA - Voluntary Restraint Agreement

Source: Annual Report of the President of the United States on the Trade Agreements Program, 1983, Table 7.

The partial equilibrium proportion of the total purchases of product j that domestic residents will satisfy through imports is assumed to be a function of the industry-specific real exchange rate indicator and the real level of the country's international trade, i.e.,

$$IP_j^* = \left(\frac{M_j}{C_j}\right)^* = f(R_j, T) \qquad (2)$$

where R_j is the real exchange rate for product j, and T is the trade variable. 1/ Other factors that influence the total domestic demand for the product are assumed not to be differentiated between foreign and domestic goods.

The trade variable, T, is the sum of real total imports plus total exports. This measure is similar to the measure of "real openness" devised by Beenstock and Warburton (1983). Their measure was real imports plus real exports, divided by real GNP. Beenstock and Warburton pointed out that this type of measure has the advantage of abstracting from terms of trade movements and responding only to changes in trade volumes. In the measure of real trade used in this study, real imports and exports are not divided by real GNP, since this term contains real net exports, which would be correlated with the real exchange rate variable. 2/

Equation (2) is assumed to represent a demand-determined relationship between the import penetration ratio, the real exchange rate, and the level of trade. The real exchange rate variable reflects the relative prices of domestic and imported goods, which are in turn functions of their relative costs to the domestic market. Such an approach makes the implicit assumption that the selling price of the domestic good is a given proportional markup over the labor cost of production. 3/ Of course, this specification also makes the simplifying assumption that movements

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1/ T does not have a subscript because it applies to aggregate trade and not just the industry's trade.

2/ Over a very long sample period it would be appropriate to scale T because IP is theoretically bounded from above by 1. However, in practice, as IP is actually measured (see, for example, data from the World Bank's Market Penetration System Data Base), it is not bounded from above because of the possibility that imports are added to inventory or are re-exported. Over the sample period examined, the relationship between IP and T is approximately log-linear. Estimation of the model using a scaled version of T did not produce significantly different results.

3/ Of course, restricting the indicator to labor cost alone misses other aspects of the cost of production. However, labor cost is a very important element in determining the overall cost structure and international competitiveness of the domestic industry. See Artus and Knight (1984) for a discussion of measures of the real exchange rate based on unit labor cost.

in each industry's real effective exchange rate are exogenous to the industry. Since the exchange rate is endogenous to the macroeconomy as a whole, this assumption is obviously a rather strong one, particularly in the longer run.

Although consumers are assumed to be indifferent as to the source of C_j, this does not necessarily imply that M_j and D_j must sell for the same price. As Goldstein and Khan (1984) have noted, a large number of empirical studies have shown that the "law of one price" does not appear to hold continuously within countries, even at disaggregated commodity levels. Aside from differences in quality, delivery dates, after-sales service and other factors, a given product need not be sold by two different suppliers for the same price in the short to medium term, since the prices reflect the cost conditions of their respective producers, with the exact relationships depending on the competitive structure of the industry. Of course, in a competitive market the low cost producer would eventually drive out all competitors. But it is important to note that this may not happen in a flexible exchange rate system where importers perceive that a foreign supplier's cost advantage (or disadvantage) is the temporary result of an overvaluation (or undervaluation) of the home country currency in real terms. Equation (2) is thus a composite function representing a relationship between the share of imports in total domestic consumption of product C_j and the relative price of domestically produced j to imported j; which is, in turn, a function of the costs of domestic producers relative to the cost of the imported substitute. 1/

Equation (2) is estimated in the form of a partial adjustment model with all variables, except dummies, as natural logarithms. 2/ It is assumed that domestic purchasers do not respond immediately to changes in their ex ante demand for imports relative to total consumption, because of adjustment costs associated with altering their sources of supply. Letting IP_t equal the actual import penetration ratio at time t (the j subscript is deleted below for notational simplicity), the change in the import penetration ratio is assumed to follow

$$\ln IP_t - \ln IP_{t-1} = \lambda [\ln IP_t^* - \ln IP_{t-1}] \qquad (3)$$

1/ Equivalently, equation (2) can be viewed as the reduced form relationship that summarizes both the supply and the demand functions for the share of imports in the domestic consumption of product C_j in the case where the elasticity of the supply of imports is assumed to be infinite. As noted by Goldstein and Khan (1984), it is relatively more plausible to argue that the elasticity of supply is infinite in the case of a country's imports than its exports.

2/ The issues associated with using this type of lag structure have been covered extensively in the literature, recently by Goldstein and Khan (1984). As noted in the next footnote, alternative specifications of the lag structure did not produce significant variations in the estimates, which suggests that the choice of a simple partial adjustment model has not unduly biased the results.

where λ is the coefficient of adjustment and IP_t^* is the desired value of the import penetration ratio. Corresponding to equation (2), IP_t^* is a function of the real exchange rate and the level of real trade,

$$\ln IP_t^* = \beta_0 + \beta_1 \ln T_t + \beta_2 \ln R_t \tag{4}$$

Substituting (4) into (3) and rearranging terms gives

$$\ln IP_t = \lambda\beta_0 + \lambda\beta_1 \ln T_t + \lambda\beta_2 \ln R_t + (1-\lambda) \ln IP_{t-1} \tag{5}$$

Equation (5) is estimated below in this paper. 1/ The hypotheses are that the signs of β_1 and β_2 are positive, while λ, the adjustment coefficient, is between 0 and 1. The coefficient β_2 is the elasticity of the import penetration ratio with respect to the real exchange rate. Using the definition of the import penetration ratio, imports divided by domestic consumption, β_2 is equal to the elasticity of imports with respect to the real exchange rate, minus the elasticity of domestic consumption with respect to the real exchange rate, or

$$\beta_2 = \varepsilon_m - \varepsilon_c. \tag{6}$$

Thus, the hypothesis that $\beta_2 > 0$ is equivalent to the hypothesis that $\varepsilon_m > \varepsilon_c$, assuming ε_m is positive. Alternatively, equation (6) can be expressed as

$$\beta_2 = (\frac{D}{C})\varepsilon_m - (\frac{P}{C})\varepsilon_P + (\frac{E}{C})\varepsilon_E \tag{7}$$

where ε_P and ε_E are the elasticities of domestic production and exports with respect to the real exchange rate. Thus the hypothesis that β_2 is positive is equivalent to the hypothesis

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1/ A more complex form of the model with equation (3) as

$$\Delta^2 \ln IP_t = \delta\lambda[\ln IP_t^* - \ln IP_{t-1}] - \delta\Delta \ln IP_t$$

where Δ is the difference operator was also estimated. This examination did not produce significantly different estimates of β_1 and β_2. This suggests that the specification of the adjustment process more simply as equation (3), which has a geometrically declining lag, has not significantly biased the estimates of β_1 and β_2. Similarly, forms of the model with equation (4) as

$$\ln IP_t^* = \beta_0 + \beta_1 \ln T_{t-1} + \beta_2 \ln R_{t-1}$$

and

$$\ln IP_t^* = \beta_0 + \beta_1 \ln T_t + \beta_2 \ln R_{t-1}$$

were also estimated and did not produce significantly different results.

$$\varepsilon_m > (\frac{P}{D})\varepsilon_P - (\frac{E}{D})\varepsilon_E \qquad (8)$$

The left-hand term, ε_m, is usually assumed to be positive. Table 2 gives a range of estimates available for the price elasticity of import demand in the United States, the United Kingdom, and Germany in SITC categories 5 through 9, which include the four manufacturing industries analyzed here. 1/ Furthermore, Table 3 presents some available information on estimates of the price elasticity of import demand in the 3-digit ISIC categories considered in this study. 2/ The information in these two tables reveals that in the long run the demand for imports in these categories is fairly responsive to changes in relative prices. However, such information does not necessarily imply that import demand is responsive to movements in real exchange rates. Artus and Knight (1984) estimated the elasticity of the import volume of manufactures with respect to a real exchange rate measure, relative normalized unit labor costs, in a number of industrial countries including the three examined here. They found that in both the short run (less than six months) and the long run, the responsiveness of imports to movements in relative normalized unit labor costs was estimated not to be very large, although positive.

On the right-hand side of equation (8), ε_E is usually assumed to be negative. 3/ The sign of ε_P is assumed to be negative. 4/ The rationale for this assumption is as follows. As their costs increase, domestic producers can either raise their prices or cut their profit margins. Because of price competition from imports, at least part of the impact of increased production costs falls on profit margins, and in the longer term, increases in domestic costs of production lead to declines in domestic production. However, regardless of the assumption about the sign of ε_P, equation (7) makes clear that the sign of β_2 is an empirical question. Traditional assumptions from trade theory concerning the response of imports and exports to real exchange rate movements do not automatically imply that the import penetration ratio will respond in a certain direction to exchange rate changes.

1/ The elasticities of import demand in Tables 2 and 3 are defined as negative numbers, whereas ε_m in the text is defined as a positive number. All elasticities in this paper are defined to carry their natural sign.

2/ As explained in the appendix, the 2-digit SITC categories and 3-digit ISIC categories called textiles, clothing, iron and steel, and transport equipment are the same except for very minor differences.

3/ The findings of Artus and Knight (1984), Table 2 support the assumption that ε_E, as defined here, is negative.

4/ The results reported by Deardorff, Stern, and Greene (1979), Table 5.2 support the assumption that ε_p, as defined here, is negative in the industries examined.

Table 2. Range and "Best" Point Estimates of Long-Run Elasticities of Demand for Imports in SITC Groups 5 to 9 by Country

	Range of Estimates	Best Point Estimate 1/
United States	-0.48 to -10.55	-1.84
United Kingdom	-0.66 to -6.00	-1.22
Germany	-1.68 to -3.23	-2.53

Source: Stern et al. (1976), Table 2.1.

1/ "Best" is defined by Stern et al. as the median of the range of estimates.

Table 3. Selected Range and 'Best' Point Estimates of Long-Run Elasticities of Demand for Imports in ISIC 3-Digit Groups

ISIC Category	Range of Estimates	Best Point Estimate 1/
United States		
Transport equipment	-2.34 to -6.00	-3.28
Iron and steel	-0.85 to -2.00	-1.42
Textiles	-0.99 to -1.92	-1.14
Clothing	-3.77 to -4.06	-3.92
United Kingdom		
Transport equipment	-1.37 to -3.00	-2.16
Iron and steel	-2.95 to -3.06	-3.00
Textiles	-1.30 to -2.06	-1.69

Source: Stern et al. (1976), Table 2.3.

1/ "Best" is defined by Stern et al. as the median of the range of estimates.

3. Estimation results

Equation (5) was estimated for each of the four industries and three countries in the study on the basis of a sample of 72 quarterly observations extending over the period 1963 to 1980. Estimates of equation (5), which are presented in Table 4, provide support for the hypothesis that increases in import penetration are positively related to appreciating real exchange rates. All variables, except dummy variables, are in the form of natural logarithms. These 12 equations were independently estimated, using a nonlinear estimation technique for iterative minimum distance estimation as implemented by Berndt, Hall, Hall, and Hausman (1974). 1/ Three seasonal dummies were used in the estimations, although these coefficients have been omitted from Table 4. There was no evidence of significant serial correlation and thus no correction was made for it. 2/

In 8 out of 12 individual cases the coefficient β_2 has the expected positive sign and is significant at least at the 10 percent level. In another 3 cases β_2 has its expected positive sign but is not statistically significant. The evidence of a link between the real exchange rate and the import penetration ratio is most persuasive in the cases of the United States and Germany. 3/ For the United Kingdom the link is, in general, less evident. In addition, the estimates of equation (5) provide very strong evidence that increases in import penetration are related to the level of the country's international trade. In all 12 cases, the sign of β_1 is positive at statistically significant levels.

On the right-hand side of Table 4 there is information on adjusted R^2's for each equation. The first column, entitled "levels," shows the portion of the total variance of the levels of the import penetration ratio that the estimated equations are able to explain. Based on F statistics, these equations are all significant at the 1 percent level. The second column, entitled "changes," contains adjusted R^2's for a version of each equation in which the dependent variable is the change in ln IP at time t. The R^2's based on changes in the dependent variable provide an indication of the portion of the variance of changes in the import penetration ratio that the estimated equations are able to explain. 4/ Based on F statistics, the equations are all significant at the 1 percent level except for the U.S. transport equipment industry which is significant at the 5 percent level.

1/ Quadratic interpolation was used as the search method for determining the parameter step size at each iteration.

2/ The tests for autocorrelation were based on the h-statistic and the Durbin-Watson bounds test.

3/ The tests in this paper do not establish "causality" between the variables. However, it seems unlikely that increasing import penetration would cause the real exchange rate to appreciate.

4/ See Boughton (1984) for a similar use of adjusted R^2's for levels and changes.

Table 4. Estimated Import Penetration Equations
Time Period: Q1 1963 - Q4 1980

$$\ln IP_t = \lambda\beta_0 + \lambda\beta_1 \ln T_t + \lambda\beta_2 \ln R_t + (1-\lambda) \ln IP_{t-1}$$

	Estimated Coefficients					Equation Statistics	
	λ	β_0	β_1	β_2	Dummy 2/ Variables	R^2 (levels)	R^2 (changes)
United States							
Textiles	0.320 (3.94)	-5.458 (2.75)	0.585 (2.68)	0.845 (4.06)		0.787	0.342
Clothing	0.395 (4.96)	-5.479 (4.56)	1.475 (10.87)	0.300 (2.34)		0.971	0.323
Iron and steel	0.279 (3.78)	-9.810 (3.16)	1.170 (4.82)	1.410 (3.17)		0.882	0.282
Transport equipment	0.105 (2.90)	-15.806 (2.89)	2.110 (4.36)	1.856 (2.52)		0.983	0.105
Germany							
Textiles	0.257 (4.29)	-3.779 (2.76)	0.768 (5.40)	0.792 (1.89)		0.986	0.602
Clothing	0.386 (5.67)	-3.627 (6.10)	1.455 (11.34)	0.187 (0.81)	-0.071 (3.13)	0.996	0.669
Iron and steel	0.192 (2.83)	-3.490 (3.55)	0.409 (1.69)	0.907 (2.26)		0.977	0.381
Transport equipment	0.434 (5.02)	-4.437 (3.98)	0.789 (3.11)	0.925 (1.92)	-0.138 (3.63)	0.955	0.621
United Kingdom							
Textiles	0.267 (3.88)	-39.065 (5.73)	4.894 (15.28)	4.243 (3.31)		0.983	0.294
Clothing	0.570 (5.45)	-31.222 (3.44)	7.036 (10.62)	0.568 (0.38)		0.899	0.316
Iron and steel 1/	0.470 (4.71)	-6.815 (1.76)	4.250 (5.85)	-2.262 (1.81)		0.762	0.353
Transport equipment 1/	0.321 (3.10)	-24.121 (3.81)	4.479 (3.71)	1.602 (0.72)		0.930	0.290

The numbers in parentheses are the ratio of the parameter estimate to the standard error for that parameter and are asymptotically normally distributed. All variables are defined as natural logarithms. These equations were estimated with seasonal dummies which are omitted from this table.

1/ The time period for the U.K. iron and steel industry is Q1 1963 to Q4 1979. The time period for the U.K. transport industry is Q1 1963 to Q1 1976.

2/ These dummy variables are to take account of restrictive trade actions that occurred during the sample period and other special factors. See the Appendix for details.

Table 5 presents information on the mean time lag of the response of the import penetration ratio, that is the time required for just over 60 percent of the adjustment to be completed, along with estimates of the long- and short-run elasticities with respect to the real trade variable and the real exchange rate. With regard to the mean lags, Goldstein and Khan (1984) reported that studies of import demand equations, using Koyck-type lag structures, have found that most of the adjustment to price changes occurs within about four quarters. The median lag of the equations in Table 4 is about 6 months, so these results are basically consistent with earlier empirical work.

Artus and Knight (1984) estimated impact and long-run elasticities of import volume with respect to relative normalized unit labor costs for the United States, Germany, and the United Kingdom, using semi-annual data. While equation (7) makes clear that β_2 is not the same as the elasticity of demand for imports with respect to the real exchange rate, the difference between these two measures will be small if total domestic consumption is not very responsive to changes in the real exchange rate. The results reported in Table 5 for the United States and Germany are similar to those reported by Artus and Knight, while the results for the United Kingdom in Table 5 are, in general, larger in absolute value.

For the United States, the results in Table 4 strongly support the hypothesis that the real value of trade and the real exchange rate are significant determinants of the import penetration ratio at least for these industries. Based on two-sided tests for the significance of "t-statistics," the coefficients for β_1 are all significant at the 1 percent level as are the β_2 coefficients for the textiles and iron and steel industries. 1/ The β_2 coefficients for the clothing and transport equipment industries are significant at the 5 percent level.

As discussed earlier, Cline (1984), in a study of the United States, found a significant relationship between the import penetration ratio and protectionism. Thus the evidence in Table 4, taken in conjunction with that in the Cline study, tends to support the hypothesis that industry-level real exchange rate appreciations may indeed result in increased protectionism in the United States. However, the results also suggest that the growth and increasing openness of U.S. trade can lead to increases in import penetration even if the real exchange rate is depreciating. Section IV uses the empirical results for the United States transport equipment industry in Table 4 to illustrate the effects of a hypothetical trade restriction.

For Germany, the results in Table 4 also support, although not as strongly, the hypothesis that the real level of international trade and the real exchange rate are significant determinants of the import

1/ The statistic that is referred to as the "t-statistic" is, in fact, asymptotically normally distributed.

Table 5. Mean Lags and Long- and Short-Run Elasticities

	Mean Lag 1/ (quarters)	Real Trade Variable 2/		Real Exchange Rate 2/	
		Long Run	Short Run	Long Run	Short Run
United States					
Textiles	2.1	0.585	0.188	0.845	0.271
Clothing	1.5	1.475	0.583	0.300	0.119
Iron and steel	2.6	1.170	0.327	1.410	0.394
Transport equipment	8.5	2.110	0.222	1.856	0.195
Germany					
Textiles	2.9	0.768	0.197	0.792	0.203
Clothing	1.6	1.455	0.562	0.187	0.072
Iron and steel	4.2	0.409	0.079	0.907	0.174
Transport equipment	1.3	0.789	0.342	0.925	0.401
United Kingdom					
Textiles	2.7	4.894	1.306	4.243	1.132
Clothing	0.8	7.036	4.007	0.568	0.324
Iron and steel	1.1	4.250	1.997	-2.262	-1.063
Transport equipment	2.1	4.479	1.436	1.602	0.514

Source: Table 4.

1/ The formula for the mean time lag is $(1-\lambda)/\lambda$.

2/ The short-run elasticities are $\lambda\beta_i$ and the long-run elasticities are β_i. The short-run elasticity shows the percentage change in the import penetration ratio during the first quarter for a given percentage change in an independent variable. The long-run elasticity gives the total percentage change in the import penetration ratio after all adjustment has taken place.

penetration ratio. 1/ In two of the German industries dummy variables were used to account for special factors. In the case of the clothing industry, the special factor was the Multi-Fiber Arrangement that went into effect on January 1, 1974. In the case of the transport equipment industry the special factor was rising oil prices. 2/ The significance of the positive sign of β_2 in the transport equipment industry is dependent on the inclusion of this dummy variable. Cline (1984) found a statistically significant relationship between the import penetration ratio and protectionist actions in Germany. Thus, as in the case of the United States, the results in Table 4 tend to support the hypothesis of a positive relationship between the real exchange rate and protectionism.

For the United Kingdom, the results in Table 4 do not provide much support for the hypothesis that the real exchange rate is a determinant of the import penetration ratio. 3/ Only in the textile industry is the sign of β_2 significantly positive (at the 1 percent level). In contrast, the level of British trade does appear to be an important determinant of the industry import penetration ratios. The β_1 coefficients are all significant at the 1 percent level. The failure to uncover a significant link between industry-level real exchange rate movements and import penetration at the industry level may be due to data problems that were encountered in this case. Alternatively, as can be seen from Chart 3, the British industry-level real exchange rates showed relatively less change over the sample period compared to the United States and Germany and this may have complicated the estimation procedure. Interestingly, Cline (1984) did not uncover a significant link between British NTBs and import penetration, although the estimated relationship was positive.

IV. Some Policy Implications

Besides tending to confirm the hypothesis that, at the industry level, an appreciating real exchange rate will lead to increases in import penetration, the empirical estimates in the previous section also provide support for the hypothesis that the growth of international trade and the associated increase in the openness of industrial countries are important determinants of the import penetration ratio. These estimates emphasize that rising import penetration is a natural part of growing international trade and not a problem that must be tackled with trade restrictions. These results also imply that economies experiencing an

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1/ The "t-statistics" for β_1 are significant at the 1 percent level except in the iron and steel industry, where the significance level is 10 percent. For β_2, the coefficient is significantly different from zero at the 5 percent level in the iron and steel industry and at the 10 percent level for the textiles and transport equipment industries.

2/ See the Appendix for further details on the dummy variables.

3/ For the iron and steel industry and the transport equipment industry the estimation periods were somewhat shorter than in the other cases. See the Appendix for details.

appreciating exchange rate and rising protectionism will not necessarily see protectionist pressures end should the exchange rate begin to depreciate.

The results of the previous section also suggest that in many cases the net effect of an overvalued exchange rate may be a decline in the profitability and level of output of the country's export sector. The initial effect of an overvalued exchange rate may be to harm both the import-competing and export sectors. However, as described in this paper, the import-competing sector may be able to obtain protection from the adverse effects of the overvaluation. If, as Clements and Sjaastad (1984) argue, the cost of the protection falls as a tax on exporters, the export sector may suffer from a kind of "double punch."

As noted in Section I, trade restrictions designed to limit increases in import penetration resulting from a real appreciation of the domestic currency often take the form of quantitative limits rather than import duties, because the effective protection provided to a domestic industry by a quantitative restriction increases as the domestic currency continues to appreciate in real terms, whereas the effective protection delivered by a tariff decreases. Thus the relative importance of such nontariff trade barriers is likely to increase in the future, particularly given the commitment of the Tokyo Round to reducing tariff barriers against manufactures to modest levels. This suggests that it is important to refine quantitative techniques for estimating the effects of NTBs.

This section illustrates how estimates such as those presented in Table 4 might be used as a tool for examining the effects of a quantitative limitation on imports. Specifically, the present analysis shows that it is possible to estimate the "shadow" real exchange rate associated with any given level of quantitative trade restrictions by solving the estimated equation (5) for the level of the real exchange rate given a fixed import penetration ratio. Comparison of the actual exchange rate with the (depreciated) shadow exchange rate then gives a quantitative impression of the economic effect of the quota. For example, suppose that in the fourth quarter of 1980 a decision had been taken to limit the penetration of imports into the U.S. transport equipment industry to 10 percent of the domestic market for the next five years (the actual penetration of imports in the fourth quarter of 1980 was about 14.5 percent in this industry). In this example, the year 1980 was chosen because it coincides with the end of the estimation period for the results in Table 4 and it enables one to examine what the effects of the trade restriction would have been over the last four years. Although this restriction is hypothetical, it is roughly analogous to the proposed Fair Trade in Steel Act of 1984. In the debate in the U.S. Congress, this Act was proposed to limit U.S. carbon steel imports to 15 percent of the domestic market for five years, compared to an actual ratio of 20 1/2 percent in 1984. 1/

1/ The New York Times, August 23, 1984.

Using the estimated equation (5) for the U.S. transport equipment industry, an implied value of the real exchange rate over the period 1981 to mid-1984 can be derived based on the assumption that the import penetration ratio is held fixed at 10 percent. The shadow exchange rate is then extrapolated from 1980 to 1984 on Chart 5 against an estimated measure of the actual movement of the real exchange rate for the industry over this period. This experiment suggests that at first the trade restriction would have had little effect on the real exchange rate, as the recession in the United States led to a decline in the demand for imports. However, after early 1983 the continuing real appreciation of the U.S. dollar and strengthening of the U.S. economy would have caused the demand for imports to increase, and the import restriction would have corresponded to a depreciating real exchange rate for the transport equipment industry. By mid-1984 the shadow real exchange rate implied by the trade restriction is estimated to be about 25 percent below the level it actually held without the restriction.

If it is assumed that the trade restriction is imposed in a sector for which home country consumption is small relative to the size of the total market, then the restriction would cause a corresponding increase in the domestic price of the good. As is well known, the higher domestic selling price would result in economic rents being generated for domestic producers, and for those foreign producers that were allowed to to fill the quota. Given that the actual value of the real exchange rate appreciated from 1980 to 1984 in Chart 5, the rent generated for domestic producers would have gradually risen to the equivalent of as much as 25 percent of the labor cost of gross output in mid-1984.

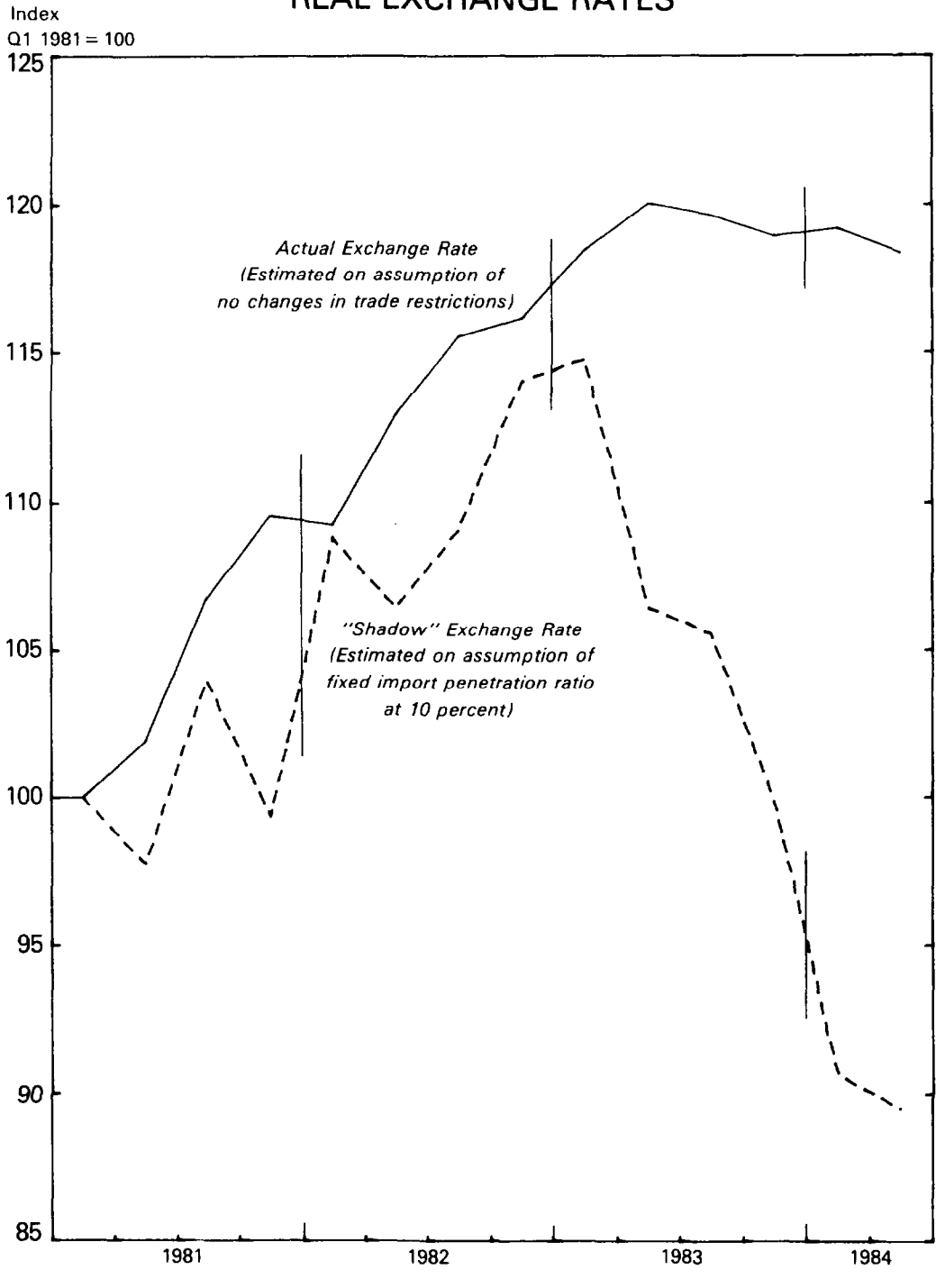
The short-run effect of the limitation on import penetration in the U.S. transport equipment industry can be simply illustrated. Chart 6 presents a partial equilibrium picture of this industry in the short run. The initial price of the good is P_0. 1/ At this price, domestic consumption would be C_0 and domestic production, D_0. The import penetration ratio would be $IP_0 = (C_0 - D_0)/C_0$. The trade restriction is to set IP_1 equal to a constant less than IP_0. Given the supply and demand conditions in Chart 6, this implies C_1, and D_1, and the internal price rises to P_1 for the given external price P_0. 2/ Thus in the short run, the quantitative restriction bestows economic rents on domestic producers whenever $IP_1 < IP_0$. That is, as the domestic selling price rises so do the sizes of the rents resulting from the quantitative restriction on imports. The estimate of the economic rent accruing to domestic producers in the short run is equivalent to the area $P_1 ABP_0$ in Chart 6.

1/ The initial prices of the imported and domestic goods are assumed to be the same.

2/ Of course, the demand and supply conditions could be such that an import penetration ratio implied several different possible combinations of C, D and P.

CHART 5

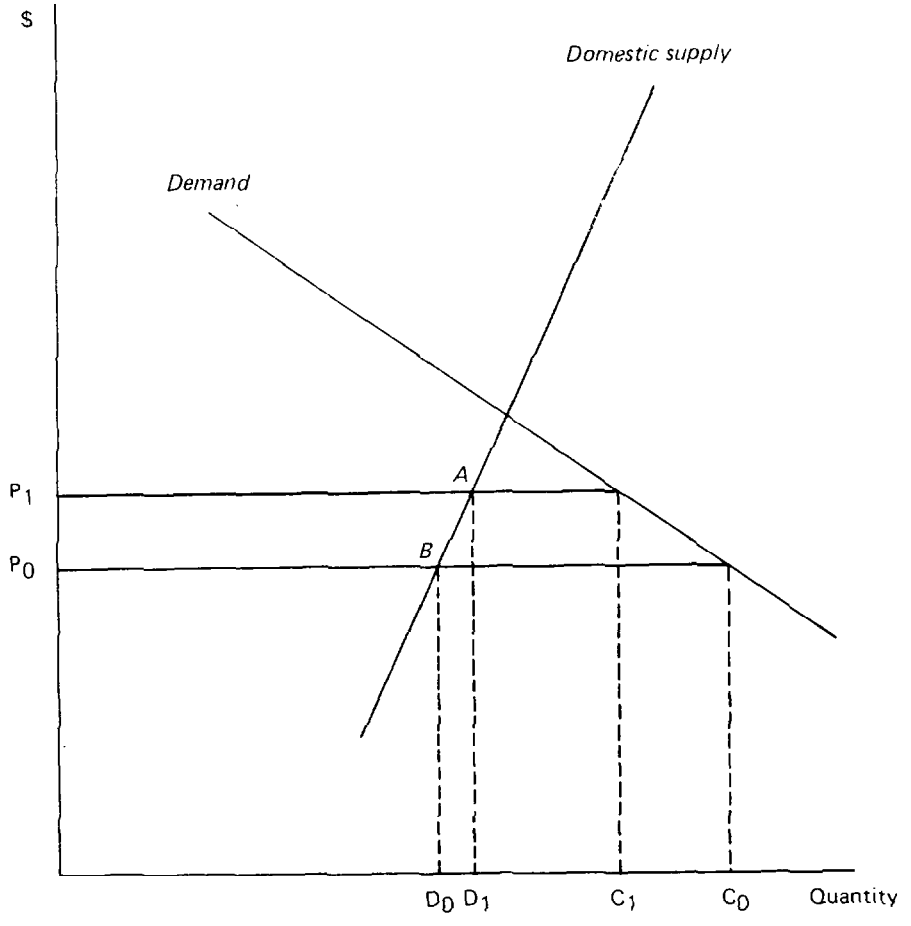
U.S. TRANSPORT EQUIPMENT INDUSTRY-ESTIMATED REAL EXCHANGE RATES[1]



[1]The real exchange rates are defined as an estimate of unit labor cost in the industry divided by the unit value of imports of those goods with all values converted to domestic currency. See the appendix for notes on the data in this graph.

CHART 6

AN ILLUSTRATION OF A RESTRICTION ON IMPORT PENETRATION



The quantitative restriction causes the domestic selling price of imports to rise (it is assumed to remain fixed externally) allowing domestic producers to raise their prices, although by less than the rise in the price of imports, and capture a larger share of the domestic market. The quantitative restriction allows domestic producers to earn economic rents although the rents may decline in the long run, depending on the cost structure and conditions of entry into the industry.

It must be stressed that the above exercise is only meant as an illustration and not as an analysis of any actual or proposed U.S. trade policy. 1/ Nonetheless, it is interesting to compare the example with the history of the voluntary restraints on Japanese automobile exports to the United States that took effect in 1981. 2/ This program limited exports of Japanese passenger cars to the United States to a rate about 8 percent below their 1980 level. Following the imposition of this restraint, U.S. automobile producers were able to increase their profits to record levels in 1983. The sales volume for the domestic auto industry in 1983 was similar to that in 1980, a year when the industry had incurred large losses.

The estimates of the elasticities of the import penetration ratio with respect to the real exchange rate in Table 5 provide some indication of where the greatest economic rents would be generated by quantitative restrictions. The more inelastic the relationship between the real exchange rate and the import penetration ratio, the more a given quantitative restriction on import penetration will cause a divergence between external and internal prices. The estimates for the United States and Germany suggest that the economic rents generated over the long run by a quantitative restriction would likely be the greatest in the textile and clothing industries. 3/

It is also possible to examine how the economic rents generated for domestic producers in the industry would accrue to the various factors of production. If it is assumed that capital is not mobile between the various industries, then the return to capital rises in the industry with the trade restriction and falls in other industries. 4/ If labor is mobile between industries, wages fall relative to prices in the industry

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1/ This particular industry was chosen for the example because it is a case where the effects of the import restrictions are egregious. In some other cases, a restriction on import penetration might have had little effect over the 1981 to mid-1984 period.

2/ The discussion of the restraints on Japanese automobile exports to the United States is based on International Monetary Fund document SM/84/178, Supplement 1. The illustration is based on the entire transport equipment industry and not just automobiles; and the example's decline in imports is much larger than actually occurred in the automobile industry.

3/ This assumes that cost structures and conditions of entry are the same across countries and industries.

4/ See Mussa (1984) for details.

with the restriction and rise relative to prices in other industries. If labor in the restricted industry has some monopoly power, then it can increase the degree to which it shares in the rents that accrue to domestic producers.

Finally, it is interesting to note that the empirical estimates in the previous section are at least broadly consistent with the popular view that exchange rate volatility can lead to a steady increase in protectionist pressure, even if the average level of a country's real exchange rate does not appreciate over time. This can happen because although an appreciation of an exchange rate may lead to protectionist actions, a depreciation is unlikely to result in moves to dismantle existing impediments to trade. If this is the case, real exchange rate fluctuations may lead to the absolute level of protection ratcheting continually higher even if the level of the real exchange rate shows little change in the long run. 1/ The effects of exchange rate volatility on protectionism have been discussed elsewhere but usually with the relationship described somewhat differently. For example, Anjaria et al. (1982) discussed the possibility that increasing exchange rate volatility may lead firms to experience difficulties competing internationally because of rapid shifts in exchange rates. 2/ In the struggle to survive these firms may seek protection from imports.

V. Summary and Conclusions

This study provides evidence on the existence of a positive relationship between the import penetration ratio and the real exchange rate in individual manufacturing sectors for several major industrial countries. This evidence is useful because, in conjunction with the work of Cline (1984) and others, it tends to confirm empirically the existence of a link between real exchange rate movements and protectionism. As noted in Section II, little empirical evidence on this topic has been forthcoming except for anecdotal reviews of trends in commercial policy. The estimates in Table 4, in general, support the arguments of Anjaria et al. (1982), Bergsten and Williamson (1983), and Corden (1984), among others, that an appreciating real exchange rate can lead to protectionist pressures. It must be stressed, however, that while the estimates in Table 4 suggest that exchange rate developments may explain some of the pressure for protection, these developments do not justify either generalized or sectoral protection. In addition, given the recent drift toward protectionism, any extrapolation based on past trends in the association between import penetration and protectionism may not hold in the future. Protectionist measures in the industrial countries, being the outcome of policy deliberations, are not influenced in a mechanical way by the import penetration ratio or any other variable.

1/ The "ratchet" effect discussed here is also described in Bergsten and Williamson (1983) and Corden (1984). A formal test of this hypothesis is not attempted here or in the two cited works.

2/ Bergsten and Cline (1983) made a similar argument.

This study also demonstrates that it is possible to develop simple quantitative estimates of the effects of NTBs, and to assess their implications for the rents generated in specific industries. Further work in this area is extremely important if policymakers and consumers in the industrial countries are to be convinced of the harmful effects of NTBs.

Data Sources and Definitions

This appendix provides further details on the sources of the data used in this study and the methods employed to calculate the industry real exchange rates and import penetration ratios. The real exchange rate indicators for each industry were constructed by using data on labor costs in the International Standard Industrial Classification (ISIC) categories:

321 Textiles;
322 Wearing apparel, except footwear;
371 Iron and steel basic industries; and
384 Transport equipment.

Index numbers for the labor cost of a unit of gross output (LCU) in local currency were derived from data on labor cost and production in various issues of United Nations, Yearbook of Industrial Statistics, Vol. 1--General Industrial Statistics. Industry specific data were available only on an annual basis. The yearly data were benchmarked using the procedure of Denton (1971) to form quarterly data. The benchmark series were data on normalized unit labor costs for each countries' entire manufacturing sector.

Each LCU index series was divided by an index series estimate of the unit value of imports in that industry. For the United States, the unit value of imports was an aggregate measure from International Financial Statistics. For Germany, data on import unit values in the Standard International Trade Classification (SITC) categories 6, 7, and 8 were used. These data were taken from Federal Statistical Office, Foreign Trade Series 5, Special Trade According to the Classification for Statistics and Tariffs. For the United Kingdom, data on import values in disaggregated SITC sectors from Central Statistical Office, Monthly Digest of Statistics were used for years after 1971. Before 1971, data on the aggregate unit value of imports from International Financial Statistics were used.

The import penetration ratios were calculated as real imports divided by real domestic consumption, which is defined as gross output minus exports plus imports. The trade data cover the SITC Revision I categories:

65 Textile, yarn, fabrics, etc.;
84 Clothing;
67 Iron and steel; and
73 Transport equipment.

These categories are equivalent to the previously mentioned ISIC categories except for very minor differences. Annual trade data from the OECD's Trade Series C were used in forming the import penetration ratios. These data were benchmarked to form quarterly data using the procedure of Denton (1971). The benchmark data were quarterly trade data from the previously mentioned German and British statistical publications and the OECD's Trade

Series A. In the case of the United Kingdom, the quarterly import penetration ratios for the iron and steel industry in the year 1980 and for the transport equipment industry in the years 1976-78 proved unreliable; hence they were omitted from the estimations in Table 4. Estimations for these two industries using annual data over the period 1963-80 did not produce significantly different results from those reported in Table 4. In Chart 3 the graph of the import penetration ratio for the transport equipment industry is interpolated between 1975 and 1979. The data on production for all three countries were taken from the previously mentioned United Nations publication and the OECD's Indicators of Industrial Activity.

The trade variable used is an index series of the volume of merchandise imports plus exports. The data were taken from International Financial Statistics.

Dummy variables were used in two of the estimated equations for Germany. In the clothing industry a dummy variable was used to account for the Multi-Fiber Arrangement (MFA) that went into effect on January 1, 1974. Before that date the dummy is equal to one and afterwards it is equal to zero. In the transport equipment industry a dummy variable was used to account for rising oil prices. The dummy equals zero until Q4 1973. Afterwards it is equal to one except in Q3 1978, Q3 1979, and Q2 1980 to Q4 1980, when it equals two.

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