Short-Range Forecasting of U.S. Imports

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THE MAINTENANCE of a satisfactory dollar balance in world trade depends to an important extent on a continued high level of U.S. imports. Therefore, fluctuations in U.S. imports are viewed with the greatest interest all over the world. In planning economic policy, on both the national and the international level, it would clearly be of value if the magnitude of U.S. imports could be known with reasonable accuracy a certain time in advance.

Total Imports

The simplest method of forecasting imports—and one that may be used as a minimum test of the results obtained from any more refined method—is to assume that next quarter's imports will be equal to those of the current quarter.[1] Since most economic phenomena—especially in the short run—show a strong tendency toward persistency, this method might be expected to be reasonably satisfactory in most cases. And it is. If the previous quarter's total imports are used to predict total imports in each quarter of 1952,[2] the average error—when the estimates are compared with actual imports—is only slightly greater than 7 per cent, and the largest error (in the first quarter) is only 10 per cent. If the same method is used for the 20 quarters in the five-year period, 1947–51, the average error is 7.9 per cent, and the largest error—in the third quarter of 1950, after the outbreak of hostilities in Korea—is 18.5 per cent.[3]

The same principle may be applied in a somewhat more sophisticated way by calculating a regression between total imports and lagged total imports (or total imports in the preceding quarter) and using this regression relation to predict imports. The following equation is the result

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[1] All the import series considered in this study are U.S. imports for consumption.

[2] Most of the calculations in this study were completed early in 1953 when few observations were available for that year. Thus the relations in the study were originally fitted for the period 1947–51, the four quarters of 1952 being reserved as independent observations by which various forecasting schemes might be tested. The charts included herein have been drawn on the same basis.

[3] These results are better than those obtained by assuming that a previous change in imports will persist in the next quarter, i.e., that if imports in quarter 2 are X above quarter 1, imports in quarter 3 will be X above quarter 2.

of such a computation based on the 20 quarters in the five-year period, 1947–51:

$$M = .929\, M_{-1} + 191.794 \qquad (1)$$

where M = U.S. total imports in millions of current dollars and $M_{-1} = M$ of the preceding quarter. The correlation coefficient is .926.

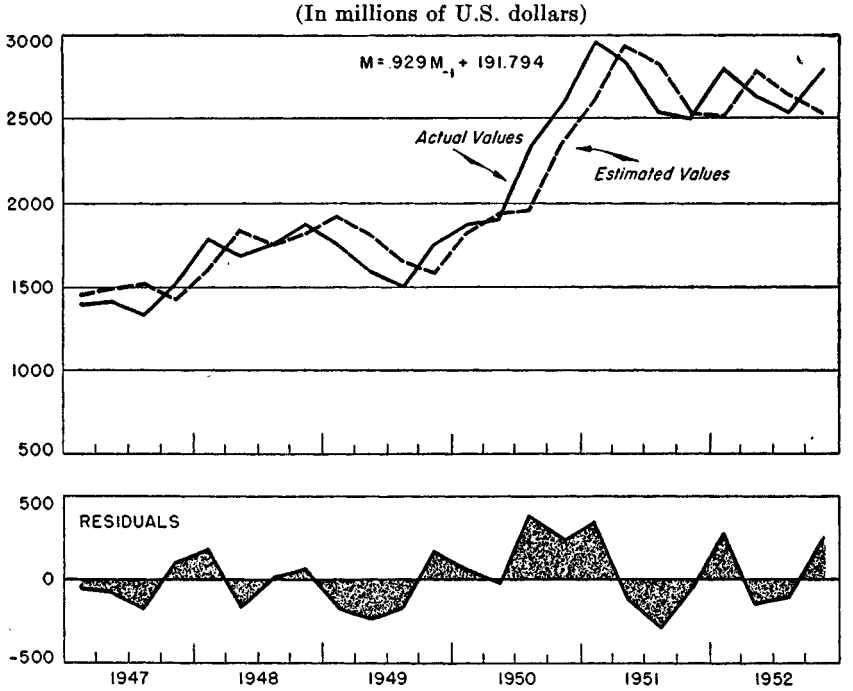
Predictions for the four quarters of 1952 based on this equation yield an average error of 7 per cent, the largest error being 9.9 per cent. For the five-year period, 1947–51, the average error is 7.7 per cent and the largest error in any quarter 16.1 per cent. This "autoregressive" method thus gives results that are only very slightly closer to the recorded figures of imports than the forecasts obtained from the more naive method. It has, however, the advantage of formalizing the relationship and producing measurements with which the results of other, more complicated, forecasting schemes may be compared.[4]

From its very nature, this method of forecasting is incapable of predicting the turning points in imports, which are of primary importance for short-range forecasting. Obviously, the level of total imports is not likely very often to change markedly from one quarter to the next. It therefore is not surprising that the simple method just discussed should give a correct forecast of total imports within a reasonable margin of error in, say, 8 quarters out of 10. It is, however, the other 2 quarters—the turning points—that are of greatest interest for short-range forecasting, and the autoregressive method necessarily fails to provide a basis for prediction at these points (see Chart 1).

In this situation, those who wish to forecast U.S. imports naturally search for some other series whose past movements have consistently preceded the recorded movements of imports by a more or less uniform period of time, and whose future movements may therefore reasonably be expected to indicate future peaks and troughs in the movements of imports. No simple causal relationship is necessarily postulated between the movements of the selected series and the movements of imports. Both series may, indeed, be the results of a complex congeries of other "causes." If, however, it is found that these causes have in the past produced their results in the selected series more promptly than in imports, it is reasonable to make forecasts on the assumption that in the future, too, these results will appear in approximately the same time order.

[4] The residuals found by subtracting computed values based on equation (1) from actual values for imports are essentially random, as tested by the von Neumann ratio. The ratio of the mean square successive difference to the variance of the series is 1.44, a value which is not inconsistent with the hypothesis that the series is random. No significant improvement in the relation is therefore likely as a result of including additional variables.

CHART 1. COMPARISON OF ACTUAL VALUES OF U.S. TOTAL IMPORTS BY QUARTERS, 1947–52, WITH VALUES ESTIMATED BY AUTOREGRESSIVE METHOD[1]



[1] For description of method of estimate, see text.

At first sight the movement of dollar acceptances for imports into the United States might reasonably be expected to indicate what the movement of imports would be in some succeeding period. Such a relation would be strictly a mechanical one, the movement of dollar acceptances supposedly reflecting orders placed for imports to be delivered sometime in the near future. Actually, the series[5] shows leads, lags, and coincidences with the peaks and troughs in the import series and thus is not a very reliable indicator of these peaks and troughs. Apparently the methods of financing U.S. imports are so varied that variations in the volume of one particular type of financing cannot be interpreted as indicating the probable timing of fluctuations in imports as a whole.

Both gross national product (GNP) and national income have been generally considered the most important determinants of U.S. imports,

[5] As published by the Board of Governors of the Federal Reserve System in the *Federal Reserve Bulletin*, table, "Commercial Paper and Bankers' Acceptances Outstanding."

and many regression relations between imports and GNP, or national income, have been calculated in the literature on this subject. An examination of quarterly data, however, reveals practically identical major turning points in GNP, in national income, and in total imports, so that neither lagged GNP nor lagged national income can be used to indicate these turnings. The only forecast that is possible is a conditional forecast, which states that, *if* GNP or national income moves in a certain way, the corresponding change in imports will probably be so much. For the greater part, such conditional forecasts really beg the question in short-range forecasting. They merely state that "if B changes so much, there will be a corresponding change in A of such an amount." If we are particularly concerned with the movements of A, we are still confronted with the task of forecasting B. Unless B is controllable or easily forecast, the forecast of A goes begging. Moreover, the correlation coefficient based on quarterly data for the period 1947–51 between total imports and GNP is only .904; between total imports and lagged GNP it is .917. Neither of these figures shows any improvement over the simpler autoregressive relation.

Investment, also sometimes considered by economic model builders as the determinant of GNP, fares no better in comparison, the correlation coefficients based on quarterly data for the period 1947–51 being .911 between total imports and investment expenditures and .916 between total imports and lagged investment expenditure. Neither does estimated fixed investment expenditure for the succeeding quarter, based on current plans reported by business,[6] show any pattern of leads relative to total imports (or to other major economic magnitudes) that can be relied on.

An indicator that is somewhat less indirect is the series "value of new orders placed with manufacturers" as reported by the U.S. Department of Commerce. This series does in fact lead many of the major economic magnitudes in the course of the business cycle. It is one of the eight indicators chosen by G. H. Moore for their performance as leaders of economic activity at cyclical turning points.[7] An examination of its

[6] To the U.S. Department of Commerce and the Securities and Exchange Commission.

[7] National Bureau of Economic Research, Inc., Occasional Paper No. 31 (New York, 1950); see especially Table 12, p. 64. The series in Moore's paper is "new orders, durable goods industries." The aggregate series used in the present study (new orders, durable and nondurable), however, reflects the turning points as well and is more relevant in relation to U.S. imports. The seven other indicators used by Moore are (1) total liabilities involved in business failures, industrial and commercial (Dun's), (2) industrial common stock price index (Dow-Jones), (3) residential building contracts, floor space (Dodge), (4) commercial building contracts, floor space (Dodge), (5) average hours worked per week, manufacturing (BLS), (6) number of new incorporations (Dun's), and (7) wholesale price index, 28 basic commodities (BLS).

relationship with the movement of the value of imports in the succeeding quarter yields satisfactory results, both for the interwar period and for the period since 1947, with variations in two quarters in 1950 and 1951 when political influences associated with the hostilities in Korea disturbed the relation.

This relationship makes possible a direct forecast of imports in the sense that, if the level of new orders in any one quarter is known, the probable level of imports in the succeeding quarter can be predicted. If such a direct forecast is to be made, it should in any event be based on quarterly data. It is exceedingly difficult to discover any economic relations—especially among large economic aggregates—which display lags that are identifiable in annual data. On the other hand, it is obviously necessary for practical reasons to take account of the lag inevitably connected with the reporting of economic data and ranging from minutes and hours for some series to years for others. Not much is gained if it is discovered that series *A* normally follows series *B* after an interval of, say, two weeks, but that series *B* is also normally subject to a reporting lag of a month or longer. Judged by this test, the relation between new orders and imports is worth examination. Although both the new orders series and the imports series are subject to reporting lags, the new orders series is available sufficiently early to make possible a forecast of imports about two months in advance of the period to which the forecast pertains, and more than three months before the record of imports is published.

Variations in new orders placed with manufacturers might be expected, a priori, to be closely associated with subsequent variations in imports. The new orders series is an objective manifestation of businessmen's intentions and their expectations for the coming period. In the series, as reported, new orders are recorded net, that is, they take into account order cancellations. Also, the orders series is a better barometer of expectations than the various series of inventories or inventory investment, for the latter are dependent upon both a voluntary and an involuntary component. New orders are the basis on which manufacturing production in the coming period is scheduled. For those imports which are fed into the production process—crude materials and semimanufactures—the relation between new orders and imports is obvious. Those imports that are sensitive to business expectations, such as imports of finished manufactures, might also be expected to show a lagged relation with new orders. It is only for imports that are sensitive to consumption levels, such as imports of crude and manufactured foods, that the relation becomes tenuous. Even there the relation is plausible, but the chain of events—new orders generating production, production generating income, and income generating consumption—is so extended that the

relation might be poor. Thus, there appears to be a prima facie case for a careful study of the statistical relationship between new orders and total imports.

For the post-World War II period, a series on manufacturers' new orders is published by the Office of Business Economics of the U.S. Department of Commerce.[8] For 1929–39 the only series on manufacturers' new orders available is in index number form (1936 = 100) and is on a seasonally adjusted basis. This index was published in the National Industrial Conference Board's *Economic Record* of January 16, 1939 and in subsequent issues.

For the present study, the Department of Commerce series without seasonal adjustment has been used for the period since World War II; and the NICB seasonally adjusted index has been used for the interwar years, 1929–39. The data indicate that for both periods there is a high coefficient of correlation between manufacturers' new orders, lagged one quarter, and total imports. The equation for 1947–51 is

$$M = 40.449\, N_{-1} - 296.497 \tag{2}$$

where M = U.S. total imports in millions of current dollars, and N_{-1} = manufacturers' new orders, lagged one quarter, in billions of current dollars. For 1929–39 it is

$$M = 1.042\, N_{-1} + 8.236 \tag{3}$$

where M = index numbers (1936 = 100) of the value of U.S. total imports, and N_{-1} = index numbers (1936 = 100) of the value of manufacturers' new orders lagged one quarter.

Equation (2) recalculated with the basic data transposed to index numbers, in order to make the regression coefficients roughly comparable to (3), is

$$M = 1.184\, N_{-1} - 16.608 \tag{4}$$

where M and N_{-1} are the same as in equation (2) but are expressed as index numbers (1948 = 100). The coefficient for the period 1947–51 is .936; and for the 42 quarters from the third quarter of 1929 through the fourth quarter of 1939 it is .952. These correlation coefficients, however, are not much higher than that of the autoregressive relation, .926. A further comparison of the two relations, for the period 1947–51, is given in Table 1; it will be seen that no significant advantage is indicated for the new orders relation over the autoregressive relation.

[8] For unadjusted data for the period prior to 1953, see *Survey of Current Business*, October 1950, 1951, 1952, and December 1953. For current data, see *Industry Survey*.

TABLE 1. PERCENTAGE ERRORS OF FORECAST OF VALUE OF U.S. TOTAL IMPORTS BASED ON (1) AUTOREGRESSIVE RELATION AND (2) NEW ORDERS RELATION[1]

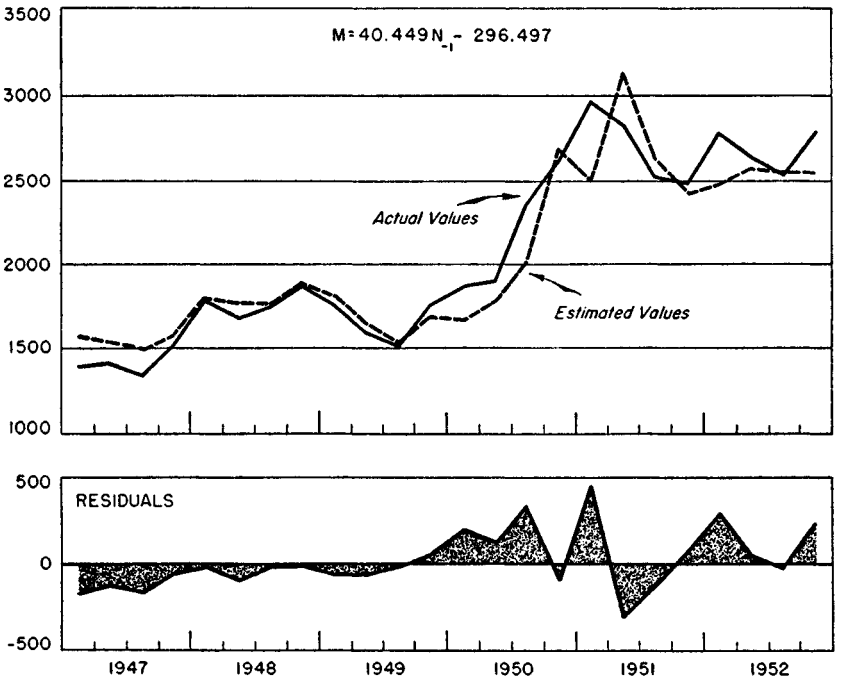
	Average Error		Maximum Error	
	1947–51	1952	1947–51	1952
Autoregressive relation	7.7	7.0	16.1	9.9
New orders relation	6.2	5.6	15.5	10.9

[1] For description of method of estimate, see text.

A graphical comparison of computed values for total imports obtained from the two relations with actual total imports brings out a much more significant difference between the two relations. The new orders relation does very well in indicating turning points (see Charts 2 and 3), while in this respect the autoregressive relation is a very poor indicator (see Chart 1). Chart 2 shows that the new orders relation traces the ups

CHART 2. COMPARISON OF ACTUAL VALUES OF U.S. TOTAL IMPORTS BY QUARTERS, 1947–52, WITH VALUES ESTIMATED ON BASIS OF MANUFACTURERS' NEW ORDERS[1]

(In millions of U.S. dollars)

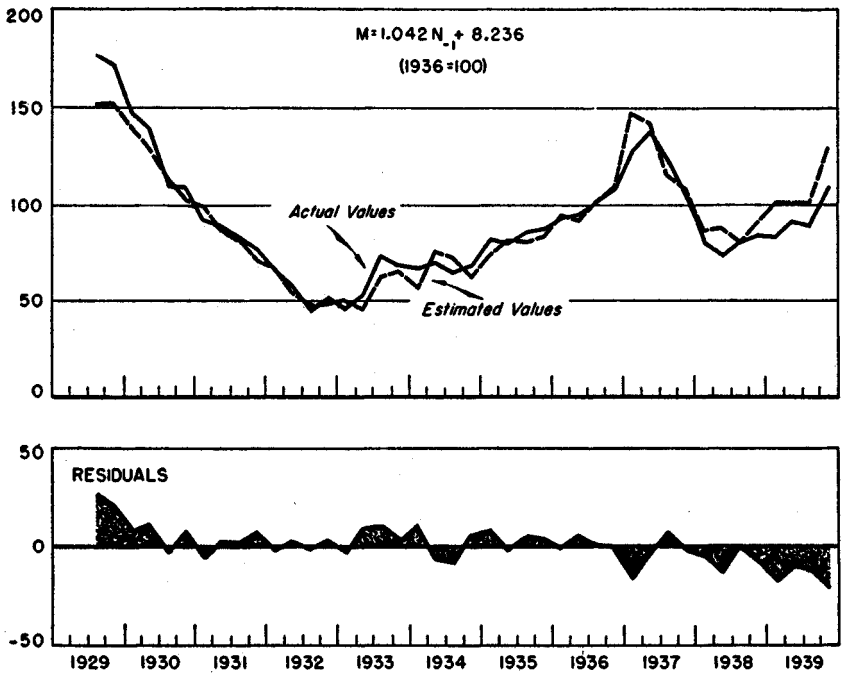


[1] For description of method of estimate, see text.

and downs in total imports very accurately until the end of 1949, but for 1950 and 1951 the fit is not good. This poorness of fit and the miscued turning point in 1951, however, are due primarily to the political shocks of the initiation of hostilities in Korea in mid-1950, and the entry of the Chinese Communist forces into that war at the end of 1950. The latter event led to a speculative surge in imports that eliminated the one quarter lag between new orders and imports, both series reaching a peak in the first quarter of 1951. It would have been necessary to predict these political developments if accurate forecasts of imports during the second half of 1950 and early 1951 were to have been made. Such predictions, however, cannot be expected from economic relations.

CHART 3. COMPARISON OF INDEX OF ACTUAL VALUES OF U.S. TOTAL IMPORTS BY QUARTERS, 1929–39, WITH INDEX OF VALUES ESTIMATED ON BASIS OF MANUFACTURERS' NEW ORDERS[1]

(1936 = 100)



[1] For description of method of estimate, see text.

Viewed in the light of these considerations, the superiority of the new orders relation over the autoregressive relation is seen to be much greater than is suggested by the correlation coefficients alone. The relation between new orders and total imports appears to be a reliable forecaster

of total imports. The expectation is justified that major fluctuations in new orders will usually be followed by changes in the same direction in imports one quarter later.

It was mentioned earlier that the closeness of the relationship between movements in manufacturers' new orders and movements in different categories of imports is unlikely to be uniform. Therefore the question that remains to be studied is whether further improvements in forecasting total imports might be made by "disaggregating" and forecasting separately the movements in major import categories by (1) using new orders to explain the variation in those import categories where the relation is most direct and (2) using other variables to explain the variation in import categories where the relationship with new orders is somewhat tenuous. The following sections examine in order the relation between movements in imports of crude materials and semimanufactures, of finished manufactures, of crude foodstuffs, and of manufactured foodstuffs and various "explaining" variables.

Imports of Crude Materials and Semimanufactures

New orders placed with manufacturers for finished goods lead to a derived demand from manufacturers for crude materials and semimanufactures. Though most of these materials come from domestic sources, the part coming from foreign sources accounts for about one half of all U.S. imports. It might be expected that that part of these materials coming from foreign sources would move in a manner broadly similar to the total. It might also be expected that new orders would show a lead in time over the actual delivery of these materials as imports coming from foreign sources. If quarterly data are used and imports of crude materials and semimanufactures are correlated with manufacturers' new orders lagged zero, one, and two quarters, a one-quarter lag is seen to be the appropriate lag. For the period 1947–51 a relation fitted with a one-quarter lag explains 92 per cent of the variation in imports of crude materials and semimanufactures. This relation[9] is

$$M^1 = .024\, N_{-1} - .295 \qquad (5)$$

where M^1 = U.S. imports of crude materials and semimanufactures in millions of current dollars, and N_{-1} = manufacturers' new orders, lagged one quarter, in billions of current dollars. The correlation coefficient is .959.

[9] The residuals derived from this relation are essentially random, the ratio of the mean square successive difference to the variance being 2.16, a value which is not inconsistent with the hypothesis that the series is a random series. No significant improvement in the relation is therefore to be expected from the inclusion of additional variables.

If the National Industrial Conference Board's data on new orders in the interwar period are correlated with imports of crude materials and semimanufactures for the period 1929–39, the relation is

$$M^1 = 1.250\, N_{-1} - 8.055 \qquad (6)$$

where M^1 = index numbers (1936 = 100) of the value of U.S. imports of crude materials and semimanufacturers, and N_{-1} = index numbers (1936 = 100) of the value of manufacturers' new orders lagged one quarter. The coefficient of correlation is .958. Equation (5) recalculated with the basic data transposed to index numbers, in order to make the regression coefficients roughly comparable to (6), is

$$M^1 = 1.315\, N_{-1} - 31.768 \qquad (7)$$

where M^1 and N_{-1} are the same as in equation (5) but are expressed as index numbers (1948 = 100). The coefficient of correlation is .961. The similarity between the interwar and postwar coefficients is as striking here as it was for total imports and new orders. And, as there, though the two new orders series are not strictly comparable, the similarity of the correlation and regression coefficients lends support to the new orders relation as a forecasting device.

The good fit obtained is not due entirely to parallel price movements in the two series; a relation of the same form and for the period 1947–51 using deflated variables[10] yields a correlation coefficient of .77.[11]

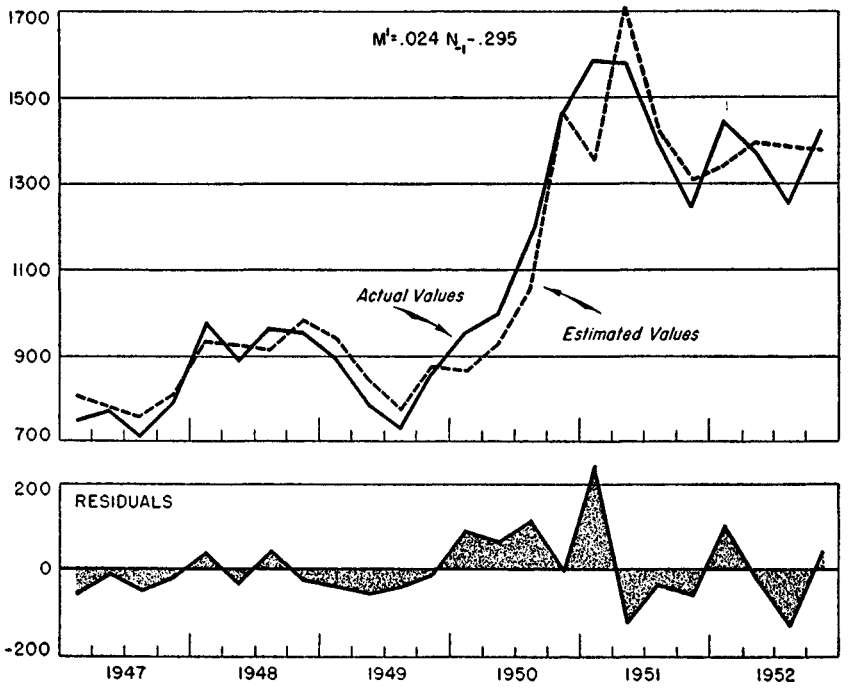
Actual imports of crude materials and semimanufactures and imports computed on the basis of equation (5) are shown in Chart 4. Since only the data for the period 1947–51 were used to obtain equation (5), the computed values shown for 1952 are true forecasts. The over-all fit of the computed and actual values as shown in the chart is quite good. Though the computed value of imports for each of the four quarters of 1949 is greater than the actual value, the computed series does very well in indicating the turning points in the 1949 recession and the subsequent recovery. That the computed relation does not fit the actual pattern in 1951 too well is not surprising in view of the political shocks of that period. It is doubtful that any systematic method which used predetermined variables for forecasting imports could have done better, or even as well. The forecast for 1952 does not fit the actual pattern too well in the first and third quarters. This may, however, have been due to

[10] Imports of crude materials and semimanufactures in 1948 dollars were obtained by multiplying the respective 1948 imports of these two groups by the respective volume indexes and adding. New orders were deflated by wholesale prices of manufactured goods.

[11] This may be compared with a correlation coefficient of .72 between imports of crude materials and semimanufactures in constant dollars and industrial production unlagged (1947–51).

CHART 4. COMPARISON OF ACTUAL VALUES OF U.S. IMPORTS OF CRUDE AND SEMIMANUFACTURED MATERIALS BY QUARTERS, 1947–52, WITH VALUES ESTIMATED ON BASIS OF MANUFACTURERS' NEW ORDERS[1]

(In millions of U.S. dollars)



[1] For description of method of estimate, see text.

special factors operating to increase imports in the first quarter and to lower them in the third quarter. In the first quarter there seems to have been some increased movement of raw materials into the U.S. strategic stockpile from British Government stocks. However, the actual magnitude of this operation is not known. In the third quarter speculative influences pending the reopening of certain commodity markets in London may have led to reduced imports. These factors may account, at least in part, for the poorer fit of the forecasts in these two quarters.

Imports of Finished Manufactures

Imports of finished manufactures form a highly autoregressive series, the serial correlation coefficient being as high as .946 for the period 1947–51. This fact suggests that lagged imports should be included in the regression relation forecasting these imports. However, as argued

above, an autoregressive relation cannot by itself forecast turning points. While in the case of total imports the addition of lagged new orders to the autoregressive relation does not improve the relation, it does improve the fit in the case of finished manufactures, and it is also statistically significant, as can be seen from the following equation for the period 1947–51:

$$M^2 = \underset{(.119)}{.575\, M^2_{-1}} + \underset{(.819)}{3.271\, N_{-1}}\ 27.227 \qquad (8)$$

where M^2 = U.S. imports of finished manufactures, in millions of current dollars, $M^2_{-1} = M^2$ lagged one quarter, and N_{-1} = manufacturers' new orders, lagged one quarter, in billions of current dollars. The multiple correlation coefficient is .970. The figures in brackets are the standard errors of the regression coefficients.[12]

The values of imports computed from equation (8) and actual imports of finished manufactures are given in Chart 5. As can be seen, the over-all fit is quite good except in three of the quarters covered by the calculations. The estimated series is one quarter late in indicating the downturn in imports that actually occurred in the first quarter of 1949. The upturn in the third quarter of the same year, however, is indicated correctly. The impetus given to new orders by the entry of the Chinese Communist forces into the Korean war in the first quarter of 1951 was not shared by imports of finished manufactures, which accounts for the large error in the second quarter of 1951. In each of the four quarters of the forecast period, 1952, actual imports are greater than computed imports. In the first three quarters, however, the error is small; only in the fourth quarter is the error of sizable magnitude.

Imports of Crude Foodstuffs

There is a somewhat larger element of random variation in imports of crude foodstuffs than in imports of crude materials, semimanufactures, or finished manufactures. In addition to a trend factor, these imports are subject to notable seasonal fluctuations. The result of relating these two factors to crude food imports for the period 1947–51 is shown by equation (9):

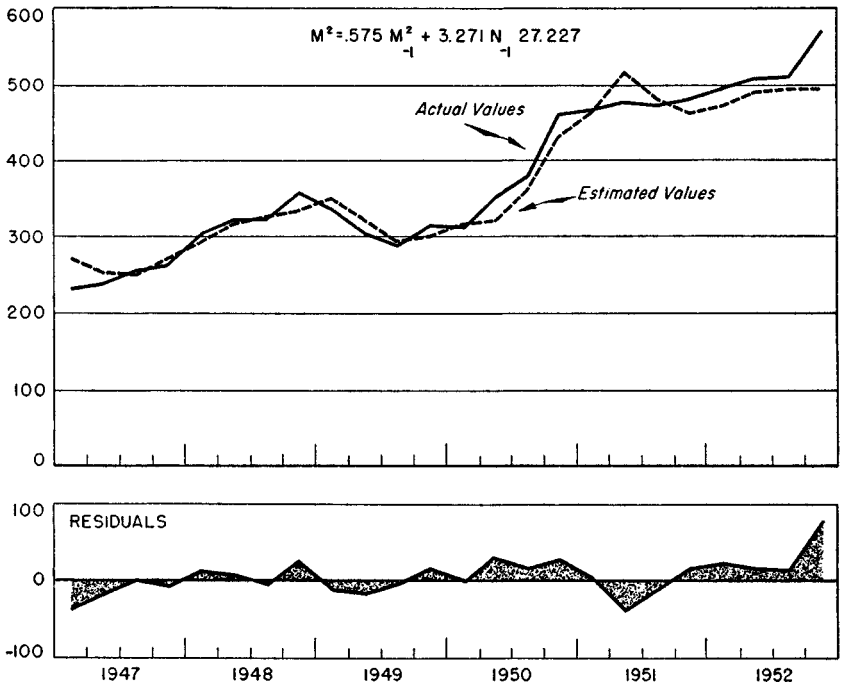
$$M^1 = \underset{(.878)}{3.520\, S^1} + \underset{(.913)}{8.117\, t} + 19.547 \qquad (9)$$

where M^1 = U.S. imports of crude foodstuffs in millions of current dollars, S^1 = seasonal index of crude food imports, and t = time

[12] The residuals derived from the relation are essentially random. The ratio of the mean square successive difference to the variance is 1.38, a value not inconsistent with the hypothesis that the series is random.

CHART 5. COMPARISON OF ACTUAL VALUES OF U.S. IMPORTS OF FINISHED MANUFACTURES BY QUARTERS, 1947–52, WITH VALUES ESTIMATED ON BASIS OF MANUFACTURERS' NEW ORDERS[1]

(In millions of U.S. dollars)



[1] For description of method of estimate, see text.

(1947 $I = -19$, 1947 $II = -17$, etc.). The multiple correlation coefficient is .905. The residuals derived from equation (9) are essentially random.[13]

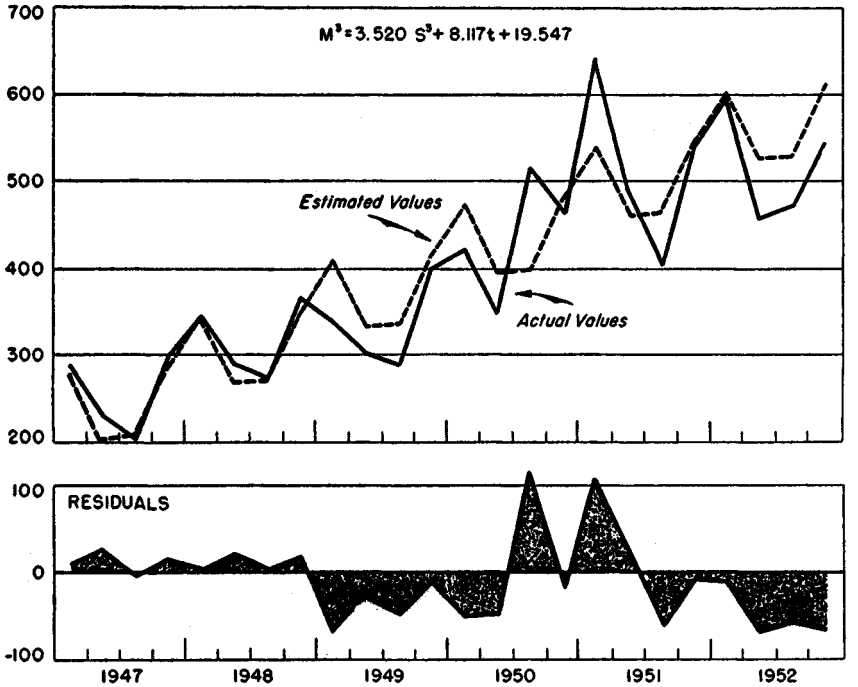
The seasonal index was derived by the ratio-to-trend method. This method utilizes more fully than any other method all the available observations—a consideration of some importance in view of the shortness of the period. The trend reflects both quantity and price movements. In each of the five years, 1947–51, the volume of crude food imports increased. The unit value index exceeded that of the preceding year in all years except 1949.

As can be seen in Chart 6, the fit between actual imports of crude foodstuffs and the values obtained on the basis of equation (9) is not

[13] The ratio of the mean square successive difference to the variance is 2.20, a value not inconsistent with the hypothesis that the series is random.

CHART 6. COMPARISON OF ACTUAL AND ESTIMATED VALUES OF U.S. IMPORTS OF CRUDE FOODSTUFFS, BY QUARTERS, 1947–52[1]

(In millions of U.S. dollars)



[1] For description of method of estimate, see text.

nearly so good as similar relationships for crude materials, semimanufactures, and finished manufactures. At three points in particular the fit is bad: (1) in the first quarter of 1949, when a cyclical downturn upset the seasonal pattern; (2) in the third quarter of 1950, when speculative imports at the beginning of the Korean war upset the seasonal pattern; and (3) in the first quarter of 1951, when speculative imports after the entry of Chinese Communist forces into the Korean war exaggerated a seasonally high quarter's imports. For only the first of these instances should fault be found with the fit of the relation. For the other two, speculative imports arising from political shocks could not be expected to be forecast by economic relationships. The relation could not, by its very nature, predict the 1949 recession in imports of foodstuffs. Obviously, a relation composed of a trend factor and a seasonal component cannot predict turning points, unless they are seasonal turning points, as 1949 was not. It is, however, very difficult to improve the relation in this respect. The use of a cyclical variable such as dis-

posable income or lagged new orders, instead of the trend variable, worsens the fit. A separation between coffee imports (which account for about 50 per cent of the imports in this group) and "all other" crude food imports does not lead to better relationships either. For the "all other" group a fit as close as that of equation (9) can be found on the basis of time and an index of seasonal fluctuations; but this, again, cannot predict a cycle. Also it leaves coffee imports still to be forecast. Mrs. Holzman in an unpublished study, "The U.S. Demand for Imports of Certain Individual Commodities in the Interwar Period," explained variations in coffee consumption (imports corrected for changes in stocks) in terms of real national income, the deflated retail price of coffee, and a linear trend for the period 1920–39, using annual data. She found that the trend was "by far the most important explanatory variable in this regression." It might perhaps have been expected that coffee imports into the United States could be forecast on the basis of a series, "coffee clearance from Brazil," reported in the *Survey of Current Business* of the U.S. Department of Commerce. But this method does not yield satisfactory results either. The series for coffee clearance leads coffee imports into the United States by one month in most instances, but it explains only about 50 per cent of the variation in coffee imports.

Thus, while equation (9) is not a very satisfactory solution, nothing better seems to be available.

When the forecasting equation was applied to the four quarters of 1952, the seasonal component was found to hold fairly well, but the actual trend in 1952 was somewhat less steep than the forecasts, all of which were therefore a little higher than the actual values (see Chart 6). This weakening in the trend factor seems to have been due to a leveling off, or near leveling off, of crude food unit values.

Imports of Manufactured Foodstuffs

As might be expected, the forecasting of imports of manufactured foodstuffs brings problems similar to those arising in forecasting crude food imports. In both groups, the element of random variation is larger than in the imports of crude materials, semimanufactures, or finished manufactures. In manufactured foods, as in crude foods, the dominant elements seem to be a trend factor and a seasonal component:

$$\underset{}{M^4} = \underset{(.659)}{2.020\, S^4} + \underset{(.335)}{2.790\, t} + .301 \qquad (10)$$

where M^4 = U.S. imports of manufactured foodstuffs in millions of current dollars, S^4 = seasonal index of manufactured food imports, and

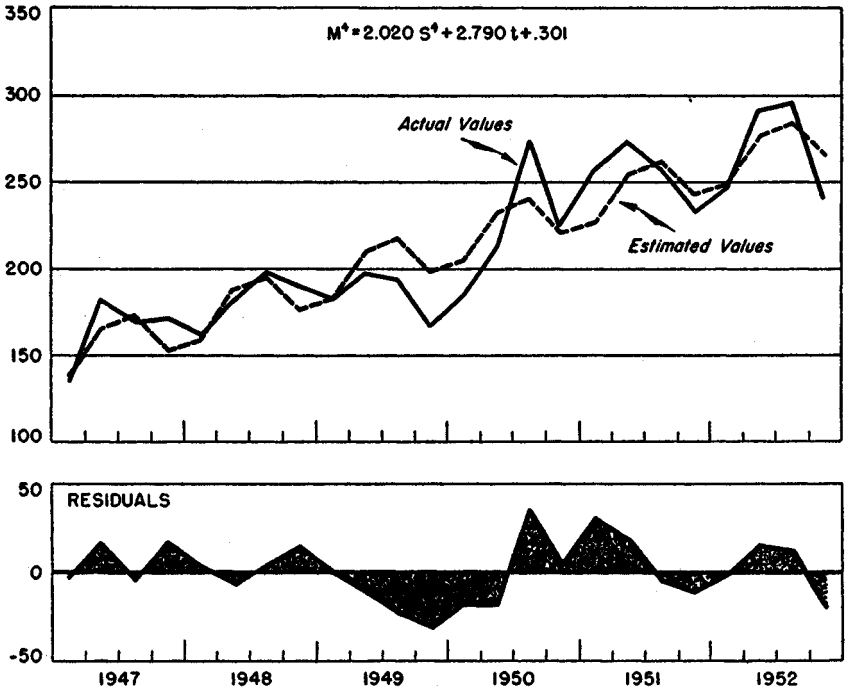
t = time (1947 I = −19, 1947 II = −17, etc.). The multiple correlation coefficient is .893.

The ratio-to-trend method was used to derive the seasonal index for manufactured food imports for the same reasons that justified its use for imports of crude foodstuffs.

For manufactured, as for crude, food imports, the volume increased in each of the five years, 1947–51, and 1949 was the only year in which the unit value index was lower than in the preceding year. The residuals derived from equation (10) are essentially random.[14]

CHART 7. COMPARISON OF ACTUAL AND ESTIMATED VALUES OF U.S. IMPORTS OF MANUFACTURED FOOD PRODUCTS, BY QUARTERS, 1947–52[1]

(In millions of U.S. dollars)



[1] For description of method of estimate, see text.

As can be seen in Chart 7, the points of poorest fit of the manufactured foods relation are the same as in the crude foods relation, i.e., the cyclical downswing in 1949, the third quarter of 1950, and the first quarter of

[14] The ratio of the mean square successive difference to the variance is 1.38, a value not inconsistent with the hypothesis that the series is random.

1951. The fit in the cyclical downswing in 1949 is even poorer here than it was for the crude foods relation. And again the inclusion of a cyclical variable, such as disposable income or lagged new orders, in place of the trend variable does not improve the fit.

Nor can a satisfactory solution be found by further disaggregation. Sugar imports account for about 50 per cent of U.S. imports of manufactured food products. A relation can be found between "all other" manufactured food imports, time, and an index of seasonal fluctuations with about the same goodness of fit as equation (10); this relation again fails to be improved by the inclusion of "cyclical variables." Sugar imports are subject to an annual quota set by the U.S. Secretary of Agriculture, which is usually announced in December of the year preceding its applicability. Since this quota is subject to revision during the year, it is not likely to prove very useful in predicting turning points. Thus, for manufactured food imports, as for crude food imports, the best relation that can be calculated is not very satisfactory.

We are therefore forced back to the simpler approach of equation (10). For neither manufactured nor crude food imports has a satisfactory forecasting equation been found.

Total Imports Reconsidered

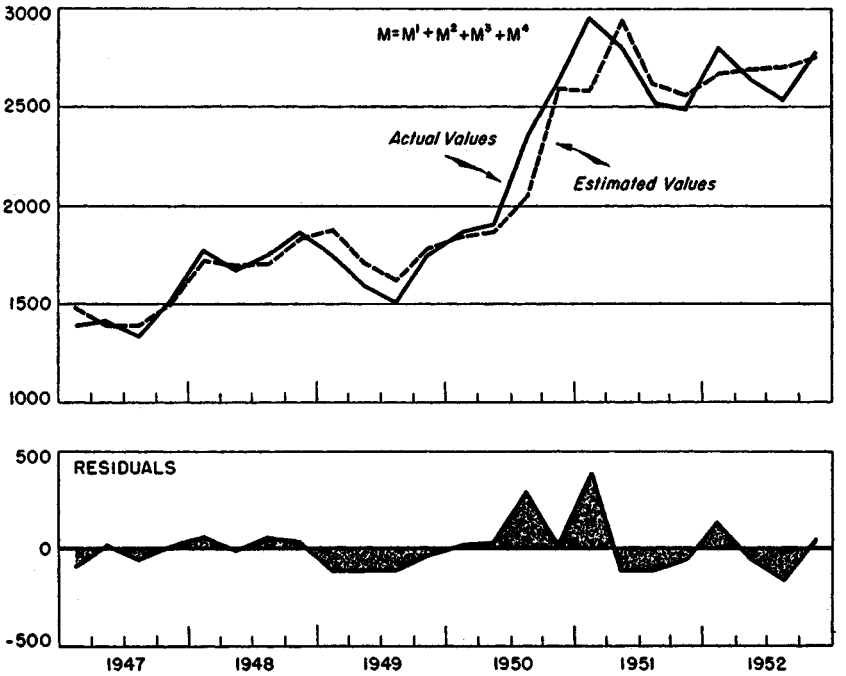
An estimate of total imports derived from the partial totals indicated by the relations calculated for the four major groups of imports, (1) crude materials and semimanufactures, (2) finished manufactures, (3) crude foods, and (4) manufactured foods, is shown in Chart 8. The estimated values have been computed by summing the computed values from the four regression equations, (5), (8), (9), and (10). The computed values for the four quarters of 1952 are true forecasts, since the regression relations were computed by using only the 1947–51 data. The over-all fit including each of the four quarters of 1952 is satisfactory. At four points, however, the fit is not very good: the large residuals in the third quarter of 1950 and the first quarter of 1951 and the miscued turning points at the beginning of 1949 and 1951.

The large residuals in the third quarter of 1950 and the first quarter of 1951 and the miscued turning point in early 1951 were all to be expected; they were associated with the political developments which have already been mentioned. As these developments could not have been predicted, little could have been done about the fit of the relations in this period.

The tardy forecast of the turning point in imports at the end of 1948 was due predominantly to the poor performance of the food imports relations. The noncyclical variables used to explain these imports are

CHART 8. COMPARISON OF ACTUAL VALUES OF TOTAL U.S. IMPORTS, BY QUARTERS, 1947–52, WITH VALUES ESTIMATED ON BASIS OF CALCULATIONS FOR FOUR MAJOR ECONOMIC GROUPS[1]

(In millions of U.S. dollars)



[1] For description of method of estimate, see text.

by their very nature incapable of explaining a cyclical pattern such as that of 1948–49. The cyclical variables that were tried proved no better predictors.

How does this multiple relation system for predicting total imports compare with the simpler new orders-total imports relation developed earlier? That relation, it will be remembered, did as well as any other in predicting quarterly imports. It did better than any other in indicating turning points.

With regard to over-all fit, the multiple relation system is somewhat superior to the single equation relation, giving a correlation coefficient of .971[15] for the period 1947–51, against .936. The average and the maximum error of forecast are smaller both for the period of correlation and for the four quarters of genuine forecast in 1952 (Table 2).

[15] The residuals, as for the single relation, are random and show no serial correlation.

TABLE 2. PERCENTAGE ERRORS OF FORECAST OF VALUE OF U.S. TOTAL IMPORTS BASED ON (1) MULTIPLE RELATION SYSTEM AND (2) SINGLE RELATION[1]

	Average Error		Maximum Error	
	1947–51	1952	1947–51	1952
Multiple relation system	4.2	3.4	12.9	6.3
Single relation	6.2	5.6	15.5	10.9

[1] For description of method of estimate, see text.

A comparison of Charts 2 and 7, however, reveals the single equation to be slightly superior to the multiple relation system in indicating turning points. The downturn in total imports at the beginning of 1949 is indicated by the single equation, but the multiple relation system does not indicate it until one quarter late. With regard to the other turning points, the performance of the two forecasting methods is much the same. There is thus no unequivocal answer to the question of which of the two methods of estimating total imports is the better. The multiple relation system is somewhat superior in over-all accuracy and the single equation is somewhat superior in indicating turning points, though in neither case is the degree of superiority marked.

Forecasts for 1953

A comparison of the performance of the two forecasting methods with the actual record of imports in 1953[16] gives results somewhat different from those summarized above. Only in the first quarter of 1953 is the forecast by the multiple relation system nearer than that of the single regression equation to the recorded values of imports (Table 3). Also, while both methods forecast inadequately the decline in imports in the third quarter, the single regression equation does better in this respect. The multiple relation system cannot be said even to forecast a decline until the fourth quarter.

The poor fit of the multiple relation system in this period is due primarily to forecasting errors in the crude foods relation. In Chart 6, forecasts by this relation for 1952 can be seen to be above the reported values in each of the four quarters of that year. As previously mentioned, this discrepancy is due to the use of too steep a trend component in the relation. In 1953, the trend component contributed an even greater element of error to the forecasts. This factor and the inability of the foods relation to forecast a cyclical decline, such as has occurred since

[16] The preceding sections of this paper and the relations discussed therein were developed when import data for 1953 were not available.

TABLE 3. FORECASTS OF TOTAL IMPORTS BY QUARTERS, 1953[1]

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
		(millions of dollars)		
Multiple relation system	2,870	2,920	2,918	2,828
Single relation	2,579	2,753	2,717	2,510
Actual total imports	2,753	2,814	2,656	2,556
		(percentages)		
Error, multiple relation system	+4	+4	+10	+11
Error, single relation	−6	−2	+2	−2

[1] These forecasts were made by using data as first reported. The use of data that include revisions made after the period of forecast and thus are not available for "forecasting" would be misleading and, obviously, not a test of the ability to forecast. The actual reported values for imports, of course, include all revisions.

the second quarter of 1953, are responsible for most of the error in the multiple relation system's forecasts for 1953. If in place of the crude foods relation the quarterly average of crude food imports in 1952, adjusted for the seasonal movement in these imports, is used in the system to forecast imports in 1953, then the multiple relation forecasts for the four quarters of 1953 would be $2,792 million, $2,783 million, $2,756 million, and $2,665 million. These figures are considerably nearer the recorded values for imports shown in Table 3. They forecast the downturn in imports in the third quarter, though somewhat inadequately, and their accuracy is exceeded by that of the single relation system in only two of the quarters. Manipulation of this sort, however, might well be criticized as forecasting after the fact, and the point would be well taken.

It would seem, therefore, that if forecasts of imports are to be made the simple regression equation is more reliable, as well as simpler.

Forecasts for 1954

The Department of Commerce published in December 1953 a revision of the unadjusted new orders series for the period 1950–52, incorporating new data.[17] These revisions increase the figures for 1950, 1951, and 1952, the increase being negligible for 1950 and greatest ($1.2 billion at a quarterly rate) for the fourth quarter of 1952. Using these revised data and including data for 1952,[18] we recomputed the total imports-new orders relation. The result was a small improvement in the correlation

[17] See *Survey of Current Business*, December 1953, for a detailed explanation of the revisions.

[18] It should be remembered that the relations described earlier in this study were based on data only for the period 1947–51.

coefficient; it rose from .936 to .945. The recomputed relation for the period 1947–52 is

$$M = 42.527\, N_{-1} - 393.096 \qquad (11)$$

where M and N_{-1} are the same as in equation (2).

Forecasts of total U.S. imports, using the recomputed relation, for the fourth quarter of 1953 and the first and second quarters of 1954 are $2,575 million, $2,398 million, and $2,435 million, respectively. A strong upturn in the new order series in February and March 1954, after a low point in January, is responsible for the indicated break in the second quarter of the downward movement in imports that has been in progress since the second quarter of 1953. Reported values of imports in the fourth quarter of 1953 and the first quarter of 1954 were $2,556 million and $2,533 million. Thus, the forecasts compare favorably with the actual record in these latest two quarters.

Forecasts for Longer Periods

It would obviously be desirable to forecast more than a quarter ahead. This would require finding either an indicator that leads imports by a wider margin than the new orders series does, or some series, or ratio, by which manufacturers' new orders in turn might be the subject of direct forecast. Preliminary investigations along both lines have not proved fruitful. The new orders relation has proved, so far, to be the best indicator of total imports, with respect to both accuracy and direction of movement. Attempts to find devices to forecast new orders have not yielded any satisfactory results.

Thus, at present, a one-quarter forecast of total imports, about eight weeks in advance of the actual event, based on movements in the value of manufacturers' new orders, appears to be the best that can be expected from any method of direct forecasting based on the use of regression techniques. The error of forecast is likely to be small except, of course, when a speculative development in imports caused by political events upsets the relationship between imports and new orders.