UNITED STATES IMPORTS, 1947–1958

BY LAWRENCE B. KRAUSE

United States imports of manufactured products during the period 1947 to 1958 are examined in order to investigate the importance of changes in relative prices, ad valorem tariffs, and domestic production as explanatory variables. A cross section technique using first differences of product data over time is employed. Calculations were made after some stratifications of the data in order to illuminate additional aspects of the problem. Variable time lengths were used in the estimating process in an effort to evaluate the effect of time itself on the parameter estimates and also to determine whether peculiarities exist with respect to the particular years involved. The results were interpreted as reflecting institutional changes that have occurred in United States trade policy during this period.

1. INTRODUCTION

The discussions of commercial policy in the United States within recent years have become increasingly concerned with questions of a quantitative nature. The advisability of lowering (or raising) tariffs to a large extent has been determined by what was thought to be the impact of such a reduction on the resulting level of imports. While the impact of changes in U.S. policy on other countries has of course also received great attention, the degree to which a proposed tariff concession will affect the sales of domestic industries seems to have been of commanding importance. Over seventy industries sent one or more representatives to present evidence before the Committee on Ways and Means, House of Representatives in 1958 when the renewal of the Trade Agreements Act was under consideration [17]. Most of these witnesses presented estimates of the consequences of the legislation for the sales of their industry. Furthermore the employment effect of increased imports has received much emphasis in appraising the significance of import changes and was therefore weighed in the policy decision. A great deal of testimony was taken concerning the loss of jobs directly attributable to imports, on the one hand.

This paper represents the first report of research being conducted at the Cowles Foundation for Research in Economics at Yale University. I wish to acknowledge the advice and suggestions that I have received from Harold Watts and Andrew Bain. Helen Stone and Mrs. Karen Hester assisted in gathering data and John Arena in making computations.
hand, and the dependence of American workers on exports, on one hand. This issue must be of great concern to the legislators who must after all defend their actions to the electorate.

The three thousand pages of hearings in 1958 suggest that there is no lack of quantity of evidence; however, the usefulness of the material can be seriously questioned. Most of the testimony is in the form of subjective determinations of people closely associated with a particular industrial situation who have attempted to generalize from their experience to conclusions applicable to the economy as a whole. It was only with the path-breaking efforts of Piquet [6] that any intensive empirical research was devoted to the general effects of a tariff reduction. Within recent years, there have been some efforts made in a more sophisticated manner to determine the employment effects of import changes by Salant [7,8,9] and Vaccara [19,20]. This paper is an attempt to increase the growing body of empirical knowledge concerning American imports.

2. U.S. IMPORTS AND GNP

The study was conducted for the purpose of attempting to explain the major determinants of competitive manufactured product imports into the U.S. since World War II. It is generally believed that imports now pose a much greater "threat" to domestic industries of the United States than they did a decade ago. This is true despite the fact that aggregate imports of merchandise as a per cent of gross national product have not shown a noticeable upward drift (Table I).

<table>
<thead>
<tr>
<th>Year</th>
<th>Ratio</th>
<th>Year</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>2.92%</td>
<td>1953</td>
<td>2.98%</td>
</tr>
<tr>
<td>1959</td>
<td>3.19%</td>
<td>1952</td>
<td>3.09%</td>
</tr>
<tr>
<td>1958</td>
<td>2.93%</td>
<td>1951</td>
<td>3.33%</td>
</tr>
<tr>
<td>1957</td>
<td>2.93%</td>
<td>1950</td>
<td>3.11%</td>
</tr>
<tr>
<td>1956</td>
<td>3.01%</td>
<td>1949</td>
<td>2.57%</td>
</tr>
<tr>
<td>1955</td>
<td>2.86%</td>
<td>1948</td>
<td>2.75%</td>
</tr>
<tr>
<td>1954</td>
<td>2.81%</td>
<td>1947</td>
<td>2.46%</td>
</tr>
</tbody>
</table>


The ratio of imports to gross national product does fluctuate directly with the state of business in the United States reflecting an income propensity to import of greater than one. This fluctuation, however, has remained around a mean value of 3 per cent for other than the artificially low early
postwar years. The increased fear of imports must arise from the fact that the growth of imports has been concentrated in relatively few industries rather than proportionally across our entire productive structure. The tendency toward structural concentration of imports has not only occurred as between industries, but also quite markedly as between different products of the same industry. This suggests that there is some benefit to be gained by studying imports on a disaggregative basis, e.g., using product information as the basic data. It was hoped that an explanation would be forthcoming as to why some products have resisted the inroads of foreign competition while others have succumbed. The fact that the product is also the decision level for tariff making also provides some additional justification for a disaggregative approach. More specifically, the study was undertaken in order to ascertain the importance of some of the major variables determining the changes in United States imports from 1947 to the present (1958 is the most recent year for which complete data are available).

Large import gains have been recorded among primary products as well as manufactured goods. The decision to narrow the investigation to competitive imports of manufactured goods stems from the fact that it is in this area that the most spectacular gains have occurred and would be the most sensitive to changes in commercial policy. Furthermore, there are certain restrictions in the market that prevent a general analysis from providing sensible explanations for imports of strictly agricultural or extractive products. The quota limitations on most major crops as part of the all encompassing U.S. agricultural policy plus similar barriers on certain primary extractive products make inoperative the normal market forces that usually determine the quantities of imports.

3. Model of Imports

The formal model used to explain the changes in imports is similar to one developed by Chenery [1] with respect to the patterns of industrial growth as follows:

\begin{equation}
M_i^t/X_i^t = f(P^t_i / P^t_{di} , (1 + T_i^t), X_i^t)
\end{equation}

where

- $M_i^t$ is the quantity of imports of commodity $i$ in year $t$,
- $X_i^t$ is the quantity of domestic shipments of good $i$ in year $t$,
- $P^t_i$ is the foreign price (FOB) of good $i$ in year $t$,
- $P^t_{di}$ is the price of domestically produced good $i$ in year $t$, and
- $T_i^t$ is the United States ad valorem import tariff rate for good $i$ in year $t$.

The inclusion of relative prices and the tariff rate as explanatory variables of the import ratio does not require any justification; however, the use of the
level of domestic shipments for this purpose does demand an explanation. The level of domestic shipments in this formulation is being employed as a measure of the size of the domestic market for the commodity and, in the final form, will measure changes in the size of the market over time. Chenery's [1] results indicate that the import ratio is related to the size of the market. A large domestic demand enables production to be initiated at a sufficient level to capture the economies of scale that may be present in the production function and, through the normal workings of comparative advantage, the import ratio may well decline after the size threshold point is reached. In a similar vein, Hirschman [4] concluded that import replacement would be a natural development as the size of the domestic market increases. Imports provide information to domestic producers as to what can be sold at home removing possibly the sole impediment to domestic production, namely ignorance of the market. Possibly the introduction of small cars by American firms within recent years is a case in point. It was felt, therefore, that there is enough presumption of the existence of a significant relationship to warrant inclusion.

In two respects, the specification of the model was known to be incomplete. The variable $X_t^i$, the quantity of domestic shipments of good $i$, should be corrected for that part of domestic shipments being exported. Exports on the average represent only 3 to 4 per cent of domestic production and certainly much less than that for products which we import in considerable amounts. It was felt, therefore, that adjusting domestic shipments for exports would not greatly affect the variable $X_t^i$, and it is extremely difficult to effect these adjustments because of classification problems.  

In addition, the variable $P_t^i$ (the foreign price of good $i$) should have been adjusted for the differential costs of transportation as between foreign and domestic suppliers. To include this factor in a rigorous way would have required a detailed analysis for each product of both its major originating areas and its final market areas using freight rates by products, which in most cases are not available. In any event, the analysis was beyond the scope of this study.

It should be noted that relative prices and the level of ad valorem tariffs could have been treated as a single variable rather than separately as is done in this formulation. This form was selected because a price decline resulting from a tariff reduction has a different supply effect compared to that resulting from a lowering of the foreign offer price. In the former case, the foreign supplier will receive the same return per unit (or even higher if the entire tariff change is not passed on to the consumer) while in the latter one, he will receive less. This would lead one to expect that the quantity of goods

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2 An explanation of the classification problem involved in this decision can be found in Appendix A along with a discussion of other classification problems in the study.
imported would react differently to an equal percentage change in the two elements.

The dependent variable \( M_t^i/X_t^i \), the ratio of imports to domestic shipments, was taken to be a multiplicative function of the three variables \( P_{it}^t/P_{it}^a \), \( 1+T_t^i \), and \( X_t^i \):

\[
M_t^i/X_t^i = K^t(P_{it}^t/P_{it}^a)^{\beta_1}(1+T_t^i)^{\beta_2}X_t^i\nu_t^i
\]

where \( K^t \) is a constant in year \( t \) for all products and \( \nu_t^i \) is a random error term. This form of the equation was selected because it yields parameters in the form of elasticities and tends to give the best statistical fit. Equation (2) was converted into a linear form by making a double logarithmic transformation.

\[
\log(M_t^i/X_t^i) = \log K^t + \beta_1 \log(P_{it}^t/P_{it}^a) + \beta_2 \log(1+T_t^i) + \beta_3 \log(X_t^i) + \log\nu_t^i.
\]

In order to investigate the changes that have occurred in United States imports over time, a first difference transformation of equation (3) was employed.

\[
\log(M_t^i/X_t^i) - \log(M_{t-n}^i/X_{t-n}^i) = \log C_{t-n}^i + \beta_1 \left[ \log(P_{it}^t/P_{it}^a) - \log(P_{it-n}^t/P_{it-n}^a) \right] + \beta_2 \left[ \log(1+T_t^i) - \log(1+T_{t-n}^i) \right] + \beta_3 \left[ \log(X_t^i) - \log(X_{t-n}^i) \right] + \log\nu_t^i - \log\nu_{t-n}^i
\]

where \( C_{t-n}^i \) is a constant for all products but changes depending on the years involved and the expected value of \( \log\nu_t^i - \log\nu_{t-n}^i = 0 \).

4. SOURCES OF DATA

The data used for estimating the changes of U.S. imports were taken from cross sections at the product level. Since the cross sections are available at a number of points in time, a rectangular array of data results. Published reports of agencies of the U.S. Government provided the primary source of data. The import figures were taken from the Census Bureau’s reports [11]. While quantity statistics are called for in the model, constant dollar amounts (1947–49 base) were used in order to make cross product calculations possible. The domestic price statistics used are the wholesale price indexes of individual commodities, 1947–49 base, as reported by the Bureau of Labor Statistics [15]. For products having a legislative tariff already in the ad valorem form, the rates were taken directly from the Census Bureau’s tariff lists [12]. In the case of all other products, the ad valorem equivalent of the specific or compound rate had to be used. The data are calculated on a continuing basis by the U.S. Tariff Commission and were made available by them although they are not published. The statistics of domestic shipments
were taken from three major sources: the Censuses of Manufacturing [13], the Bureau of Mines production series [16], and the U.S. Tariff Commission reports of production of the organic chemical industry [18]. These figures are also constant dollar values on a 1947–49 base.

The measure of foreign prices was calculated by forming an index of unit values (value divided by quantity) of import products with a 1947–49 base. Haberler [3], among others, has pointed out a number of reasons why unit values will yield poor estimates of price movements. Unit values operate as if either the statistical class is made up of homogeneous products or else the structure does not change over time and there is no change in quality. While these criticisms can be leveled against any price index, unit value indexes are certainly worse than most on this score. No other source of foreign export prices is available, however, and so deficiencies had to be overlooked.³

5. SELECTION OF SAMPLE

There are approximately 20,000 separate import classes as identified in U.S. import statistics. While imports are actually recorded in less than half of the classes, the numbers involved and the degree of disaggregation make it impossible to deal with each class as a separate product. A sample was therefore drawn from the population of imports to be represented in the study.⁴ A product was included in the sample of import products if it was manufactured and imported into the United States in the value of at least one million dollars in 1957 or 1958 and the data were available from all of the relevant sources. A total of 150 products were finally selected for inclusion on this basis representing roughly 900 import classes. Complete data were available for the census years 1947, 1954, and 1958. Most of the data were available for the intermediate years by use of the Annual Surveys of Manufacturing [14], but there are instances of lack of detailed breakdowns and certainly the reliability of the statistics are on a much lower level. For this reason, the only non-census year involved in the estimates was 1957.

The products in the sample were directed into one of two groups depending on their physical characteristics. The determining characteristic involves the short run elasticity of the major raw materials incorporated into the product. For illustrative purposes, let us consider changes in the importation of a raw material (even though they are outside the bounds of study). The United States has only a limited supply of pulp woods. If there is an increase in

³ The inadequacy of the import price data did have an effect on the study. Since unit values are notoriously poor as measures of prices of machinery, many products of this type that had all the characteristics necessary for inclusion in the sample had to be excluded on this ground. Exclusions included agricultural machinery, transport equipment, machine tools and many others.

⁴ This sample was not drawn through a probability mechanism of any sort.
demand for pulp woods in the U.S., the enlargement in domestic supply forthcoming would be only nominal, as in the short run supply is almost perfectly inelastic and therefore practically all of the increase in demand will be met through larger imports. Variations in quantity imported are going to reflect changes in total market demand and to a much lesser extent, the state of relative prices. While pulp woods, non-manufactured products, are excluded from the study, wood pulps are included. The conditions determining variations in the quantities of wood pulps imported, however, are very similar to those affecting pulp woods. If there is an increase in demand for wood pulp in the U.S., it is possible for domestic supply to provide for the additional requirements. Domestic production of wood pulps can be increased through greater use of domestic raw materials, or, if they are not available, through increased imports of pulp woods. On the other hand, pulp woods are very difficult to transport and although they do enter international trade, location factors usually force the processing of pulp woods into wood pulps before shipping them. The short run domestic supply of wood pulps is likely to be inelastic because the raw material is inelastic in supply and variations in quantities imported will reflect mainly changes in total demand, although relative prices do have some influence. The closer the manufactured product is to the raw material stage and the greater the difficulty of shipping the raw material, the more important will be changes in total demand relative to prices in determining quantity of imports. Products greatly affected by conditions of the raw material were classified as group B, while all others were classified as group A. Paper products and aluminium sheets, for instance, are included in group A, while wood pulps and aluminum ingots were put into group B. There are a total of 91 Group A and 59 Group B products in the sample.\footnote{The products included in groups A and B are listed in Appendix B.}

6. THE REGRESSION ANALYSIS

Equation (4) attempts to explain the changes of imports that have occurred over time through cross section analysis. Since the price elasticity parameter ($\beta_1$) does give a measurement of percentage change of the import ratios that would result from a uniform change in relative prices, it is possible to interpret the results of the model somewhat the way one would interpret an aggregate import function. There are some significant differences, however, that limit the analogy. An aggregate import function would certainly include national income as an explanatory variable. Since the change in national income between two years is the same for all products in the cross section, income cannot be introduced as an explanatory variable. Income in this formulation is picked up along with other excluded factors through the
constant term, and so, in general, the estimated parameters will differ due to the fact that the interaction of price and income is not represented. Furthermore, the parameters estimated in this model only reflect the products that happen to be in the sample selected. If they are representative also of excluded products, then this equation may give an approximation of aggregate behavior. Since this will not usually happen when a non-probabilistic mechanism is used for sample selection, a more limited interpretation of the results is required.

A simple least squares estimating procedure was used and the results of the calculation for the products of group A are shown in Table II and for group B in Table III. Figures in parentheses are the standard errors. The units of measurement involved are as follows: the dependent variable is a ratio of constant dollar figures, the price variable is a ratio of indexes on the same base, the tariff variable is the actual level of ad valorem tariffs, and the domestic shipments variable is in thousands of constant dollars.

All of the estimates were calculated without imposing any a priori restrictions on the parameters. The estimates of the parameters were expected, however, to conform to some preconceived notions as to their signs and, to a lesser extent, their magnitudes. The price elasticity parameter \((\beta_1)\) should have a negative sign reflecting the expectation that if the foreign price increases relative to the domestic price of a product, the ratio of imports to domestic shipments will decline. In addition, we have some guides as to what magnitudes to expect of this parameter from aggregate studies.\(^6\)

Following the early postwar "elasticity pessimism" period, estimates of U.S. aggregate price elasticity of demand for imports have appeared within the range of \(-1.0\) to \(-3.0\), depending on the years included and the level of aggregation chosen. This may well set a sensible range within which this parameter should fall even though this is not strictly a demand elasticity. Furthermore, it has been demonstrated that longer run price elasticities will be more negative than short run elasticities [10]. This means that we should expect \(\beta_1\) to be more negative when a longer time change is involved, i.e., 1947–1958 as compared to a shorter period, i.e., 1957–1958.

We should also expect the sign of the tariff elasticity coefficient \((\beta_2)\) to be negative. If the import tariff levied on a product is reduced, the amount of protection it provides is presumably diminished and, ceteris paribus, the ratio of imports to domestic production will increase. Aside from the supply differences previously mentioned, \((\beta_2)\) should be of the approximate magnitude of \((\beta_1)\). The domestic shipments variable \((X_1)\) occupies an ambivalent position with respect to the import ratio. If changes in import quantities by themselves were unrelated to changes in domestic shipments, then \(\beta_2\) would

\(^6\) A useful survey of statistical estimates has been published by Cheng [2]. They are at best only roughly comparable to these estimates.
be exactly equal to $-1.0$ as $X_t$ appears in the denominator of the import ratio as well as being an independent variable. It is believed, however, that changes in imports are in fact related to changes in domestic shipments because $X_t$ does indicate the level of domestic demand for the product. Thus an increase of domestic shipments would denote an increase in domestic demand, and, if the other variables remain the same, an increase in the total market would raise the level of imports. This would lead one to expect the domestic shipments parameter ($\beta_3$) to be greater (less negative) than $-1.0$. At the same time, however, imports and domestic production of the same product are direct substitutes. With a given level of market demand, the greater the quantity supplied by domestic sources, the less room will there be for imports, leading to the anticipation that $\beta_3$ should be less than $-1.0$. The estimated value of $\beta_3$ will depend therefore on whether the market or the substitution effect predominates.

The constant term ($C_t^{-n}$) will reflect all those factors influencing the general ratio of competitive imports to domestic shipments over time that are not included as independent variables. Of the known forces that are excluded, changes in the level of aggregate national income are by far the most important. Since United States imports are generally believed to be quite income elastic, the constant term should be the largest for those periods in which the increase in national income has been the greatest.

The rationale for dividing the products into two groups implies that we should expect systematic differences in the calculated parameter estimates. For group B products, changes in relative prices are not expected to be very important in determining changes in the import ratio as compared to variations in domestic shipments. There is no preconceived notion of this sort with respect to group A products. This difference may appear in the statistical significance of the $\beta_1$ parameter for group B, (less significant) and the $\beta_3$ estimate is expected to be somewhat greater for this group.

7. Results of the Calculations

The estimates of the model for group A products seem to conform to expectation and are in general satisfactory. Estimates were made for the change in imports from 1957 to 1958, 1954 to 1958, 1947 to 1958, and 1947 to 1954. The estimates indicated that from 30 per cent to 65 per cent of the total variance of import ratio changes was explained by the independent variables. The $R^2$'s are all significant at the .99 level as measured by their $F$ ratios.

The use of cross section data in general, of course, does lead to lower levels of explained variance than time series. This is particularly true of these data which are product observations without taking into account industry differences, historical institutional arrangements, or the myriad of location
TABLE II
REGRESSION OF CHANGES OF IMPORT RATIOS OVER SELECTED YEARS OF GROUP A PRODUCES ON CHANGES OF RELATIVE PRICES, TARIFFS AND DOMESTIC SHIPMENTS

<table>
<thead>
<tr>
<th>Years</th>
<th>Constant</th>
<th>$\beta_t$ (Δ Prices)</th>
<th>$\beta_t$ (Δ Tariffs)</th>
<th>$\beta_t$ (Δ Shipments)</th>
<th>$R^2$ n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1957-1958</td>
<td>.031</td>
<td>-1.237</td>
<td>.266</td>
<td>-.912</td>
<td>.641**</td>
</tr>
<tr>
<td></td>
<td>(.012)**</td>
<td>(.201)**</td>
<td>(.1934)</td>
<td>(.088)**</td>
<td>n = 90</td>
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<tr>
<td>1954-1958</td>
<td>.203</td>
<td>-1.322</td>
<td>-.524</td>
<td>-.799</td>
<td>.412**</td>
</tr>
<tr>
<td></td>
<td>(.028)**</td>
<td>(.122)**</td>
<td>(.280)*</td>
<td>(.248)**</td>
<td>n = 91</td>
</tr>
<tr>
<td>1947-1958</td>
<td>.635</td>
<td>-1.179</td>
<td>-5.641</td>
<td>-.798</td>
<td>.370**</td>
</tr>
<tr>
<td></td>
<td>(.106)**</td>
<td>(.316)**</td>
<td>(2.106)**</td>
<td>(.233)**</td>
<td>n = 91</td>
</tr>
<tr>
<td>1947-1954</td>
<td>.530</td>
<td>-1.542</td>
<td>-4.491</td>
<td>-7.09</td>
<td>.317**</td>
</tr>
<tr>
<td></td>
<td>(.082)**</td>
<td>(.309)**</td>
<td>(1.832)**</td>
<td>(.314)**</td>
<td>n = 91</td>
</tr>
</tbody>
</table>

* Significant at .95 level.
** Significant at .99 level.

TABLE III
REGRESSION OF CHANGES OF IMPORT RATIOS OVER SELECTED YEARS OF GROUP B PRODUCTS ON CHANGES OF RELATIVE PRICES, TARIFFS AND DOMESTIC SHIPMENTS

<table>
<thead>
<tr>
<th>Years</th>
<th>Constant</th>
<th>$\beta_t$ (Δ Prices)</th>
<th>$\beta_t$ (Δ Tariffs)</th>
<th>$\beta_t$ (Δ Shipments)</th>
<th>$R^2$ n</th>
</tr>
</thead>
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<tr>
<td>1957-1958</td>
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<td>-.080</td>
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<td>-.688</td>
<td>.365**</td>
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<td>(.028)*</td>
<td>(.278)</td>
<td>(.855)</td>
<td>(.132)**</td>
<td>n = 59</td>
</tr>
<tr>
<td>1954-1958</td>
<td>.122</td>
<td>-.082</td>
<td>-2.729</td>
<td>-.901</td>
<td>.239**</td>
</tr>
<tr>
<td></td>
<td>(.044)**</td>
<td>(.313)</td>
<td>(1.991)</td>
<td>(.246)**</td>
<td>n = 59</td>
</tr>
<tr>
<td>1947-1958</td>
<td>.318</td>
<td>-1.977</td>
<td>-6.21</td>
<td>.831</td>
<td>.332**</td>
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<td></td>
<td>(.100)**</td>
<td>(.484)**</td>
<td>(.844)</td>
<td>(.233)**</td>
<td>n = 59</td>
</tr>
<tr>
<td>1947-1954</td>
<td>.344</td>
<td>-1.889</td>
<td>-6.59</td>
<td>.495</td>
<td>.329**</td>
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<td></td>
<td>(.076)**</td>
<td>(.422)**</td>
<td>(.777)</td>
<td>(.184)**</td>
<td>n = 59</td>
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</tbody>
</table>

* Significant at .95 level.
** Significant at .99 level.

factors unique to products. Each of these factors does influence the level of imports of individual products to a large extent. They were not taken into account primarily because they are of lesser interest for this study and secondarily because of the immense difficulty of doing anything in practice with them. When a long time period is involved (in the case of 1947-1958, twelve years), many things can happen that will affect import ratios. Technical changes in production, shifts in taste, alteration of government non-tariff trade restrictions all work toward weakening the explanatory power of the equation for the longer time spans. With this in mind, a 30 per cent explanatory level seems as high as one could expect without explicitly introducing a great many more factors into the analysis.

The parameter estimates of group A are particularly interesting. The price elasticity estimates ($\beta_t$) agree perfectly with expectations. They are
all negative, significant at the .99 level and within the range of -1.0 to -3.0. While the tendency is not extremely pronounced, the length of the time period does affect the magnitude of the estimate. The largest coefficient (most negative) resulted from the longest time span 1947-1958, and the smallest from the shortest period, 1957-1958. The four estimates of $\beta_1$ are really quite similar, indicating an encouraging degree of stability.

The tariff change coefficient ($\beta_2$) is even more remarkable. The one year change led to an estimate of $\beta_2$ not significantly different from zero. This was drastically altered, however, when the changes from 1947 to 1954 and 1947 to 1958 were involved. The year 1947 marked the first multilateral tariff reduction agreement under the auspices of the General Agreement on Tariffs and Trade. At that time, the U.S. drastically reduced its tariff by approximately 50 per cent on practically all dutiable goods. The effect of this tariff reduction as measured by these estimates was remarkable in that it evoked a large increase in imports. Since that time, however, U.S. tariff reductions have been small and very selective, leading to only marginal changes in imports as observed in previous research [5], and confirmed by these estimates.

It was asserted previously that relative price changes and tariff changes of the same magnitude should lead to unequal changes in the import ratio. This hypothesis can be examined by testing the equality of the parameter estimates of $\beta_1$ and $\beta_2$. This test was made and the results indicated that $\beta_1$ is significantly different from $\beta_2$ at the .95 level for all calculations except the 1957-1958 estimate in which the null hypothesis of equality could not be refuted.

The estimated coefficients associated with changes in domestic shipments ($\beta_3$) are all significantly different from zero but not significantly different from -1.0. Since all the estimates are greater than -1.0, it appears that the market effect predominates but not as distinctly as with the group B estimates.

The estimates of the constant term are consistent with the expectation that they will reflect changes in income. The ranking of the constant terms by size corresponds exactly to the ranking of the magnitudes of the changes in U.S. national income for the years involved. Since the constant term also reflects other excluded factors, an exact measurement of this relationship is not possible. In every case, the constant term is significantly different from zero at a .99 level.

The test is accomplished by recomputing the equation subject to the following linear restrictions: $a_1 x_1 + a_2 x_2 + a_3 x_3 = 0$, where the $a$'s are the new regression coefficients and $a_1 = 1$, $a_2 = -1$, and $a_3 = 0$, and comparing the resulting level of explained variance with that previously obtained by use of the $F$ ratio. See Tintner, G., Econometrics.
TABEL IV
REGRESSION OF CHANGES OF IMPORT RATIOS OVER SELECTED YEARS OF GROUP A PRODUCTS ON CHANGES OF RELATIVE PRICES, TARIFFS AND DOMESTIC SHIPMENTS AND DUMMY VARIABLES FOR THE PAPER, LEATHER, NON-METALLIC MINERAL, AND METAL PRODUCT INDUSTRIES

<table>
<thead>
<tr>
<th>Years</th>
<th>Constant</th>
<th>$\beta_1$ (\Delta Prices)</th>
<th>$\beta_2$ (\Delta Tariffs)</th>
<th>$\beta_3$ (\Delta Domestic Ship.)</th>
<th>$\beta_4$ (Paper)</th>
<th>$\beta_5$ (Leather)</th>
<th>$\beta_6$ (Non-Metallic)</th>
<th>$\beta_7$ (Metal)</th>
<th>R², N</th>
<th>R²Adjusted</th>
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<tr>
<td>1957-58</td>
<td>.029</td>
<td>(.016)**</td>
<td>(1.222)</td>
<td>.810</td>
<td>(.989)**</td>
<td>(.098)**</td>
<td>(.038)</td>
<td>(.040)</td>
<td>.034</td>
<td>.033</td>
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<tr>
<td>1954-58</td>
<td>.210</td>
<td>(1.989)</td>
<td>(.501)</td>
<td>-.860</td>
<td>(.098)**</td>
<td>(.038)</td>
<td>(.040)</td>
<td>(.042)</td>
<td>.025</td>
<td>.033</td>
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<tr>
<td>1947-58</td>
<td>(.039)**</td>
<td>(2.13)**</td>
<td>(2.75)**</td>
<td>(.276)**</td>
<td>(2.082)</td>
<td>(.087)**</td>
<td>(.090)**</td>
<td>(.070)</td>
<td>.070</td>
<td>.088</td>
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<tr>
<td>1947-54</td>
<td>(.118)**</td>
<td>(3.19)**</td>
<td>(2.050)**</td>
<td>(.239)**</td>
<td>(.202)**</td>
<td>(.222)**</td>
<td>(.213)**</td>
<td>(.183)**</td>
<td>.135</td>
<td>.135</td>
</tr>
<tr>
<td>1947-54</td>
<td>(.629)</td>
<td>(1.430)</td>
<td>(1.749)**</td>
<td>(.306)</td>
<td>(.175)**</td>
<td>(.190)**</td>
<td>(.179)</td>
<td>(.158)**</td>
<td>.171</td>
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* Significant at .00 level.
** Significant at .05 level.
*** Significant at .01 level.
A precursory effort was made to make use of the available information on the industry differences and similarities among the products. The model for group A products was recalculated with four dummy variables standing for wood and paper products, leather and leather products, non-metallic mineral products, and metal and metal products industries. This assumes that industry differences affect the constant term associated with particular products but do not affect their responses to the real independent variables. The results of the calculations are shown in Table IV. The addition of the dummy variable did add to the explanation as seen by the multiple partial coefficient of determination \( R^2_{1957-1958} \). One would not expect industry affiliation to be very important as differences over time are involved and industry affiliation does not change. The only estimates for which some real significance was found involved changes from 1947. This may be due to the fact that price indexes were used rather than absolute prices and 1947 was in the base period. The industry coefficients may, therefore, represent an adjustment for the actual price relatives existing in 1947. The coefficients of the real variables are not greatly different from the estimates obtained without taking industry differences into account.

8. GROUP B ESTIMATES

The estimates for the group B products in general are not as good as the previous ones. While the coefficients of determination are all significant at the .99 level, only about 30 per cent of total variance is explained. The price elasticity coefficient was uniformly negative. The magnitudes of \( \beta_1 \) in the significant calculations are surprisingly large as compared to the group A estimates. This may, in part, be due to the fact that changes in prices are themselves correlated with changes in tariff rates. For products whose tariff rates are in the specific form (fixed dollar amounts per physical unit), import price changes lead to an ad valorem tariff change in the opposite direction. Most of the group B products do, in fact, have tariff rates in this form. This may mean that the estimates of \( \beta_1 \) and \( \beta_2 \) are not independent and the indicated parameters are biased. The \( \beta_3 \) coefficients, as expected, are significant and quite large. The comparison of the \( \beta_3 \) estimates for group B and group A bore out the expected relationship as they are larger for B group in every case save the 1954–1958 calculation.

8 These industries were selected by stratifying the 91 group A products in one year (1958) into eight industrial groups and estimating the equation separately for each group. Only the four industries mentioned above showed signs of significance. An inspection of the parameter estimates indicated that the constant term differed among the separate estimates but not the slope coefficients. This allowed the recombining of the products by use of the dummy variable technique.
9. CONCLUSIONS

One can draw a number of tentative conclusions concerning the important determinants of United States import ratios from this study. While the level of national income was not explicitly considered in the calculations, there are indications to support the belief that aggregate imports are, in fact, largely determined by income. In this study, the aggregate level of imports (or changes in this level) are reflected in the constant term. For the calculations which proved to be significant, the constant terms consistently reflected differences in income level and changes in income. These results support the findings of aggregate studies on this question.

Within a given level of aggregate imports, however, the results indicate that relative prices are particularly important in determining the patterns of trade. For other than resource oriented goods, the relative price elasticities were uniformly negative and indicate a fairly elastic response of imports to prices. This finding does not reflect upon the oft heard thesis that American products are losing their price competitiveness in our own markets, but it does indicate that if the price of a domestic good gets out of line with import prices, a substantial shift toward imports would occur. The results of group A are most instructive in this regard. The estimate of the short run price elasticity of $-1.237$ suggests an elastic response by imports in the United States.

The frequently discussed factor that is supposedly quite important, the tariff rate, must be examined very carefully. Large tariff changes applicable "across the board" like the reductions of 1947 do seem to cause large relative changes in the import ratios. However since 1947, tariff movements did not prove to have an appreciable effect upon changes in import ratios. There is, however, a major qualification to this finding. If a tariff rate is high enough efficiently to bar all imports, the value qualification would not have been met and the product therefore could not appear in this study. There is no way to measure perfect protection easily, so this factor has eluded research efforts to date. It is true, none the less, that recent changes in our tariff rates have not led to substantial increases in imports. This is not very surprising when one considers the care which our government goes to in an effort to offer tariff reductions only on products where there is some assurance that imports will not in fact increase. If it were not for human error, our investigation procedures would effectively eliminate all tariff reductions on sensitive products. Since the size of the tariff reductions since 1947 have themselves been very small, the results seem quite plausible. If we returned to the practice of cutting tariffs by a major fraction applicable to all dutiable imports, we might well find that imports would respond significantly as they did following 1947. This possibility, however, seems remote at best.
While imports very likely have replaced domestic production in some lines of activity, in general the results of this study indicate that increasing imports are associated with growing domestic production. This is true not only for resource oriented goods, but also for non-resource goods, although to a lesser extent. The market effect dominates the substitution effect in every calculation without exception. This finding has major political importance in that adjustment to competition is always easiest within a growth setting. Since adverse domestic effects have in the past been the primary factor limiting a more liberal commercial policy for the U.S., the belief that American industry could easily adjust to freer trade could lead to a substantial change in our policy if generally held.

APPENDIX A

Classification Problems

The data used in this study came from three major sources, each of which has its own classification scheme. The most detailed statistics came from the import trade returns which are classified on a seven digit basis. Statistics of domestic shipments from the Census of Manufacturers are mainly available only on a five digit basis based on SIC codes. This required some aggregation of import classes to make them comparable to domestic shipments. The price statistics from the Bureau of Labor Statistics represents a third classification scheme based on a six digit breakdown. In a few instances, a further aggregation was required to make these data comparable.

In order to use the export statistics, a further round of aggregation would have been required. Export statistics are based on a five digit classification scheme which differs in detail from the import data. Since the cost of this aggregation was considerable and the expected benefits quite small, export figures were disregarded.

APPENDIX B

Products Included in Group A

cotton grey cloth

woolen wearing apparel

cotton blankets

confectionery

cotton rugs

canned fruit

wool yarns

canned vegetables

wool rugs

canned fish and meat

Wilton rugs

plywood

synthetic yarns

hardwood veneer

synthetic fabrics

softwood veneer

hats

wooden chairs

gloves, non-leather

wallboard and pulpwood
cotton shirts

finished paperboard
cotton raincoats

wallpaper

handkerchiefs

coated paper
book and printing paper  womens' shoes
wrapping paper  mens' shoes
dextrose  calf and kid leather
perfumes  cattle leather
glycerine  industrial leather products
ammonium sulphate  leather slippers
primary iron and steel  leather gloves
iron and steel tubes and pipes  leather handbags
steel strip  other leather products
aluminum sheets  plate glass
type metal  sheet glass
nuts, bolts, rivets, screws  asbestos shingles
typewriters  asbestos textile fiber
printing presses  earthenware
 duplicating machines  china ornaments
tractors  household china
buttons and notions  blown glass
sporting goods  glassware
metal toys  asbestos paper fiber
pins and needles  electric lamps
vinyl resins  aluminum foil
menthol  steel wire, rope and strand
caffeine  wire mesh
medicinals  scissors and shears
dyes  knives, not all metal
organic cyclic intermediates  aluminum hospital and household ware
synthetic rubber  watches
gelatin  spectacles
 cellulose  photo lenses*
naphthalene  still photo cameras
benzene  motion picture cameras
creosote oil  cutlery, all metal
tires and tubes

Products Included in Group 1B

beer  chemical wood pulp, sulphate, bleached
still wines  and unbleached
distilled liquors  newsprint
cigars and cheroots  essential oils
non-woven wool felts  potash materials
softwood lumber  litharge lead
hardwood lumber  zinc oxide
red cedar shakes  iron oxide
wood pulp — mechanically ground  acetene black
chemical wood pulp, sulphite unbleached  sodium sulphate
chemical wood pulp, sulphite bleached  cobalt oxide
wood pulp, soda, bleached and unbleached  crude drugs

* Not available for 1957.
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<td>sodium chloride</td>
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REFERENCES


