A Study of Imports, Part 3. Materials for Further Non Agricultural Production

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SECTION 4: A STUDY OF IMPORTS, PART 3. MATERIALS FOR FURTHER NON AGRICULTURAL PRODUCTION

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§4.1. *Introduction*

Part 1 of this study presented seasonally corrected quarterly totals of merchandise imports, disaggregated according to function, from 1958 to 1968. Part 2 analysed the behaviour of imports of consumption goods ready for use, and set out some forecasting models for this category of import. The current part of this study attempts a similar exercise for the largest import category, materials for further non-agricultural production. As in Part 2, the method is to apply regression analysis to seasonally corrected quarterly data, and to test various combinations of potential explanatory variables.

§4.2 *Imports of Materials, Potential Factors*

The great majority of imports in this category are materials or semi finished products for further processing by manufacturing industry. Consequently the obvious explanatory factor to consider first is the level of activity in manufacturing industry.

There is little practical difficulty in this, as the index of the volume of production in manufacturing industry is available on a quarterly basis throughout the period considered. Of course this index is weighted according to the value added in Ireland by the various industries concerned, and not by the volume of imports of each industry. Thus if those sections of industry with low imports relative to value added were to follow a different time path of fluctuations and growth from those with high imports and a low value added, no close correspondence between the index of industrial production and the level of materials imports could be expected. It is difficult to know how far this reservation has any practical significance. There are considerable variations between industries in the rate and timing of growth, but this, in itself, does not necessarily greatly affect the balance between output and imports. Also, in spite of these variations, there remains a tendency for most industries to respond more or less together to general economic conditions. On balance it seems reasonable to expect that this consideration will disturb, but not destroy, the anticipated relationship between materials imports and the index of industrial production.

The level of output in manufacturing industry itself is dependent on demand in home and exports markets. Consequently it is of interest to replace the index of production by series representing such demand factors. Thus in one set of equations

the variables of industrial exports, the retail sales index, and consumer goods imports (reflecting the alternative source of supply for domestic consumption) are used in place of the index of production.

Manufacturers' stocks of materials are an important factor influencing imports in any particular quarter, but no quarterly, or even adequate annual, figures are available for movements in manufacturers' stock levels, and consequently no specific variable can be included for this factor. A credit variable, such as total bills, loans and advances within the State, might to some extent reflect movements in stocks, although it would also respond to movements in many other factors, and can be expected to suffer from a considerable degree of collinearity with industrial production. It is however worth including in at least some formulations, particularly as it is a variable which can be influenced by policy decisions. It is also possible that stock levels are influenced by interest rates, and accordingly the ordinary overdraft rate of Commercial Banks has been included in some formulations.

Conceptually there are difficulties concerning the factor of relative prices. Imports of materials for further production cover a wide range of products, some of them with close domestic substitutes and some without. It has sometimes been argued that such imports should be divided into competing and non-competing categories, with the expectation that the former should be relatively price elastic and the latter price inelastic. To the writers however such a division does not appear to meet the difficulty. Few goods have an identical substitute, while none can be regarded as having no substitute at all, however distant. Consequently it is unrealistic to postulate a clear dividing line between two categories. Rather there is a continuous spectrum of substitutability; and any dividing line must be extremely arbitrary. Consequently no attempt is made further to subdivide materials imports for price purposes, and no strong expectations are held as to the likely impact, if any, of this factor on the analysis. The actual variable chosen is a relative price index obtained by dividing the wholesale price index of home produced materials for use in industry by that for imported materials for use in industry, and seasonally correcting the results. As the imported materials price index includes tariffs, this constructed series should take care of the effects of changes in tariffs and import levies over the period studied. In some formulations where the relative price index is not included a dummy variable for tariff changes is used.

Alterations in quota and licensing restrictions must have had a considerable effect on the behaviour of materials imports in recent years. However, the nature of these alterations, particularly in the case of licensing, where the change may be in interpretation rather than in the basic rules, makes it impossible to construct a meaningful quantitative index, or even to approximate to the timing of effective changes by means of dummy variables. An attempt to use a simple dummy variable for quotas in the analysis of consumer imports was not very successful. Accordingly such a dummy is used in only a few of the formulations tested.

As in the case of consumer imports it is necessary to allow for the effect of trade disrupting labour disputes, such as U.K. dock strikes and the seamens strike of 1966. In some equations this is done through the inclusion of dummy variables for these strikes, in others by adjusting the relevant series to remove as far as possible the effects of the strikes. In most of the equations calculated, the principal explanatory variable is the index of production in manufacturing industry. As this is a volume index, it has been felt appropriate to convert the material import figures to a volume basis. This has

been done by deflating the published value figures by the unit value index for all imports. While not an ideal deflator, this index based on c.i.f. prices seems better than any available alternative. In those equations where the demand variables, rather than the been done by deflating the published value figures by the unit value index for all imports. are taken as the dependent variables. On further adjustment to the import figures for certain equations is the removal of cereal imports for further production, as these appear to be dependent more on supply conditions of domestic cereals than on industrial demand factors. This point will be discussed further in §4.5.

All series, with the exception of time and dummy variables, are seasonally corrected, and are expressed in appropriate forms for the various formulations (e.g. absolute levels, percentage first differences, moving three quarter average of first differences). In many cases lagged terms of the independent variables are included as well as the current terms while in some formulations leading terms are also included. In most instances only one quarter lags are used, as a priori, longer lags seem unlikely to be helpful, and no attempt is made to introduce any complicated lag structures. With most equations containing a large number of independent variables any attempt to experiment with lag structures would tend to become excessively complex.

§4.3 *Volume of Materials Imports, absolute levels*

As an introduction to the analysis proper, a very simple test of absolute levels of the volume of materials imports regressed on the index of production in manufacturing industry, time and a composite dummy variable for strikes is made. The results are shown in Table 4.1. As can be seen, the fit by any of the usual tests appears good. However, as explained in the analysis of consumer imports, regressions on absolute levels are not of great benefit for prediction purposes because of problems of collinearity between the main explanatory variable and time, and because the standard error of estimate is so large compared to the first differences which need to be predicted.

§4.4 *Volume of Materials Imports, percentage changes*

An attempt was made to use these data, together with some of the additional variables discussed in §4.2, in first difference terms. Both straightforward percentage changes with or without lags, and changes adjusted for strikes and three-quarter moving averages of changes were tested. The results are uniformly disappointing and for that reason are not given in detail. The fit, measured by either R or the F-test, is poor, the standard errors of estimate high, and the significance of what a priori should be the main explanatory variable, industrial production, tends to be low. The simple regression between percentage change in materials imports and industrial production, adjusted for strikes and with both series smoothed, gives the result $Y_c = -0.68 + 1.49\ X_1$, with an R of .573 and F-value of 18.06 and a standard error of estimate of 2.07. This is not good enough for prediction purposes, and the addition of other variables, while improving the R, does not yield results sufficiently better, to be of any assistance.

§4.5 *Cereal Imports*

Re-examination of the data suggests one important reason for this disappointing performance. The import category materials for further production in industry includes

TABLE 4.1: VOLUME OF MATERIALS IMPORTS, ABSOLUTE LEVELS, REGRESSION ANALYSIS

A. *Variables*

Dependent Y =materials imports, constant prices, seasonally corrected quarterly 1958–68, index 1958=100.

Independent X_1=volume of production index, manuf. industry, seasonally corrected quarterly 1953=100.

X_2=composite dummy for major strikes.

X_3=time, 1st Q 1958=1, 4th Q 1968=44.

B. *Significance and Fit*

Equation No.	Independent Variable	Significant at 1%	Not Significant at 20%	R	F Value	Standard Error of Estimate
A1	1,2,3	1,2	3	.985	434	6.53
A2	1,2	1,2	—	.985	668	6.45
A3	1,3	1	3	.977	437	7.91
A4	1	1	—	.977	887	7.85

C. *Regression Coefficients*

Equation	X_1	X_2	X_3	Intercept
A_1	1.091	9.258	0.085	—15.86
A_2	1.126	9.194	—	—19.20
A_3	1.310	—	—0.440	—37.54
A_4	1.132	—	—	—20.22

cereals for milling and compounding. Although these products are of course an input to industrial production, the value added to the input by the processing is relatively small, and the value added is the basis for weighting each industrial sector in the overall index of industrial production. Thus variations in the level of grain milling and feed compounding have little impact on the performance of the index of industrial production, but can have a great influence on the level of inputs, including, in this case, imports. Even more important, imports of these products very largely fill the role of bridging the gap between domestic cereal production, and the input needs of the milling and compounding industries. Thus these imports are highly sensitive to variations in domestic output of cereal crops, whether these are due to changes in the acreage planted or in the yields obtained.

If it can be demonstrated that in fact cereal imports respond to these factors rather than to the general level of industrial activity, it seems justifiable to exclude them from the main analysis of materials imports. A few simple and rather crudely formulated regression equations have been calculated to test whether the expected structural relationships exist. As quarterly figures are meaningless for the production of crops with an annual harvest, the series are constructed on an annual basis.

Domestic production of corn crops on a volume (starch ton) basis, X_1, is taken from annual data. So also is the alternative domestic supply variable, value of sales of corn crops, X_2. Annual purchases of animal feed by farmers for the following calendar year are taken as the demand variable X_3. The dependent variable Y is imports of cereals in the 12 months October to September following the harvest concerned in

X_1 or X_2. Ideally of course X_3 should cover the same period, from October to September, as Y, but the three month overlap, which cannot easily be avoided, should not distort the results very much. Similarly it would be better to take cereal imports in volume terms, but no suitable price deflator is available and the caculations involved in converting the quantity trade figures for each cereal to a consistent denominator such as starch tons does not seem worthwhile in what is, after all, a fairly peripheral section of the main exercise.

All combinations of the X's were tested and all gave quite good results, the most satisfactory being that for X_1 and X_3.

$$Y_c = 27.9 - 0.03\ X_1 + 0.25\ X_3. \qquad R = .879\ F = 20.35$$
$$(T = 4.06)\quad (T = 3.96) \qquad S.E.E. = 1.85$$

While the equation is not really suitable as a precise forecasting model, this result, with both coefficients significant at the 1% level and with the expected signs, seems satisfactorily compatable with our hypothesis concerning cereal imports. Consequently, we proceed to examine the volume of material imports excluding cereals.

§4.6 *Volume of Material Imports, excluding cereals*

As a first test to see whether the exclusion of cereals improves the relationship between the volume of materials imports and the index of industrial production, with or without other explanatory variables, we take a small selection of equations on the absolute data. The results are shown in Table 4.2, and comparison with Table 4.1 shows that there is in fact some improvement. The simple regression on the index of industrial production has slightly higher R and F-value in B5 than in A4, while the standard error of estimate when divided by the mean of Y is a little lower. Direct comparison is less easy where the other variables are added, as these are not the same in the two sets, but in general it appears that the results in Table 4.2 are marginally better than in Table 4.1.

It is interesting that, in equation B1, the relative price and credit variables have little or no significance, add very little to the fit in comparison with B2, and have the "wrong" signs to their coefficients. Similarly in B3 the addition of these two variables does little to improve the fit obtained with the production index alone as in B5, and the signs remain in the wrong direction. The addition of the dummy variables, and to a lesser extent the lagged term of the production index, as in B2 and B4, do appear to improve the fit. However the main impression to be gained from Table 4.2 is that there is a close structural relationship, as is to be expected, between the volume of materials imports and the volume of industrial production, while there is little or no evidence that other factors, apart from disturbances caused by strikes, have any marked effect on the level of materials imports.

However, the arguments already expressed against relying on absolute data in arriving at a forecasting model remain strong. It is therefore advisable to proceed to a consideration of percentage first differences.

TABLE 4.2: MATERIALS IMPORTS, LESS CEREALS, ABSOLUTE VOLUME LEVELS, REGRESSION ANALYSIS

A. *Variables*

Dependent Y = materials imports excluding cereals, constant prices, seasonally corrected quarterly 1958–68. £m.

Independent X_1 = volume of production index, manufacturing industry, seasonally corrected quarterly 1958–68, 1953=100.
$X_2 = X_{1(t-1)}$
X_3 = dummy variable, dock strike 1963, 3rd Q.
X_4 = dummy variable, seamen's strike 1966, 2nd Q.
X_5 = dummy variable, dock strikes 1967 3rd, 4th Q.
X_6 = relative price index, domestic/import, seasonally corrected, 1953=100.
X_9 = bills, loans, advances within the State seasonally corrected.
X_8 = time 1st Q. 1958=1, 4th Q. 1968=44.

B. *Significance and Fit*

Equation No.	Variables Significant at 1%	5%	20%	Not Significant at 20%	R	F Value	Standard Error of Estimate
B1	1	3,4	2,6,8	5,7	.989	189	1.47
B2	1,3,4	—	5	—	.986	347	1.53
B3	1	7	6	—	.981	348	1.76
B4	1,2	—	—	—	.983	571	1.68
B5	1	—	—	—	.979	984	1.81

C. *Regression Coefficients*

Equation	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	Intercept
B1	0.477	—0.094	2.591	1.465	0.603	—0.253	—0.016	—0.181	7.97
B2	0.276	—	2.807	2.050	0.899	—	—	—	—5.78
B3	0.380	—	—	—	—	—0.223	—0.043	—	9.25
B4	0.497	—0.226	—	—	—	—	—	—	—5.59
B5	0.278	—	—	—	—	—	—	—	—6.07

§4.7 *Volume of Material Imports, Excluding Cereals, Percentage Changes*

The variables included in the analysis are the same as those used for the absolute data, with the addition of lagged terms for credit and relative prices, an extra disturbance dummy for the abnormal weather and possible effects of reduction in tariffs of the first quarter of 1963, and with the time variable, of course omitted.

The results of the more interesting equations are set out in Table 4.3. Equations C1, C3, and C6 show that the lagged terms, used either alone with the dummies or in conjunction with current terms, have little significance and contribute practically nothing to the fit. Equation C7 shows that on its own industrial production has a highly significant relationship with materials imports, but a rather low R. Equation C5 shows that the dummy variables on their own account for a great deal of the behaviour of materials imports, but comparisons with equation C4 demonstrates that the introduction of X_1, the production variable, does improve the fit considerably. Equation C2 suggests that some further improvement is achieved when the current terms of the relative prices

TABLE 4.3: VOLUME OF MATERIALS IMPORTS, EXCLUDING CEREALS, PERCENTAGE CHANGES, REGRESSION ANALYSIS

A. *Variables*

Dependent Y = Materials imports excluding cereals, constant prices, seasonally corrected quarterly 1958–68 % 1st differences.

Independent X_1 = volume of production index, manufacturing industry, seasonally corrected quarterly 1958–68 % 1st differences (1953=100).

$X_2 = X_{1\ t-1}$

X_3 = Bills, loans advances within State, seasonally corrected quarterly, 1958–68 % 1st differences.

$X_4 = X_{3\ t-1}$

X_5 = relative price index, domestic/import, seasonally corrected quarterly 1958–68 % 1st difference.

$X_6 = X_{5\ t-1}$

X_7 = dummy variable dock strike 1963, 3rd Q.

X_8 = dummy variable seamen's strike 1966, 2nd Q.

X_9 = dummy variable dock strikes 1967, 3rd, 4th Q.

X_{10} = dummy variable abnormal weather 1963, 1st Q.

B. *Significance and Fit*

Equation No.	Variable Significant at			Not Significant at 20%	R	F-value	Standard error of Estimate
	1%	5%	20%				
C1	1,7,8,10	5	2,9	3,4,6	.899	13.4	4.04
C2	1,7,8,10	5	3,9	—	.894	19.9	3.94
C3	7,8,10	—	—	2,4,6,9	.850	13.0	4.64
C4	1,7,8,10	—	9	—	.881	25.8	4.04
C5	7,8,10	—	9	—	.848	24.3	4.48
C6	1	2	3,5	4,6	.645	4.3	6.62
C7	1	—	—	—	.543	17.2	6.82

C. *Regression Coefficients*

Equation No.	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	Intercept
C1	1.26	—0.34	—0.25	—0.23	—1.11	0.06	6.53	5.47	2.37	8.47	1.84
C2	1.22	—	—0.37	—	—0.97	—	5.80	5.85	2.38	9.12	1.13
C3	—	—0.25	—	0.09	—	0.10	6.47	7.45	1.39	9.08	2.64
C4	1.16	—	—	—	—	—	6.29	5.55	1.38	9.65	0.44
C5	—	—	—	—	—	—	6.32	7.65	1.60	9.50	2.42
C6	2.15	—1.09	—0.82	0.25	—1.42	0.50	—	—	—	—	1.77
C7	2.14	—	—	—	—	—	—	—	—	—	—1.22

D. *Selected Equation*

C4. $Yc = 0.44 + 1.16X_1 + 6.29X_7 + 5.55X_8 + 1.38X_9 + 9.65X_{10}$

and credit variables are added, and that these variables are themselves fairly significant. However the signs of their coefficients are the opposite of what would be expected on a priori reasoning. Because of this, and because the improvement they offer in R and in the S.E.E. is very slight, it seems better to omit them from consideration and to select as a possible forecasting model from this set of equations C4 which includes only industrial production and the disturbance dummies.

§4.8 *Volume of Materials Imports, Excluding Cereals, Adjusted Changes*

As in the case of consumer imports, it has been attempted to deal with the disturbances caused by strikes by adjusting these out of the data so far as is possible. In this case the adjusted figures give rather similar results to the unadjusted, with all variables other than industrial production being either of low significance or possessing signs in the unexpected direction. The simple correlation between materials imports and industrial production is slightly lower than in the unadjusted set of equations, while the regression coefficients for industrial production at around 1.7 are between those obtained with and without the dummies in Table 4.3. In all, there seems little to be gained from the use of simple percentage changes in the adjusted data compared with the unadjusted.

A further line of inquiry is to run the regressions on the period from 1960 to 1968, thus eliminating some quite large unexplained variations in 1958 and 1959. Rather surprisingly, the shorter period produces results slightly less good than the full period.

Accordingly, as in the case of consumer imports, we proceed to smooth the various series by taking percentage changes between three quarter moving averages of the adjusted data. The results of this exercise are shown in Table 4.4.

Because the range of deviations from the mean for each series is much lower than in the case of simple quarter to quarter changes it is not surprising that the value of R is generally lower than in Table 4.3. By the same token, the standard errors of estimate are also lower, both absolutely and in relation to the mean of the dependent variable.

As in the case of earlier sets, the only series which emerges as consistently significant is industrial production, in its current term. However, the addition of the lagged term for credit, and the current term for relative prices as in equation D4, does marginally improve the fit and reduce the standard error of estimate. Although, as in the earlier sets, it is difficult to explain the negative signs of these coefficients when theoretical considerations demand that they should be positive, it seems sensible in this case to select D4 as well as D5 as equations worth testing for their predictive value.

§4.9 *Value of Materials Imports*

Although the analyses already described yield some quite good results for the volume of materials imports, excluding cereals, which can be predicted separately on an annual basis, it is felt that an alternative approach, based directly on the value figures may give a useful check on these results. In this set of variables, industrial production is omitted, and in its place the retail sales index, representing domestic consumption, and industrial exports, representing relevant external consumption are used. Because domestic consumption can be met either by domestic production as by imports of consumer goods, such imports are also included as a variable, in the ex ante expectation that they should show a negative correlation. No direct price variable is included, but dummies for tariffs, quotas and strike disturbances are tested, as are interest rates and bills loans and advances. Lags of most variables, and leads for some, are also included.

The full list of variables, and the results of some of the more successful equations, are set out in Table 4.5. Equation E1 shows that as in most other sets tested, many of the variables are not significant, and that many, especially X_8, X_{11}, and X_{13} have signs

TABLE 4.4: VOLUME OF MATERIALS IMPORTS, EXCLUDING CEREALS, MOVING AVERAGE OF CHANGES REGRESSION ANALYSIS

A. *Variable*

Dependent Y = materials imports, excluding cereals, constant prices adjusted for strikes, seasonally corrected, moving 3 quarter average of % 1st differences 1958–68.

Dependent X_1 = volume of production index, manufacturing industry, seasonally corrected moving 3 quarter average of % 1st differences 1968–68.

$X_2 = X_{1\ t-1}$

X_3 = bills loans advances within State, seasonally corrected, moving 3 quarter average of % 1st differences.

$X_4 = X_{3\ t-1}$

X_5 = relative price index, domestic/import, seasonally corrected, moving 3 quarter average of % 1st differences.

$X_6 = X_{5\ t-1}$

B. *Significance and Fit*

Equation No.	Variables Significant at			Not significant at 20%	R	F value	Standard Error of Estimate
	1%	5%	20%				
D_1	1	—	2	3,4,5,6	.740	6.9	1.81
D_2	1	—	3,5	—	.698	11.7	1.85
D_3	—	—	2	4,6	.253	0.8	2.50
D_4	1	4	5	—	.710	12.5	1.82
D_5	1	—	—	—	.673	32.3	1.86

C. *Regression Coefficients*

Equation No.	X_1	X_2	X_3	X_4	X_5	X_6	Intercept
D_1	2.31	—0.62	—0.18	—0.27	—0.37	—0.39	0.16
D_2	1.84	—	—0.39	—	—0.42	—	—0.21
D_3	—	0.68	—	—0.14	—	—0.05	1.30
D_4	1.87	—	—	—0.47	—0.53	—	—0.12
D_5	1.72	—	—	—	—	—	—0.85

D. *Selected Equations*

D_4 $Yc = -0.12 + 1.87X_1 - 0.47X_4 - 0.53X_5$

D_5 $Yc = -0.85 + 1.72X_1$

which are contrary to commonsense expectations. However, it is reassuring that the two most fundamental variables, X_1, and X_4 are significant in most of the combinations tested, and that their coefficients are reasonably stable and possess the expected positive signs.

Although the value of R rises to high levels when most of the variables are included, ease of handling, as well as the fact that some of the minor variables are not significant or have apparently perverse signs, suggests that the best equations to select for predictive testing are E4 and E6.

As this value of imports approach is designed mainly as a check on the results obtained from a volume approach, no attempt has been made to extend it to a consideration of strike adjusted or moving average formulations.

TABLE 4.5: VALUE OF MATERIALS IMPORTS, PERCENTAGE CHANGES, REGRESSION ANALYSIS

A. *Variables*

Dependent Y =value of materials imports, seasonally corrected quarterly, % 1st differences 1961–68.

Independent X_1 =value of industrial exports, seasonally corrected quarterly, % 1st differences 1961–68.

$X_2 = X_{1\ t-1}$

$X_3 = X_{1\ t+1}$

X_4 =index of retail sales, seasonally corrected quarterly, % 1st differences 1961–68.

$X_5 = X_{4\ t-1}$

$X_6 = X_{4\ t+1}$

X_7 =dummy variable for tariff costs

X_8 =dummy variable for quota relaxations

X_9 =dummy variable for major strikes

X_{10}=ordinary overdraft rate of commercial banks, quarterly average 1961–68.

X_{11}=bills, loans, advances within State, seasonally corrected quarterly, % 1st differences 1961–68.

$X_{12} = X_{11\ t-1}$

X_{13}=value of consumer imports, seasonally corrected quarterly, % 1st differences 1961–68.

$X_{14} = X_{13\ t-1}$

B. *Significance and Fit*

Equation No.	Variable Significant at 1%	5%	20%	Not Significant at 20%	R	F-value	Standard error of Estimate
E1	8	1,4	2,10,13	3,5,6,7,9, 11,12,14	.932	5.2	5.12
E2	4,8	1,9	10,11	7,13	.910	10.2	4.74
E3	4,8,9	1	11	7,10	.906	11.8	4.69
E4	9	4	1	—	.837	17.1	5.49
E5	—	13	1,4	—	.807	13.7	5.93
E6	4	1	—	—	.759	15.6	6.39

C. *Regression Coefficients*

Equation	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	Intercept
E1	0.67	0.44	—0.07	2.10	—0.49	0.38	1.42	—14.85	1.62	—2.33	—0.55	—0.91	0.59	0.05	15.11
E2	0.49	—	—	2.11	—	—	1.31	—11.36	3.24	—1.33	—0.82	—	—	—	9.35
E3	0.52	—	—	2.41	—	—	2.21	—10.82	3.99	—1.09	—0.85	—	—	—	7.60
E4	0.23	—	—	1.76	—	—	—	—	4.12	—	—	—	—	—	— 0.74
E5	0.32	—	—	1.42	—	—	—	—	—	—	—	—	0.52	—	— 2.11
E6	0.48	—	—	2.46	—	—	—	—	—	—	—	—	—	—	— 2.92

D. *Selected Equations*

E4 $Yc = -0.74 + 0.23X_1 + 1.76X_4 + 4.12X_9$

E6 $Yc = -2.92 + 0.48X_1 + 2.46X_4$

§4.10 *Forecasting Tests*

From the analysis five equations have been selected as appearing to possess reasonable potential for predictive purposes. Each has an acceptable value for R in the context of first difference regression analysis, an F value which is highly significant, and no sign of a critical level of residual autocorrelation. As in the case of the equations selected from the analysis of consumer imports in Part 2 of this study it is possible to submit

these equations to the test of "predicting" the now known level of imports in the first two quarters of 1969. As these quarters are outside the period covered by the equations the test is a valid one, although unfortunately both periods suffer from the drawback that they are affected by the maintenance dispute and its aftermath. This depressed the index of industrial production and industrial exports in the first quarter leading automatically to a very high percentage increase in the second quarter as these series recovered from the dispute.

The results of the tests are set out, both in terms of percentage changes and absolute values, in Table 4.6. Partly to minimise the effects of the maintenance dispute the value figures are given where possible for the two periods combined, which is in many ways a fairer test than either quarter on its own. It should be borne in mind that the dependent variable is defined differently between some of the equations, which accounts for the differences in the "actual" columns of the table.

On the whole these results can be regarded as good. Both the moving average "predictions" are very close to the actual outcome, and all the six month "predictions" are reasonably close. With the exception of equation E4, the "predictions" for the individual quarters are not quite so good, but, as explained, the influence of the maintenance dispute must account for much of the residuals.

However, although the results of the tests are encouraging, testing over a longer period is necessary before it can be claimed with confidence that any or all of the selected equations are really useful forecasting tools.

§4.11 *Conclusions*

As in the previous exercise on consumer imports, this analysis has involved the calculation of a large number of regression equations, of which a few of the more interesting have been presented in the tables. Apart from the dummies for temporary disturbing factors the equations have been based on about 10 different quarterly variables, analysed in different formulations, including lags, and in varying combinations.

So far as aiding an understanding of the structural relationship between materials imports and other economic variables is concerned, the positive achievement of the analysis has been to demonstrate effectively the expected close relationship between these imports and the volume of production in manufacturing industry. Although clearly implicit in the equations based on data in absolute terms, this relationship only emerges in the more rigourous analysis of percentage first differences after various adjustments are made to the original data. First, as a matter of classification, it is necessary to remove from materials inputs those cereal products whose demand depends on the size of the domestic grain harvest rather than on the level of industrial activity. Secondly, as in the case of consumer imports, it is necessary to allow for the disturbing effects of major transport strikes, either by the use of dummy variables or by adjusting the data. With these adjustments made, the relationship with industrial production becomes quite clear, even in first difference terms. Interestingly it appears as if the relationship is almost entirely a current one, with neither leads nor lags showing any significant relationship.

In conjunction with industrial production, neither relative prices nor credit, as measured by bills loans and advances, appear to influence short-term movements in the

TABLE 4.6: FORECASTING TESTS

A. *Percentage Changes*

Equation No.	Dependent Variable	1st Quarter 1969			2nd Quarter 1969		
		Actual	Predicted	Residual	Actual	Predicted	Residual
		%	%	%	%	%	%
C4	Materials imports (excluding cereals) at constant 1958 prices	—3.15	—5.61	+2.46	+7.94	+15.50	—7.56
D4	As above, centred 3-quarter moving average	+4.74	+4.06	+0.68	—	—	—
D5	Ditto	+4.74	+5.30	—0.56	—	—	—
E4	Value of Materials Imports at current prices	+1.80	+0.04	+1.76	+10.23	+12.66	—2.43
E5	Ditto	+1.80	—2.06	+3.86	+10.23	+17.26	—6.97

B. *Absolute Values*

Equation No.	Period	Actual £ million	Predicted £ million	Residual £ million
C4	1st Q. 1969	55.4	54.0	+1.4
	2nd Q. 1969	59.8	64.0	—4.2
	1st Half 1969	115.2	118.0	—2.8
D4	1st Q. 1969	57.5	57.1	+0.4
D5	1st Q. 1969	57.5	57.8	—0.3
E4	1st Q. 1969	74.3	72.4	+1.9
	2nd Q. 1969	81.9	83.7	—1.8
	1st Half 1969	156.2	156.1	+0.1
E5	1st Q. 1969	74.3	70.9	+3.4
	2nd Q. 1969	81.9	87.1	—5.2
	1st Half 1969	156.2	158.0	—1.8

volume of materials imports. This could be a mere formulation problem, so that if better series for these factors were available their significance would be shown. On the other hand it could be, particularly in the case of relative prices, that the influence is a more long term one, ultimately affecting the absolute level of materials imports, but with little relevance to quarter-to-quarter movements in them. If this is the case, the type of approach adopted here would be unlikely to show their importance, and a different approach to the problem would be necessary.

Not surprisingly, the analysis suggests that industrial production can be replaced by demand series, such as industrial exports and retail sales, as explanatory variables with a considerable degree of success. Even in this case, where an extra transaction stage is added, the relationship appears to be in current rather than lagged terms. This is an important finding, implying as it does that any increase in demand will almost immediately result in a corresponding increase in materials imports. Of course, this whole problem of lead and lag effects could be treated much more satisfactorily if adequate statistics on stock levels existed.

Thus from the point of understanding structural relationships the exercise can fairly be regarded as useful, in confirming some expected relationships, showing no evidence for the short-term existence of others, and in general implying a response within the current quarter by imports to changes in their explanatory variables.

From a forecasting point of view, most of the equations selected performed satisfactorily in the initial test for the first half of 1969, and have as sufficiently good degree of fit to hold promise for reasonable results over a longer period. However, as was explained, in the case of the consumer import equations which gave less satisfactory results on their initial test, a much longer period of testing is necessary before judgment can be passed on their utility as an addition to the collection of forecasting and consistency tools used in the Quarterly Economic Commentary.