A Study of Imports, Part 5. Total Imports

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SECTION 4: A STUDY OF IMPORTS, PART 5. TOTAL IMPORTS

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§4.1 *Introduction*

Articles in previous issues of the Quarterly Economic Commentary* have examined the pattern of imports by use category, and have analysed the behaviour of imports of consumption goods, materials for further non-agricultural production and producers capital goods. This article aims to round off the study by testing the predictive quality of the equations set out in the earlier parts of the study, and by seeing how far the predictions of the different categories of imports can be added together to provide a prediction of total merchandise imports. It also examines whether the variables which emerged as significant in the analyses of the import categories can be used directly to provide a more simple quarterly forecasting model for total merchandise imports. The prediction results given by these methods are compared with those given by existing import functions based on annual data.

§4.2 *Aggregate merchandise imports*

The analysis of each category of import tested several variables which appeared appropriate to that category. In analysing quarterly aggregate imports, it has been decided to concentrate on retail sales and industrial exports as the principal explanatory variables. As Part 2 of the study showed, there is a fairly close correlation between the value of retail sales and imports of consumer goods. Moreover, as was shown in Part 3, retail sales and industrial exports together form a reasonable proxy for industrial production in explaining imports of materials. Indirectly, through their effect on the level of industrial production, these variables can also be expected to influence the level of imports of capital goods, although the relationship was not tested in Part 4 of the study.

Various minor variables have also been included in the aggregate study, mainly in an attempt to deal with fluctuations in the level of imports due to specific but discontinuous factors such as strikes and the timing of aircraft deliveries.

The dependent variable, total merchandise imports, is expressed in both value and volume terms, each seasonally corrected. Both simple percentage first differences from quarter to quarter, and the percentage change between three-quarter moving averages, centred for each quarter, have been tested. Where the three-quarter averages, or smoothed series, are used, many of the dummy explanatory series have been dropped.

*Q.E.C. May, September, December 1969 and March 1970.

TABLE 4.1: VALUE OF MERCHANDISE IMPORTS—REGRESSION ANALYSIS

Period 1962–1968. Seasonally Corrected Quarterly Data

A. *Variables*

Dependent Y_1 = Total merchandise imports. % 1st differences.
Y_2 = Total merchandise imports. % 1st differences of 3 quarter moving averages.

Independent X_1 = Index of retail sales (value). % 1st differences.
X_2 = Index of retail sales (value). % 1st differences of 3 quarter moving averages.
X_3 = Value of industrial exports. % 1st differences.
X_4 = Value of industrial exports. % 1st differences of 3 quarter moving averages.
X_5 = Dummy variable for major trade-impeding strikes.
X_6 = 3 quarter moving average of X_5.
X_7 = Dummy variable for major aircraft imports.
X_8 = Dummy variable for quota changes.
X_9 = Dummy variable for weather in 1st quarter 1963.
X_{10} = Dummy variable for major changes in indirect taxation.

B. *Significance and Fit*

Equation No.	Dependent Variable	Independent Variables Significant at					R	F value	SEE
		1%	5%	10%	20%	>20%			
A1	Y1	1,5,9	7,8	10		3	.935	18.9	3.39
A2	Y1	1,5	7,8		3		.899	17.6	3.99
A3	Y1	1,5		8			.867	23.1	4.34
A4	Y1	1	5				.842	29.2	4.59
A5	Y2	2		4		6,8	.849	12.9	2.08
A6	Y2	2	4			8	.848	17.9	2.04
A7	Y2	2	4				.841	26.5	2.04
A8	Y2	2					.797	39.9	2.22
A9	Y2	4					.622	14.5	2.88

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
A1	2.074		.127		3.521		.662	−6.295	−8.309	3.656	−0.051
A2	2.810		.251		3.171		1.460	−7.986			−1.650
A3	3.012				2.999			−6.151			−1.079
A4	2.633				2.585						−1.143
A5		2.417		.346		.241		−1.190			−2.359
A6		2.461		.375				−1.270			−2.537
A7		2.315		.380							−2.478
A8		2.850									−1.784
A9				.770							−0.432

D. *Selected Equations*

A4 $Y_1c = -1.143 + 2.633X_1 + 2.585X_5$.
A7 $Y_2c = -2.478 + 2.315X_2 + .380X_4$.

Table 4.1 sets out the variables used and the results of the more interesting equations for the value of merchandise imports. As can be seen, the retail sales index (X_1, X_2) is significant at the 1 per cent level in every formulation in which it is included, in either simple or moving average terms. The value of industrial exports (X_3, X_4) is not significant in its simple difference formulation, although it is significant at the 10 per cent level or better in moving average form. Of the dummy variables, that for major strikes (X_5) is highly significant, and the others fairly significant in explaining the simple percentage changes in the value of imports. The F values show that all the equations are significant at the .01 level.

In both simple and smoothed form, the retail sales index shows reasonable consistency of coefficient, varying from just over +2.0 to just over +3.0. Of the other significant variables, X_5 and X_8 in the simple change form, and X_4 in the smoothed, also show a fair consistency of coefficient, except when X_4 is used on its own. The aricraft dummy X_7, however, shows a large difference in coefficient between the two equations in which it is used.

Of the equations shown, A4 and A7 have been selected for testing for predictive quality. Each of them has only two independent variables, which is of practical convenience, in each case both variables are significant at at least the 5 per cent level, each possesses a highly significant F-value and a reasonably high value of R, although the standard errors of estimate are rather high in relation to the mean values of Y, which are 3.2 for Y_1 and 2.7 for Y_2.

Table 4.2 sets out a similar analysis, except that there the dependent variable is the import volume index 1953=100, in simple and smoothed percentage change terms. The results are very similar to those set out in Table 4.1, although the degree of fit is a little lower. Again the retail sales index (deflated in this case by the consumer price index) is the dominant explanatory variable. The addition of the strike dummy in the simple change form and of industrial exports in the smoothed form improve the fit (as measured by R and by the S.E.E.) sufficiently to justify choosing B_3 and B_6 as the equations for further testing.

§4.3 *Consumer Goods Imports, Prediction Tests*

Part 2 of this Study of Imports* analysed imports of consumer goods, and nine equations were selected from that analysis for further testing as predictors. At the time of publication only one or two quarters were available for testing, and consequently the tests were inevitably inconclusive. It is now possible to test the predictive accuracy of these equations over a period of 6 or 7 quarters, which should give a much clearer idea of whether any of these equations shows promise as a forecasting tool.

The procedure adopted is to take the actual value of the independent variables for each quarter, and convert them into the appropriate percentage changes, smoothed percentage changes, or dummy values, and to calculate the predicted percentage change in the value of consumer imports for each quarter. When this percentage change is applied to the actual value in the previous quarter (or to the actual 3 quarter moving average for the previous period) the result is a predicted absolute level (simple or smoothed) of consumer imports in each quarter.

The results are set out in Table 4.3. Although each equation is based on quarterly data, and predicts quarterly values, for actual forecasting purposes it is quite possible that the equations might be used in making annual forecasts. For this reason the total

*Quarterly Economic Commentary, Section 4, September 1969.

TABLE 4.2: VOLUME OF MERCHANDISE IMPORTS—REGRESSION ANALYSIS

Period 1962–1968. Seasonally corrected quarterly data

A. *Variables*

Dependent Y_1 = Import volume index 1953=100. % 1st differences.
Y_2 = Import volume index 1953=100. % 1st differences of 3 quarter moving averages.

Independent X_1 = Index of retail sales (deflated by consumer price index) % 1st differences.
X_2 = Index of retail sales (deflated by consumer price index) % 1st differences of 3 quarter moving averages.
X_3 = Volume of industrial exports (value deflated by "other exports unit value index") % 1st differences.
X_4 = Volume of industrial exports (value deflated by "other exports unit value index") % 1st differences of 3 quarter moving averages.
X_5 = Dummy variable for major trade impeding strikes.
X_6 = 3 quarter moving average of X_5.
X_7 = Dummy variable for aircraft imports.
X_8 = Dummy variable for quota changes.
X_9 = Dummy variable for weather in 1st quarter 1963.
X_{10} = Dummy variable for major changes in indirect taxation.

B. *Significance and Fit*

Equation No.	Dependent Variable	Independent Variables Significant at					R	F value	S.E.E.
		1%	5%	10%	20%	>20%			
B1	Y1	1,10	5	7,8		3,9	.906	12.5	3.80
B2	Y1	1	5			3	.825	16.3	4.62
B3	Y1	1,5					.824	25.5	4.53
B4	Y1	1					.737	29.7	5.30
B5	Y2	2				4,6,8	.795	8.57	2.01
B6	Y2	2			4		.792	18.55	1.92
B7	Y2	2					.766	32.68	1.98
B8	Y2	4					.582	11.80	2.51

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
B1	2.016		.163		2.822		1.372	−5.440	2.309	6.301	1.241
B2	2.113		.049		3.018						0.982
B3	2.163				3.186						1.123
B4	2.952										.654
B5		2.331		.230		.294		−.163			0.114
B6		2.365		.274							−0.066
B7		2.843									0.571
B8				.665							−0.061

D. *Selected Equations*

B3 $Y_1c = 1.12 + 2.163X_1 + 3.186X_5$
B6 $Y_2c = -0.07 + 2.365X_2 + .274X_4$

prediction for the year 1969 is shown. In the first total 1969 column the simple sums of the predictions for each quarter of the year are shown. However, each of these is based on knowledge of the actual level of consumer imports in the previous quarter, and of course such knowledge would not be available at the beginning of the year in question. Consequently the second total 1969 column shows the results obtained by basing each predicted change on the predicted rather than the absolute value of consumer imports in the previous quarter. This is the result which would be obtained if, at the beginning of the year, perfect estimates were made of the behaviour of each of the independent variables throughout the year, but (more realistically) nothing were known of the actual behaviour of consumer imports in the course of the year. Of course, with this procedure, any error of prediction in the early part of the year is liable to be magnified in the remainder of the year, even if the percentage changes predicted in the later part of the year are themselves accurate.

The third total column for 1969 is the result of using the equations directly for annual forecasts. Each coefficient is applied to the percentage change in the annual average of the relevant variable, and the intercept value is multiplied by four. The annual percentage change thus predicted is applied to the 1968 level of consumer imports to obtain the values shown in column Total C. This method of using a quarterly model on an annual basis is open to certain theoretical objections, but it is undeniably convenient to use. Moreover, given the additional uncertainty inherent in predicting the time path as well as the overall rise in each independent variable, the direct method may well prove more accurate than the quarter by quarter approach in

TABLE 4.3: TESTS OF IMPORT EQUATIONS—CONSUMER GOODS

Seasonally Corrected £ million

	1968	1969							1970		
	IV	I	II	III	IV	Total A	Total B	Total C	I	II	III
A. *Quarterly Value at Current Prices.*											
Actual		31.7	34.7	35.2	33.4	135.0	135.0	135.0	35.3	38.8	38.6
Predicted by equation: B4		32.8	35.0	35.3	36.5	139.6	144.0	137.7	36.2	34.0	39.4
B4*		32.6	35.5	35.1	36.5	139.7	144.3	138.3	36.5	33.4	39.2
B7		32.9	34.6	35.2	36.4	139.1	142.9	136.5	36.1	34.4	39.6
D8		31.8	33.4	36.6	36.5	138.3	137.4	129.0	34.1	34.5	36.5
E1		31.3	33.3	36.4	35.6	136.6	133.6	129.0	34.4	34.1	
E3		31.6	34.3	36.7	36.7	139.3	139.7	137.1	34.5	34.8	
B. *Centred 3-Quarter Moving Average of Value at Current Prices*											
Actual	31.2	32.9	33.9	34.4	34.6	135.8	135.8	135.8	35.8	37.6	
Predicted by equation: C2	30.8	33.5	34.8	36.2	36.3	140.8	146.3	141.5	35.3	36.1	
F1	31.2	33.2	35.2	35.3	34.1	137.8	141.8	140.8	34.2		
F3	31.5	33.4	35.6	35.4	33.9	138.3	144.7	143.1	33.9		

Note. Predictions for each quarter are based on percentage change from the actual level of the previous quarter.
Total A for 1969 is the sum of these quarterly predictions.
Total B for 1969 is the sum of quarterly predictions based on the percentage change from the predicted level for the previous quarter.
Total C for 1969 is obtained by applying the regression coefficients to the annual percentage changes in the independent variables.

actual forecasting situations, as distinct from prediction testing from known values, as here.

The results shown in Table 4.3 are moderately encouraging. For the first three quarters of 1969 (and for the 4th quarter of 1968 in the case of smoothed formulations) none of the equations gives a wildly erratic result, and the majority of the predictions are within £1 million (or about 3%) of the actual level. Similarly in the first and third quarters of 1970 the results are reasonably accurate. For 1969 as a whole the sums of the quarterly predictions are all within £5 million of the actual, with the majority within 3½ per cent. In the more relevant Column B the results are less good, with some equations showing an error of around £10 million, which is too great to be acceptable. Even here, some of the equations, notably D8 and E1, show acceptable results. Column C gives rather better results than Column B, five of the equations showing predicted totals within £5 million of the actual level, and none having an error of more than £8 million.

The two quarters in which all the equations based on simple percentage changes perform badly are the 4th quarter of 1969, in which none predicted the substantial fall which actually took place, and the second quarter of 1970 in which most equations predicted a fall when there was actually a substantial rise. It is the error in the fourth quarter of 1969, allied with marginal overestimates in the two preceding quarters, which accounts for the cumulative errors in the predictions for 1969 as a whole in the B total column.

It is difficult to account for the actual fall in consumer imports in the last quarter of 1969 which is responsible for the poor result of the predictions for that quarter. With regard to the second quarter of 1970 the discrepancy is due mainly to the fact that the substantial fall in the retail sales index (itself largely caused by the effects of the cement and bank disputes) was not reflected in a fall in consumer imports.

The equations which appear to give the best result in Table 4.3 have been further tested by calculating the "Inequality Coefficient" for each over the period. This test was first devised by Verdoorn and van Eijk*, and its clearest exposition is provided by Lundberg**:

"If R_t is the observed percentage change of a variable (ex post) and F_t is the corresponding forecast, then the forecasting error is equal to: $(F_t - R_t)$.

The root-mean-square error (u) over the period of n years in question then is:

$$u = \sqrt{\frac{1}{n} \Sigma (F_t - R_t)^2}$$

This measure of error is standardised by dividing by the root-mean-square of the observed changes, s being the *normal rate of change*:

$$s = \sqrt{\frac{1}{n} \Sigma R^2}$$

The inequality coefficient is thus u/s".

In the case of perfect forecasts, u/s = 0. There is no upper bound to the coefficient, but it is clear that if the coefficient exceeds unity, the equation tested is

*P. J. Verdoorn and C. J. Van Eijk. Experimental Short Term Forecasting Models. (Central Planning Bureau, 1958).

**Erik Lundberg. Instability and Economic Growth (Yale University Press 1968).

performing no better as a predictor than a naive extrapolation of the dependent variable.

The inequality coefficients over the period tested are as follows: B7 =.88, E1 = 1.01, C2 =.93, F1 = .82. It must be admitted that these results are rather disappointing. However, much of the aggregate error in each equation is caused by the experience of the second quarter of 1970, which, as discussed earlier, was in large part caused by highly abnormal temporary factors. Thus there is a possibility that in a less distorted test period, the equations would show much lower inequality coefficients.

§4.4 *Raw Material Imports. Prediction Tests*

A similar exercise has been carried out for the selected equations from Part 3 of the Study of Imports*, relating to imports of goods for further non-agricultural production. The results are set out in Table 4.4. This table has two added complications.

In the first place, much of the analysis in Part 3 was carried out in constant price terms. Where the constant price equations C4, D4, and D5 were selected the results are shown in constant prices in the top half of the Table. The second complication is that much of the analysis of material imports was carried out after eliminating imports of cereals for further industrial production. It was demonstrated in Part 3** that cereal imports followed a time path of their own, unrelated to general material imports, and that they could be crudely explained by an annual model: $Y_C = 27.9 - 0.03\ X_1 + 0.25\ X_3$, where Y_C = value of cereal imports (October to Sept.), X_1 = domestic production of corn crops and X_3 = annual purchase of animal feed. Table 4.4 shows the level of cereal imports predicted by this model for 1968-69 and for 1969/70. It is necessary to add these predictions to the values given by equations C4, D4 and D5 multiplied by the relevant price indices in order to arrive at the total value at current prices of material imports predicted by these equations. The remaining equations, E4 and E6 are based directly on current price values, including cereals.

In the B total column, the annual results for 1969 of the constant price equations, which are based primarily on the index of industrial production, are reasonably good, especially in the smoothed formulation. The value equations, based on the retail sales index and industrial exports, give a less satisfactory result for the year, although even these are within 4% of the actual annual level. The direct annual predictions shown in the C total column are not so good, with only equation C4 giving a better result than that obtained through the quarter-by-quarter approach.

Viewed quarterly, equation C4 performs well for the third quarter of 1969 and the first quarter of 1970, and reasonably for the first and fourth quarters of 1969 and the second quarter of 1970. The large error comes in the second quarter of 1969, when the strong upsurge in the index of industrial production after the ending of the maintenance dispute was not in fact accompanied by as large an increase in material imports as the equation predicted. The two value equations, E4 and E6 similarly overestimate imports in the second quarter of 1969, but they also are seriously at error in the first three quarters of 1970, a period when material imports have followed a steady, gently rising path in contrast to the rather violent fluctuations of the retail sales index.

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*Quarterly Economic Commentary, Section 4, December 1969.

***Ibid* p. 18.

TABLE 4.4: TESTS OF IMPORT EQUATIONS—RAW MATERIALS (NON-AGRICULTURAL)

Seasonally Corrected £ million

	1969							1970		
	I	II	III	IV	Total A	Total B	Total C	I	II	III
A. *Quarterly (excluding cereals) at constant 1953 prices.*										
Actual	56.4	59.8	58.0	60.4	234.6	234.6	234.6	58.6	59.6	
Predicted by equation: C4 ...	54.1	65.1	58.8	58.2	236.2	239.6	229.5	58.3	61.7	
B. *Centred 3 Quarter Moving Average (excluding cereals) at Constant 1953 prices.*										
Actual	57.9	58.1	59.4	59.0	234.4	234.4	234.4	59.5		
Predicted by equations: D4 ...	57.8	58.9	60.9	56.9	234.5	237.4	226.7	59.3		
D5 ...	57.7	59.0	60.9	57.1	234.7	237.3	228.1	58.7		
C. *Cereal Imports for Industrial Production.*										
Actual	2.1	3.0	2.2	1.7	9.0	9.0	9.0	1.8	3.1	2.8
Predicted (see text)	2.6	2.6	2.6	2.6	10.0	10.4	10.4	2.6	2.6	2.6
D. *Quarterly Value of Material Imports at Current Prices.*										
Actual	73.3	78.6	77.8	82.2	311.9	311.9	311.9	80.2	84.1	88.2
Predicted by equations: C4* ...	71.5	85.6	79.2	79.0	315.3	319.9	306.7	81.2	87.1	
E4 ...	72.8	83.3	78.4	81.6	316.1	324.6	327.5	90.0	78.1	83.6
E6 ...	70.1	87.5	76.6	82.6	316.8	322.0	334.0	91.7	77.2	80.9
E. *Centred 3-Quarter Moving Average of Material Imports at Current Prices.*										
Actual	75.0	77.6	79.2	79.7	311.5	311.5	311.5	81.8		
Predicted by equations: D4* ...	75.4	78.2	81.6	77.8	313.0	316.8	303.1	82.3		
D5* ...	75.3	78.3	81.6	78.1	313.3	316.8	304.9	81.5		

* Constant Price Prediction × Price Index + Prediction of Cereal Imports.
See also note to Table 4.3.

As might be expected, the smoothed formulations D4 and D5 show no such gross quarterly errors, but they do diverge significantly from the actual results in the third and fourth quarters of 1969.

As in the case of consumer imports, the inequality coefficients of even the better equations are disappointing, C4 having a value of 1.0, D4 of 0.6 and E4, due to the 1970 results, of 1.4.

§4.5 *Imports of Capital Goods. Prediction Tests.*

Table 4.5 sets out the actual and predicted level of imports of capital goods (excluding ships and aircraft) for each available quarter since the end of the period of observations on which the equations are based. The equations tested are those selected in Part 4 of the Study of Imports (Q.E.C. March 1970). As in the case of raw materials imports, the majority of the selected equations are in constant price terms, and are converted to current prices in the lower half of the table by multiplying by the appropriate price index.

ABLE 4.5: TESTS OF IMPORT EQUATIONS—CAPITAL GOODS

Seasonally Corrected £ million

	1968	1969							1970	
	IV	I	II	III	IV	Total A	Total B	Total C	I	II
A. *Quarterly a Constant 1953 Prices.*										
Actual		13.7	15.3	16.5	17.5	63.0	63.0	63.0	15.6	16.7
Predicted by Equations: B3		14.0	14.5	15.7	16.4	60.6	59.5	60.6	17.0	15.6
B4		13.4	13.9	13.2	13.0	53.5	53.5	53.5	12.4	12.0
B5		13.9	14.3	14.9	15.3	58.4	56.9	58.4	15.7	14.5
B. *Centred 3-Quarter Moving Average at Constant 1953 Prices.*										
Actual	13.5	14.2	15.2	16.4	16.5	62.3	62.3	62.3	16.5	
Predicted by Equations: D4	13.3	14.1	14.8	15.9	16.4	61.2	59.7	62.9	16.1	
D6	13.4	14.0	14.7	15.8	16.3	60.8	58.6	56.9	16.2	
D7	13.3	14.1	14.9	16.0	16.4	61.4	60.1	58.0	16.3	
C. *Quarterly Value at Current Prices.*										
Actual		20.1	22.6	24.6	26.5	93.8	93.8	93.8	24.0	25.9
Predicted by Equations: B3*		20.5	21.4	23.4	24.8	90.1	88.5	90.1	26.3	24.5
B4*		19.6	20.6	19.7	19.7	79.6	79.6	79.6	19.2	18.8
B5*		20.4	21.2	22.2	23.2	86.9	84.7	86.9	24.3	22.7
A3		19.9	20.8	22.7	24.0	87.4	83.4	87.4	24.8	23.3
A11		20.9	21.5	22.6	23.5	88.5	87.1	88.5	24.4	22.9
A12		21.2	21.9	23.9	25.4	92.3	92.5	92.3	26.5	24.9
D. *Centred 3-Quarter Moving Average of Value at Current Prices.*										
Actual	19.5	20.8	22.5	24.5	25.0	92.8	92.8	92.8	25.4	
Predicted by Equations: D4*	19.2	20.6	21.9	23.8	24.9	91.2	88.9	93.7	24.8	
D6*	19.3	20.5	21.7	23.6	24.7	90.5	87.3	84.8	25.0	
D7	19.2	20.6	22.0	23.9	24.9	91.4	89.5	86.6	25.2	
C6	19.3	20.4	21.7	23.6	24.8	90.5	86.5	80.1	24.7	
C11	19.9	20.8	21.9	23.4	24.7	90.8	88.6	84.6	24.8	
C12	20.0	21.0	22.1	23.7	24.8	91.6	90.6	85.9	24.9	

Excluding Ships and Aircraft.
* Constant Price Prediction × Price Index.
See also note to Table 4.3.

All the equations using smoothed variables give highly acceptable quarterly results, which is slightly surprising as the fit of these equations was poorer than most of those for consumer or material imports. Of course, the actual course of capital goods imports in the period under test is characterised by a fairly steady increase (when smoothed) which avoids the test of predicting marked divergence from trend. Nevertheless all the smoothed equations do pick up the flattening off between the last quarter of 1969 and the first of 1970. The predictions for 1969 as a whole from the smoothed equations are also satisfactory in the A and B columns, although in the C column only equation D4 gives a good result.

The simple equations (in this case based on absolute data rather than quarter-to-quarter percentage changes) perform less well. Although equation A12, and to a lesser extent equations B3 and A11 give acceptable totals for 1969 as a whole, none of the simple equations predicts the downturn in actual capital goods imports in the first quarter of 1970. Equation B4, in which the index of prices of stocks and shares is an independent variable, gives spectacularly poor results, predicting a steady decline in capital goods imports when in fact there has been a fairly steady rise.

The inequality coefficients of the more successful equations over the period are: A12 = .63, C6 = .45, C11 = .44, C12 = .36, D4 = .41, D6 = .50 and D7 = .32. All of these can be regarded as satisfactory, but as in the case of the equations for the other categories of imports a longer test under different conditions is necessary before firm conclusions can be drawn.

§4.6 *Prediction Tests. Aggregate Imports.*

The equations selected from §4.2 are based on observations to the end of 1968. They can thus be tested in the same way and over the same period as the selected equations for the various import categories. The results are shown in Table 4.6.

TABLE 4.6: TESTS OF IMPORT EQUATIONS—AGGREGATE

Seasonally Corrected

	1968	1969							1970		
	IV	I	II	III	IV	Total A	Total B	Total C	I	II	III
A. *Quarterly Value at Current Prices. £'m.*											
Actual		131.1	152.9	148.8	156.3	588.9	588.9	588.9	148.8	161.2	163.6
Predicted by A4 ...		136.1	151.9	153.5	155.3	596.8	617.3	617.2	178.2	136.8	163.3
B. *Centred 3-Quarter Moving Average of Value £'m.*											
Actual	130.8	139.8	144.3	152.7	151.4	588.2	588.2	588.2	155.6	157.9	
Predicted by A7 ...	131.0	141.2	144.9	154.0	160.2	600.3	607.8	603.7	157.4	157.3	
C. *Quarterly Volume Index* 1953=100.											
Actual		231.1	263.7	252.4	257.5	251.2	251.2	251.2	242.4	252.5	257.2
Predicted by B3 ...		228.4	256.7	261.0	262.4	252.1	248.6	246.0	282.6	211.1	251.4
D. *Centred 3-Quarter Moving Average of Volume Index* 1953 =100.											
Actual	230.3	244.6	249.1	257.9	250.8	250.6	250.6	250.6	250.8	250.7	
Predicted by B6 ...	227.2	241.0	246.0	260.7	267.0	253.7	250.0	245.4	251.6	244.1	

See Note to Table 4.3.

Equation A4 does not perform well. The B and C totals for 1969 are wrong by nearly 5%, while the results for the first two quarters of 1970 are very poor. The other three equations give better results for 1969, the B column prediction of the smoothed volume equation, B6, being very close indeed to the actual level. However, viewed quarter by quarter the results are less impressive, B3 having large errors in the first two quarters of 1970, while the equations based on smoothed variables, A7 and B6 show a large error in the fourth quarter of 1969.

The cause of these major predictive errors is that all four equations are based primarily on the relationship between imports and the retail sales index. The retail sales index has fluctuated wildly in 1970, rising 10.6% in the first quarter and falling 1.4% in the second. Imports on the other hand fell in the first quarter and rose in the second and thus the normal relationship was temporarily broken. In fact the apparent breakdown is almost certainly only one of timing, accommodated by short term movements in stock levels. Significantly, the sum of the predictions for the two quarters is very similar to the actual sum, while the smoothed series also show reasonable results for 1970. In the case of the smoothed predictions the discrepancy is moved forward to the final quarter of 1969, where the 3 quarter average includes the first quarter of 1970, but not the counterbalancing second quarter.

The effect of these discrepancies on the inequality coefficients is dramatic, and in the case of the equations based on simple percentage changes can be seen by comparing the coefficients for all seven quarters tested with those for 1969 alone.

A4 (7 quarters) = 1.24, (1969) = .28; A7 (7 quarters) = .58;
B3 (7 quarters) = 1.40, (1969) = .33; A7 (7 quarters) = .58;

Thus the inequality coefficients for 1969 alone are encouraging, while if 1970 is added they become very poor. This reinforces the point made concerning the tests of other equations that judgment cannot be made on the basis of inequality coefficients alone, especially when they are based on a limited period of observation.

§4.7 *Conclusion.*

The final step in this study of imports is to compare the results obtained by the disaggregated, quarterly approach with the results of simpler aggregate annual models. The annual models normally used as an aid in making forecasts of the Irish economy in the Quarterly Economic Commentary were devised by C. E. V. Leser, and updated by T. J. Baker and J. Durkan*. As the dependent variable in these models is imports of goods and services, whereas the current study has dealt only with merchandise imports, direct comparison is complicated. However, by using percentage errors in the forecasts it is possible to obtain some comparison of the relative performance of the models for the year 1969.

Table 4.7 sets out the results. The "disaggregate" forecasts are obtained by adding the totals for 1969 of relevant equations from Tables 4.3, 4.4 and 4.5. The first such row shows the sum of the B totals of the most accurate equations in each set. The second shows the sum of the C totals of those equations giving a good result and which are easy to use in practice. Because no volume forecasts have been made of imports of consumer goods, these rows are in current price terms, with volume equations converted where necessary by multiplying by price indices. The aggregate quarterly forecasts are taken from the B totals for 1969 from Table 4.6. The annual forecasts are based on the preliminary National Accounts estimates for 1969 shown in the September 1970 Quarterly Economic Commentary. As in the case of the earlier tables in this Section, all "predictions" are made on the basis of the actually realised values of the independent variables.

*Quarterly Economic Commentary, Section 4, September 1970.

TABLE 4.7: COMPARISON OF IMPORT PREDICTIONS 1969

Method	Total of Imports Predicted							
	Main Categories		Total Merchandise				Goods and Services	
	Current Price	Moving 3-quarter Average	Current Price	Moving 3-quarter Average	1953 Price	Moving 3-quarter Average	Current Price	Actual 1968 Price
Actual 1969 £'m	539.4	542.9	588.9	588.2	251.2	250.6	651	619
Disaggregate 1 £'m	546	549						
Error %	1.2	1.2						
Disaggregate 2 £'m	536	540						
Error %	0.7	0.5						
Aggregate Quarterly 1 £'m			617	607	249	250		
Error %			4.8	3.3	1.0	0.2		
Aggregate Quarterly 2 £'m			617	604	246	245		
Error %			4.8	2.6	2.1	2.1		
Consistency Model 1 £'m							648	598
Error %							0.5	3.4
Import Function £'m							639	
Error %							3.4	

Notes

Disaggregate 1. Current Price. Consumption E1. Raw Materials C4. Capital Goods A12.
(B predictions) Moving Average. Consumption F1. Raw Materials D5. Capital Goods C12.
Disaggregate 2. Current Price. Consumption B7. Raw Materials C4. Capital Goods A12.
(C predictions) Moving Average. Consumption C2. Raw Materials D5. Capital Goods D4.
Aggregate Quarterly 1. Table 4.6, Total B.
Aggregate Quarterly 2. Table 4.6, Total C.
Consistency Model. C. E. V. Leser. The Irish Economy in 1964/5 } Also T. J. Baker and J. Durkan.
Import Function. C. E. V. Leser. The Irish Economy in 1966 } Quarterly Economic Commentary September 1970, Section 4.

On the evidence of Table 4.7, neither the disaggregated nor the quarterly aggregate approach, used either directly or quarter-by-quarter, performed notably better or worse than the existing annual models in predicting the level of imports for 1969. The consistency model, with an error of only £3 million in current prices, the B totals of the quarterly aggregate equations in constant 1953 prices and the C totals of the disaggregated equations are all within 1% of the actual level. The disaggregate B totals are also reasonably good. The remaining equations, although not violently wrong in percentage terms, give errors in absolute terms which would be large enough seriously to distort any Balance of Payments forecast.

However, a single year cannot provide an adequate comparative test of the predictive utility of alternative models. Certainly the revised consistency model has not given such accurate results in every year as it did in 1969, while the quarterly models which have been the subject of this Study will probably perform better in some future years and worse in others than in 1969. Thus for ex ante annual forecasting it appears sensible to use both the annual and the quarterly approach in future, thus obtaining alternative predictions. As always in economic forecasting, judgement will remain necessary in interpreting these predictions, and the models should be regarded

as providing an aid to forecasting rather than themselves mechanically giving the answer.

While they thus have a role to play in ex ante annual forecasting, the greatest use of the quarterly models will be in providing a useful tool for mid-year revisions of the annual forecasts. The analysis has shown that most, if not all, of the equations examined, are occasionally liable to produce misleading results for a particular quarter. Nevertheless the alternative methods of extrapolation and subjective projection are also liable to this hazard, and the possession of the quarterly equations, both aggregate and disaggregate, should considerably reinforce the ability of the forecaster to project short-term trends in imports.

It is felt that the predictive tests reported in this part of the study, are mildly disappointing in some aspects, such as the high inequality coefficients of many of the equations. On balance, however, the results are sufficiently encouraging to allow the cautious use of the quarterly approach in actual import forecasting. This in itself goes far towards justifying the exercise in quarterly disaggregated analysis. The other main purpose of the exercise was to obtain a greater understanding of the forces acting upon the level of imports, and an indication of the relative importance of these factors. In showing the clear links between both the level of consumption and the level of industrial production and short term responses in the import level, while failing to discern such clear and immediate links with such other factors as relative price levels, industrial exports or credit creation, the exercise would appear to have met this purpose. At the same time it has demonstrated that the complicating issues of seasonal variation, irregular strikes, and other random factors can be dealt with by a combination of pre-regression data manipulation and the use of dummy variables.