A Study of Imports, Part 2. Consumer Goods

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SECTION 4: A STUDY OF IMPORTS, PART 2. CONSUMER GOODS

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§4.1 *Introduction*

In part 1 of this study[1] seasonally corrected quarterly totals of merchandise imports, disaggregated according to function, from 1958 to 1968 were presented. It was noted that although there were certain similarities in the pattern through time of the different categories, there were also sufficient divergencies for individual analyses of the major categories to seem worthwhile.

This analysis has proved more complex than had been anticipated, and consequently it has been decided to present the analysis of each major category separately. This second part of the study deals only with imports of consumer goods, and the remaining categories will be considered in further parts in subsequent issues of the Quarterly Economic Commentary.

The basic aim therefore of this part of the exercise is to apply regression analysis to the seasonally corrected quarterly data of imports of consumption goods, in an attempt to identify structural relationships and to obtain usable models for short term analysis and forecasting. This aim largely dictates the procedures followed. Various potential explanatory variables are chosen, and seasonally corrected where necessary. A brief consideration of the absolute values of these variables, which is of some help in establishing functional relationships, is followed by a much more detailed analysis in terms of percentage changes from quarter to quarter. Such analysis is not only a more rigorous test of functional relationships but is also of much greater value for purposes of prediction.

The usefulness of the results obtained, both in identifying structural relationships and as an aid to forecasting, is discussed in §4.8. Suggestions are also made for further study to clarify some questions thrown up by the analysis.

§4.2 *Imports of Consumption Goods, Potential Factors*

Throughout this section, consumption goods imports are defined as the combined total of the import categories food, drink and tobacco ready for use and other consumption goods ready for use. As it is difficult to suggest a different pattern of potential explanatory variables for the two categories, there is an obvious case for combining them. As in Part 1 of the study, consumer imports throughout are measured in value terms, c.i.f..

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1 Quarterly Economic Commentary, May 1969, Section 4.

Before proceeding to the regression analysis, it is necessary to outline the reasons, theoretical and practical, for the choice of the potential explanatory variables adopted. The theoretical considerations primarily concern the identification of factors which a priori could be expected to influence the level of consumer imports; the practical considerations concern the availability and nature of statistical series representing these factors.

The factors which appear most immediately likely to determine the level of consumer imports are the level of total consumer demand, the degree of stock building of consumer goods within the distribution sector, the relative prices of home produced and imported consumer goods, and such special events as changes in tariffs and quotas, and the incidence of strikes.

Although studies in other countries show the behaviour of stock levels to be a crucial short-run determinant of imports, no quarterly series for stock movements exist in Ireland. For total consumption, the index of retail sales is the only series which has been available on a quarterly basis for a long enough period for econometric purposes. Although by 1968, immediately before its revision, this series was becoming somewhat suspect as a true measure of consumer spending, it is probably sufficiently reliable over the total period from 1961 to 1968 to justify its use. For relative prices the wholesale price index numbers for consumption goods and for imports of consumption goods are taken, with the former being divided by the latter to obtain an index of relative prices. Although far from ideal, the indices being based on different samples of goods, some competing, some not, this index of relative prices seems to possess enough meaning to be worth including in the analysis. With this price series already in the set, it appears redundant to include changes in tariff levels, as these should be reflected in relative prices. Changes in quota restrictions however are not implicitly contained in any of the other series, and therefore need to be allowed for explicitly. In the absence of any method of precise quantification this can be done only by the use of a dummy variable, arbitrarily assuming that each change in quotas was of equal importance. Similarly the effects of major strikes involving trade, notably the U.K. seamen's strike of 1966, and the U.K. dock strikes of 1967 can most simply be handled by a dummy variable.

Thus a set of equations can be tested relating imports of consumer goods to various combinations of the explanatory variables, the retail sales index, the comparative price index and dummies for quota restrictions and strikes.

However, because of some dissatisfaction with the retail sales index as an indicator of consumption, and also because the exercise has analytical interest in its own right, it has been decided to test a second set of variables. In this set the retail sales index has been replaced by factors which can be expected to influence the level of consumption. Earlier work on consumption in Ireland has suggested that among other factors, the levels of earnings, agricultural incomes and consumer credit have important effects on the level of consumption.

The level of earnings, the most obvious of these influences, and a key variable in any analysis or forecast of the economy, is best represented on a quarterly basis by the series of average weekly earnings in the transportable goods industries contained in the Quarterly Industrial Inquiry. Although this represents only the earnings in one sector of the economy, the assumption that earnings in the other non-agricultural sectors move roughly in line with it seems inherently reasonable.

By their very nature, agricultural incomes are difficult to assess on a quarterly basis. The proxy used here, as in previous consumption studies, is the agricultural price index. Due to changes in the presentation of statistics it is not possible to construct a series for consumer credit for the period under investigation. Instead, alternative measures of total bank lending are taken, namely non-government bank debits, and bills loans and advances within the State. While each of these suffers from the disadvantage that it may not move in line with consumer credit, they possess the balancing advantage that they may reflect movements in stock levels, which, as was noted above, is a major gap in the available statistical series.

This second set of variables is completed by the relative price index as in the first set, and dummies for tariffs, to be used in combinations where the relative price index is omitted, quotas, strikes, and the impact of major changes in indirect taxes on the timing of consumer spending.

§4.3 *Regression Analysis, Absolute Levels*

Before progressing to more complicated analysis it is instructive to consider the relationships between the absolute levels of consumer imports and the retail sales index. A very simple test has been used, a linear regression of consumer imports on the retail sales index, alone and with a time variable, and for comparative purposes a simple linear regression of consumer imports on their level in the previous quarter. The results are shown in Table 4.1.

TABLE 4.1: CONSUMER IMPORTS, ABSOLUTE LEVELS, REGRESSION ANALYSIS

A. *Variables*
Dependent Y =consumer imports, seasonally corrected quarterly 1961–1968, £m
Independent X_1=index of retail sales, seasonally corrected quarterly 1961–1968, 1961=100.
X_2=time, 2nd Q 1961=1, 4th Q 1968=31.
$X_3=Y_{t-1}$.

B. *Significance and Fit*

Equation No.	Independent Variables	Variables Significant at 1%	Variables Significant at 20%	R	F. Value	Standard Error of Estimate
A1	1,2	1	2	.970	225.8	1.13
A2	1	1	—	.968	441.4	1.14
A3	3	3	—	.952	282.6	1.40
A4	2	2	—	.948	225.4	1.46

C. *Regression Coefficients*

Equation	X_1	X_2	X_3	Intercept
A1	0.351	—0.181	—	—22.16
A2	0.256	—	—	—13.02
A3	—	—	1.028	0.02
A4	—	0.470	—	11.78

The usual bugbear of time series regressions, collinearity, is obviously present, with the results of equations A3 and A4 being nearly as good as those of A1 and A2.

However, the fact that A2, the regression on the retail sales index, does give a better fit than either A3 or A4, while the multiple regression A1 is slightly better than any of the single-variable equations, suggests that there is some genuine relationship between consumer imports and the retail sales index.

The strength of the common rise through time, however, is such that it appears unlikely that either functional relationships or prediction models can be usefully derived from analysis of the absolute values of the series. Also the standard errors of estimate, at over £1 million or more than 5 per cent of the mean value of consumer imports, is too high for these equations to be much use for prediction. Accordingly the remainder of the analysis of consumer imports is conducted in terms of first differences, expressed as percentage changes over the previous quarter, for each series, other than the dummy variables. It is felt that the use of percentage changes is more relevant for prediction purposes, as well as being easier to handle computationally, than using logarithms of absolute first differences, which would give very similar results.

§4.4 *Regression Analysis, Percentage Changes, Set* 1

Linear regressions of the percentage changes from quarter to quarter of consumer imports and various combinations of the first set of variables described in §4.2 have been calculated. It will be recalled that in this set, the retail sales index is regarded as the most important variable, as a representation of the level of consumer demand. Both this series and that for relative prices are used in a lagged as well as a current form. On a priori grounds it is not felt that a lag of more than one quarter is likely to prove significant, so longer lags have not been tested.

The results of this analysis are set out in table 4.2. It can be seen that variables X_6 and X_1 both have a reasonable fit on their own, and remain significant at either the 1 per cent or 5 per cent levels in every combination tried. Not surprisingly the regression coefficient of X_6 remains fairly stable between the different equations, while that for X_1 appears stable at one level when X_6 is included in the equation and at another when X_6 is excluded.

Although X_3 fails to be significant at the 5 per cent or even the 10 per cent level throughout, and fails to improve the fit greatly, for example between equations B7 and B4, it is consistently significant at the 20 per cent level, and exhibits reasonable consistency in its regression coefficients. It is interesting that the sign of the coefficient is negative throughout. As the index is obtained by dividing the domestic price index by the import price index, this suggests that in the short run at least the demand for consumer imports is inelastic with regard to relative price.

The remaining variables, including the two lagged terms appear to have little or no significance, add practically nothing to the fit of the equations in which they are included, and exhibit very unstable regression coefficients. For either analytical or predictive purposes they can be disregarded, at least in the formulations used here.

Thus of the various equations tested in table 4.2 the choice for forecasting purposes would appear to lie between B4 and B7. Although the addition of the price variable X_3 does not greatly improve the fit, and although it is of only marginal significance, it is felt that it is nevertheless worth including, and accordingly B4 is regarded as the most

useful of the equations in the table. Although no calculations of the Durbin Watson statistics have been made, application of the simple Geary test* to the sign changes of the residuals suggests that there is no significant evidence of serial correlation in the residuals.

TABLE 4.2: CONSUMER IMPORTS, PERCENTAGE CHANGES, REGRESSION ANALYSIS

A. Variables

Dependent Y =consumer imports, seasonally corrected quarterly 1961–1968, % 1st differences.

Independent X_1=index of retail sales seasonally corrected quarterly 1961–1968, % 1st differences.

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

X_3=relative price index, seasonally corrected quarterly 1961–1968, % 1st differences.

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

X_5=Quota restrictions dummy variable, easing=1, no-change=0.

X_6=Major strikes dummy variable, strike—, post strike+.

B. Significance and Fit

Equation No.	Independent Variables	Variables Significant at 1%	5%	20%	Variables not significant at 20%	R	F. Value	Standard Error of Estimate
B1	1,2,3,4,5,6	6	1	3	2,4,5	.879	11.90	3.89
B2	1,3,5,6	6	1	3	5	.877	10.12	3.75
B3	2,4,5,6	6	–	5	3,4	.843	14.07	4.20
B4	1,3,6	6,1	–	3	–	.876	26.27	3.69
B5	1,3	1	–	3	–	.726	13.95	5.14
B6	2,4	–	–	2	4	.219	0.63	7.29
B7	1,6	6,1	–	–	–	.870	39.09	3.67
B8	1	1	–	–	–	.712	26.79	5.14
B9	6	6	–	–	–	.831	n.a.	n.a.

C. Regression Coefficients

Equation	X_1	X_2	X_3	X_4	X_5	X_6	Intercept
B1	1.417	0.135	—0.680	—0.454	0.429	4.278	0.720
B2	1.323	—	—0.598	—	1.287	4.157	0.825
B3	—	—0.005	—	0.433	3.554	5.193	2.425
B4	1.412	—	—0.609	—	—	4.236	0.829
B5	2.945	—	—0.911	—	—	—	—1.447
B6	—	—0.888	—	0.503	—	—	4.050
B7	1.267	—	—	—	—	4.313	0.845
B8	2.770	—	—	—	—	—	—1.487

D. Selected Equations

B4 $Yc=0.83+1.412X_1-0.609X_3+4.236X_6$

B7 $Yc=0.85+1.267X_1+4.213X_6$

§4.5 *Regression Analysis, Set* 1, *adjustments*

Superficially the fit of equation B4, giving an R of .876 is adequate for forecasting purposes. Unfortunately however, a great deal of the fit is accounted for by the dummy

*R. C. Geary. Non Parametric Tests for Uniformity of Fit in Least Squares Regression. E.S.R.I. Memorandum Series No. 57.

variable for strikes, X_6. This is clearly an unsatisfactory situation. In an attempt to overcome it, the series for consumer imports has been adjusted to remove, as far as possible, the effects of major strikes. The regressions are then re-run on the adjusted series, without, of course, the dummy variable X_6.

In this adjusted set, the general level of fit is slightly lower than in table 4.2. This is not altogether surprising as the strike adjustment has the effect of considerably reducing the larger deviations of the dependent variable, and thus increasing the relative importance of some of the smaller unexplained deviations. Even so the R of the simple regression on retail sales in .647, and that of the multiple including all the independent variables is .701. The pattern of results is very similar to the unadjusted set, with X_1 being significant at the 1 per cent level in every combination, with its regression coefficient consistent at between 1.6 and 1.8. X_3 just fails to be significant at the 10 per cent level in each combination and its coefficient is stable at between—.75 and —.80. The other variables, the lagged terms and the quota dummy are in general not significant at even the 20 per cent level, and their contribution to R is not great. Thus the best equation from this adjusted set appears to be that for X_1 and X_3 only, which has an R. of .673, an F. value of 10.34, a standard error of estimate of 3.52 and no evidence of serial correlation. This equation can be designated B*.4., with $Yc = 0.09 + 1.744X_1 - 0.755X_3$.

The final test for set 1 of variables is to remove some of the random fluctuations by taking 3 quarter moving averages for each series (dropping the remaining dummy, which in any case has not proved significant so far). This procedure is useful in establishing structural relationships, although by its nature it is of limited value for forecasting purposes. The results are shown in Table 4.3.

It can readily be seen that equation C2 is the most satisfactory, although on the Geary sign change test it comes near to showing evidence of positive residual auto-correlation. With these smoothed series, X_3, the relative price variable, becomes significant at the 1 per cent level, and greatly improves the fit when added to X_1.

The main difference in the regression coefficients between table 4.3 and the earlier ones is the greatly increased negative value of X_3, which entails an increase in the positive value of the coefficient for X_1 when the two variables are included in the same equation. The coefficients of the lagged terms are far from stable, in spite of the fact that in some combinations these variables are significant at the 5 per cent and 10 per cent level, and it is impossible to escape the conclusion, unfortunate from a forecasting point of view, that in this general set of variables the lagged terms are of little or no analytical value.

Thus the conclusion of this section of the analysis must be that there is an undoubted relationship between the level of retail sales and consumer imports, and also that there does appear to be an inelastic relationship with relative prices. Furthermore the effects of major trade-disrupting strikes are so large that it is obviously essential to deal with them either by means of dummy variables or by adjusting them out of the series.

While the existence of functional relationships can be taken as fairly established, some reservations must be expressed concerning the use of the coefficients in equations B4, B*.4 and C2 for forecasting purposes. The degrees of fit obtained, while reasonable

for an analysis of first differences, are not particularly high, and the standard errors of estimate are larger than would be desired. Inspection of the residuals does not suggest that better results would be obtained by testing for non-linear relationships. It seems worthwhile therefore to proceed to analysis of the alternative set of variables, in which earnings rather than retail sales can be regarded as the key factor.

TABLE 4.3: CONSUMER IMPORTS, MOVING AVERAGE OF CHANGES, REGRESSION ANALYSIS

A. Variables

Dependent Y=consumer imports, adjusted for strikes, seasonally corrected, moving 3 quarter average of % 1 st. differences. 1961–1968.

Independent X_1=index of retail sales, seasonally corrected, moving 3 quarter average of % 1 st. differences.

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

X_3=relative price index, seasonally corrected, moving 3 quarter average of % 1 st. differences.

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

B. Significance and Fit

Equation No.	Independent Variable	Variables Significant at 1%	5%	10%	20%	Not significant at 20%	R	F.	Standard Error of Estimate
C1	1,2,3,4	1,3	—	—	—	2,4	.796	9.97	1.53
C2	1,3	1,3	—	—	—	—	.792	20.98	1.54
C3	1,4	1	4	—	—	—	.703	12.24	1.79
C4	1,2	1	—	—	—	2	.634	8.42	1.96
C5	2,4	—	—	2,4	—	—	.315	1.38	2.39
C6	1	1	—	—	—	—	.622	16.40	1.93

C. Regression Coefficients

Equation	X_1	X_2	X_3	X_4	Intercept
C1	2.210	—0.146	—2.037	—0.279	0.189
C2	2.149	—	—2.225	—	0.037
C3	1.806	—	—	—1.386	0.287
C4	1.749	—0.386	—	—	0.498
C5	—	0.792	—	—1.209	1.865
C6	1.586	—	—	—	0.194

D. Selected Equation

C2 $Yc=0.04+2.149X_1-2.225X_3$

§4.6 *Regression Analysis, Set 2*

This second set, in which the retail sales index is replaced by various more basic explanatory factors, has a large number of independent variables. In order to retain sufficient degrees of freedom for statistical significance in the equations, it is impossible to combine all nineteen of these variables together. However, several of these variables are alternative measures of the same factor, and so should not be included in the same equations in any case. The result of this situation, however, is that it has

been necessary to calculate a large number of regression equations in order to test which of the alternative series is the better for each of the factors concerned, as well as to test which combination of factors gives the best explanation of movements in the value of consumer imports.

To show the results of all the combinations calculated would be unnecessarily complicated. Accordingly table 4.4 sets out the results of 16 of the more interesting combinations, which are sufficient to illustrate the important conclusions of this stage of the analysis.

TABLE 4.4: CONSUMER IMPORTS, PERCENTAGE CHANGES, REGRESSION ANALYSIS

A. Variables

Dependent

Y =Consumer imports, seasonally corrected, quarterly 1961–68, % 1st differences.

Independent

X_1 =av. weekly earnings T.G. Inds., seasonally corrected, % 1st difs.
X_3 =employment T.G. Inds., seasonally corrected, % 1st diffs.
X_5 =agric. price index, seasonally corrected, % 1st diffs.
X_7 =agric. price index, % change on corresp. Q. previous year.
X_9 =bank debits, non-govt., seasonally corrected, % 1st diffs.
X_{11} =bills, loans, advances, within state, seasonally corrected, % 1st diffs.
X_{13} =relative price index, seasonally corrected, % 1st diffs.
X_{15} =quota restrictions, dummy variable.
X_{16} =tariff reductions, dummy variable.
X_{17} =special import levy, dummy variable.
X_{18} =turnover and wholesale tax, dummy variable.
X_{19} =major strikes, dummy variable.

$X_2 = X_{1\ t-1}$
$X_4 = X_{3\ t-1}$
$X_6 = X_{5\ t-1}$
$X_8 = X_{7\ t-1}$
$X_{10} = X_{9\ t-1}$
$X_{12} = X_{11\ t-1}$
$X_{14} = X_{13\ t-1}$

B. Significance and Fit

Equation No.	Variables Significant at 1%	5%	10%	20%	Not Significant at 20%	R	F. Value	Standard Error of Estimate
D1	19	—	6,4	1,5,18, 15	2,3,9,10, 13,14	.910	5.53	4.00
D2	19,12	18,3	5,1,15	11,13,4	2,6,14	.949	10.37	3.04
D3	19	12,18	13,4	1,3,15	2,7,8, 11,14	.938	8.48	3.33
D4	19,12	18,15, 5,3	1,17, 11,2	16	4,6	.956	12.19	2.83
D5	19	18,11	5	3,15,1	—	.898	10.46	3.66
D6	19,12	15,2	4	18	6,14	.919	13.67	3.28
D7	19,18	11	5,17	16,3, 15	1	.918	11.35	3.39
D8	19,12	15,18, 2	17	4,16	6	.934	14.49	3.05
D9	19	12	18,1	4,2	3,11	.913	12.54	3.40
D10	19	—	18,4	3,1	2	.878	12.32	3.80
D11	19	—	4	—	1,2,3	.864	13.53	3.91
D12	18	—	—	1	2,3,4	.607	2.68	6.17
D13	—	—	—	—	1,2,3,4	.233	0.35	7.40
D14	19	18	—	1	—	.866	24.95	3.73
D15	19	—	18	—	2	.859	23.42	3.82
D16	19	—	—	—	—	.841	n.a.	n.a.

C. Selected Equation

D8 $Yc = 0.39 - 0.79X_2 + 1.03X_4 - 0.06X_6 + 1.10X_{12} + 5.40X_{15} + 1.93X_{16} - 3.85X_{19} + 3.46X_{18} + 4.77X_{19}$

The list of variables shows that there are three cases of alternative series for the same factor. Agricultural prices can be shown as either X_5 and X_6 or X_7 and X_8, credit by either X_9 and X_{10} or by X_{11} and X_{12}, and prices by either X_{13} and X_{14} or by the dummy variables X_{16} and X_{17}.

Comparison of the first four equations shows that of the credit variables X_{11} and X_{12} are considerably better than X_9 and X_{10}, that of the agricultural series, X_5 and X_6 are rather better than X_7 and X_8, and that for prices, the dummies X_{16} and X_{17} give better results than X_{13} and X_{14}. This finding is confirmed by other equations not shown in the table. Accordingly the inferior series of X_7, X_8, X_9, X_{10} are dropped from further consideration. In the case of prices the inherent superiority of a continuous series over intermittent dummy values has led to the retention of X_{13} and X_{14} for further study in spite of the better performance of the dummies.

The other obvious feature of the first four equations shown is the high degree of fit obtained, particularly by D_2 and D_4. However, part of this is due simply to the large number of variables included and equations containing thirteen independent variables have obvious disadvantages for forecasting purposes. In order to find more manageable combinations, as well as to test the importance of individual variables, the remaining equations gradually drop many of the series.

The main conclusions to be drawn from part B of table 4.4 seem to be as follows. The strike dummy X_{19} is significant at the 1 per cent level in every combination in which it appears, and even on its own goes a long way towards explaining the behaviour of the dependent variable. However, the addition of certain other variables does improve the fit considerably, and in particular X_{12} and X_{18} are generally significant at the 10 per cent level or less. In contrast to the previous set of variables, lagged terms do show significance in this set, and in fact the equations including only lagged terms and dummies, D6 and D8, are among the most successful, and clearly better than their counterparts D5 and D7 which are in current terms only. X_1, which was expected to be the main explanatory variable, apart from the dummies, performs surprisingly badly, being significant at the 10 per cent level only three of the equations. As equations D12 and more particularly D13 show, results are very poor when the strike dummy X_{19} is dropped.

For simplicity's sake, the coefficients of the variables are not shown in the table, but nevertheless they are of some interest. For the dummies the signs are all as expected. The credit variables X_{11} and X_{12} show positive coefficients in all cases, which is what would be expected. The current earning variable X_1 and the lagged employment variable X_4 similarly have the expected positive coefficients, and the relative price variables show negative coefficients as in the previous set. The remaining variables, X_2 X_3 X_5 and X_6 all show either unstable coefficients or have negative values where one would expect positive. None of these variables is consistently significant, as can be seen from part B of the table, but even in the combinations where one or more of them is significant, the signs of the coefficients remain perverse.

In total the results shown in table 4.4 can be regarded as quite encouraging with equation D8 probably the most useful for forecasting but as in Table 4.2 the influence of the strike dummy is so great that it tends to obscure other relationships. Accordingly the next step is to eliminate it by using strike-adjusted figures for consumer imports.

The results of this exercise are shown in table 4.5. The fit when all variables are included is quite good, but it falls fairly rapidly as variables are dropped. As might be expected from the previous table the indirect tax dummy X_{12} and the lagged credit variable X_8 show good significance throughout. The significance of the other variables differs considerably from one equation to the next. Somewhat surprisingly the lagged employment variable X_4 performs less well than in table 4.4. Once again the supposedly main variable, X_1, performs rather badly.

TABLE 4.5: CONSUMER IMPORTS, ADJUSTED PERCENTAGE CHANGES, REGRESSION ANALYSIS

A. Variables

Dependent Y=consumer imports, adjusted for strikes seasonally corrected, % 1 st. differences.
Independent

X_1 =average weekly earnings, T.G. industries, seasonally corrected, % 1 st. differences. $X_2=X_{1\,t-1}$
X_3 =employment in T.G. industries, seasonally corrected, % 1 st. differences. $X_4=X_{3\,t-1}$
X_5 =agric. price index, seasonally corrected, % 1 st. differences. $X_6=X_{5\,t-1}$
X_7 =bills, loans, advances, seasonally corrected, % 1 st. differences. $X_8=X_{7\,t-1}$
X_9 =relative price index, seasonally corrected, % 1 st. differences. $X_{10}=X_{9\,t-1}$
X_{11}=quota restrictions, dummy variable.
X_{12}=turnover and wholesale taxes, dummy variable.

B. Significance and Fit

Equation No.	Variables Significant at 1%	5%	10%	20%	Not Significant at 20%	R.	F. Value	Standard Error of Estimate
E1	8,12	11,3	5,2	7,1,9	4,6,10	.842	3.26	3.19
E2	12	8,9	7	1,3	2,4	.753	3.28	3.48
E3	12,8	9,11	—	4	1	.742	4.49	3.39
E4	12	7	9	—	1,3	.651	3.39	3.75
E5	12	—	8,1	2	4,6	.656	2.76	3.81
E6	12	—	8	—	2,4,6	.613	2.77	3.90
E7	12	8	—	1	4	.629	3.93	3.76
E8	—	—	8	1	4	.357	1.22	4.42
E9	—	—	—	—	1,4	.163	0.36	4.58
E10	—	8	—	1	—	.357	1.90	4.34

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}	X_{11}	X_{12}	Intercept
E1	0.46	—0.70	—2.00	0.78	—0.53	0.02	0.61	1.25	—0.78	0.10	7.21	5.66	—1.03
E2	0.44	0.07	—1.18	0.59	—	—	0.67	0.97	—1.67	—	—	7.68	—1.71
E3	0.26	—	—	0.85	—	—	—	1.01	—1.46	—	4.02	5.93	—0.76
E4	0.26	—	—0.82	—	—	—	0.78	—	—	—	—	7.16	0.72
E5	0.53	—0.47	—	0.63	—	0.14	—	0.79	—	—	—	5.43	—0.01
E6	—	—0.35	—	0.56	—	0.09	—	0.70	—	—	—	5.42	1.11
E7	0.44	—	—	0.22	—	—	—	0.71	—	—	—	5.53	—0.20
E8	0.41	—	—	0.07	—	—	—	0.82	—	—	—	—	—0.13
E9	0.31	—	—	0.47	—	—	—	—	—	—	—	—	1.88
E10	0.41	—	—	—	—	—	—	0.82	—	—	—	—	—0.12

D. Selected Equations

E1 $Yc=-1.03+0.46X_1-0.70X_2-2.00X_3+0.78X_4-0.53X_5+0.02X_6+0.61X_7+1.25X_8-0.78X_9+0.10X_{10}+7.21X_{11}+5.66X_{12}$

E3 $Yc=-0.76+0.26X_1+0.85X_4+1.01X_8-1.46X_9+4.02X_{11}+5.93X_{12}$

The signs of the coefficients are much the same as in table 4.4, with X_2 and X_8 remaining perversely negative. Even the size of most coefficients remain of the same order of magnitude as in table 4.4.

Equation E1 has an adequate fit for forecasting purposes, but 12 variables is rather many to handle. E3, with only 6 variables, may be more suitable, despite its lower fit. For analytical rather than forecasting purposes the results of table 4.5 are sufficiently encouraging for it to seem worthwhile to examine the relationship between moving averages of the variables, thus ironing out some of the random fluctuations and removing the two dummy variables X_{11} and X_{12}. The results are set out in table 4.6.

TABLE 4.6: CONSUMER IMPORTS, MOVING AVERAGE OF CHANGES, REGRESSION ANALYSIS

A. Variables

Dependent Y=consumer imports, adjusted for strikes, seasonally corrected, moving 3 quarter average of % 1 st. differences 1961–68.

Independent X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, as in table 4.5, moving three quarter averages of % 1st differences.

B. Significance and Fit

Eq. No.	Independent Variables	Variables Significant at 1%	5%	10%	20%	Not Significant at 20%	R.	F. Value	Standard Error of Estimate
F1	1,2,3,4,5,6,7,8,9,10	—	7,5	9,6	—	1,2,3,4,8,10	.814	3.34	1.77
F2	1,2,3,4,7,8,9	—	7	—	8,1,9	2,3,4	.765	4.02	1.81
F3	1,3,5,7,9	7	5,9	—	—	1,3	.768	6.34	1.72
F4	2,4,6,8,10	—	8	10	1,6	4	.648	3.19	2.04
F5	1,2,4,8,9	8,1	2	—	—	4,9	.715	4.61	1.87
F6	1,4,6,8	—	8	—	1	4,6	.551	2.51	2.19
F7	1,2,5,7	7	5,2	1	—	—	.739	6.92	1.77
F8	1,2,4,7	7	2	1	—	4	.689	5.20	1.90
F9	1,4	—	—	—	—	1,4	.138	0.24	2.49
F10	1,2	—	1,2	—	—	—	.377	2.07	2.33
F11	1,3,7	7	—	3	—	1	.645	5.71	1.96
F12	1,4,8	8	—	—	1,4	—	.551	3.48	2.14
F13	1,8	8	—	—	—	1	.531	4.90	2.13
F14	1,7	7	—	—	—	1	.600	7.02	2.01

C. Selected Equations

F1. $Yc = -0.91 + 0.40X_1 + 0.17X_2 + 0.72X_3 - 0.77X_4 - 1.02X_5 + 0.93X_6 + 1.45X_7 - 0.07X_8 - 1.69X_9 - 0.50X_{10}$

F3. $Yc = -1.62 + 0.28X_1 + 0.51X_3 - 0.56X_5 + 1.88X_7 - 1.44X_9$

Provided at least one of the credit variables is included, the results seem reasonably satisfactory in terms of R, F value and Standard Error. With these smoothed series the lagged terms perform rather worse than the current, as can be seen from a comparison between equations F3 and F4. Even in this form, however, the performance of X_1, average earnings, is surprisingly poor, its simple correlation with consumer imports being only .136, and its contribution to fit in various combinations being modest. Except for the current smoothed credit series X_7 the coefficients of the variables are less stable than in most previous tables. There is still, however, a tendency for X_1 and X_7 to be positive and X_5 and X_9 to be negative, perversely so in the case of X_5. In the case of employment there is a tendency for X_3 and X_4 to have exchanged signs when compared

with earlier tables, with the current term now positive and the lagged term negative, although it must be noted that in most cases neither of them is significant according to part B of the table.

On the whole it would appear that the most useful equation from this table is F3, which relies entirely on current terms, although the addition of the lagged terms, as in F1, does improve the fit somewhat. In neither case does there appear to be any problem of residual autocorrelation.

§4.7 *Forecasting Tests*

In the course of the analysis nine equations have been specified as appearing to possess some potential for forecasting. It is possible to assess the performance of these equations in "predicting" consumer imports in the first quarter of 1969, and in some cases also in the fourth quarter of 1968, periods which were not included in the compilation of data for the analysis. It is unfortunate that neither of these periods, but particularly not the first quarter of 1969, is really suitable for such a test. Both quarters are affected by the increase in wholesale tax at the beginning of January. Although this is covered in some of the equations by a dummy variable, it is unsatisfactory to test in a period for which a large part of the predicted change is determined by an arbitrarily valued dummy variable. More important, the first quarter covered the period of the maintenance men's strike, which common sense suggests must have raised temporarily the level of consumer imports. Thus, on a priori grounds, one would not expect a particularly close concordance between predicted and actual values of consumer imports for these periods. The results for the nine equations are shown in table 4.7.

TABLE 4.7: CHANGE IN VALUE OF CONSUMER IMPORTS

Equation No.	4th Q. 1968			1st Q. 1969			
	Actual	Predicted	Residual	Actual	Predicted	Residual	Effect of tax dummy
	%	%	%	%	%	%	%
B4	+3.45	+5.83	—2.38	+3.00	+0.99	+2.01	n.a.
B7	+3.45	+5.79	—2.34	+3.00	+1.64	+1.36	n.a.
B4	+3.45	+6.26	—2.81	+3.00	+0.29	+2.71	n.a.
D8		n.a.	(—0.57)	+3.00	—2.55	+5.55	3.46
E1		n.a.	(—0.96)	+3.00	—5.33	+8.33	5.66
E3		n.a.	(—3.65)	+3.00	—4.21	+7.21	5.93
	4th Q 1968, centred moving 3 quarter average						
	Actual		Predicted		Residual		
C2	+4.78		+2.69		+2.09		
F1	+4.78		+4.33		+0.45		
F3	+4.78		+4.96		—0.20		

It can readily be seen that, as expected, the predicted results for these two quarters are not very accurate. It is interesting to note that all the residuals for the fourth

quarter of 1968 are negative (including those for equations D8, E1 and E3 where this quarter is included in the data for the original analysis). Conversely all residuals for the first quarter of 1969 are positive. Part of the positive residual in the case of equations D8, E1 and E3 can probably be ascribed to the dummy variable for the wholesale tax change working too strongly in this instance, but even if this is taken into account a considerable positive residual remains in each case. It seems reasonable to ascribe part of this to the stimulating effect of the maintenance dispute on imports of consumer goods.

The results for the three equations based on moving three quarter averages seem much better than those for the individual quarters on the basis of this test. However, it is clearly necessary to test all the equations over a longer period, as later figures become available, before their usefulness as predictors can properly be assessed.

§4.8 *Conclusions*

Viewed as an analytical exercise concerned with establishing the existence of relationships, the series of regressions described in this study can be regarded as reasonably successful. The use of first differences is a very rigorous test of relations between time series, and the degrees of fit and significance obtained in many of the equations are good in this context. This is especially so if one bears in mind the doubts expressed in §4.2 about some of the data used, and the complete absence of any information on the key factor of retail and wholesale stock levels.

In addition to demonstrating the effects of such obvious exceptional events as trade disrupting strikes and major changes in the indirect tax structure, it seems fair to claim that the analysis has established clear associations between the value of consumer imports on the one hand, and the retail sales index, relative prices, and bills, loans and advances within the State on the other. Of course, these associations must not be taken as being necessarily causative.

It seems probable that total consumption (measured by the retail sales index) and consumer imports both react to much the same causative factors. The relationship with credit (represented by bills, loans and advances) may be partly causative, in that rising credit can finance both greater consumer spending and the holding of larger distributive stocks, but equally there may be occasions when both credit and imports are reacting jointly to other expansionary factors. When a longer run of information (on a comparable basis) concerning the breakdown of total bank advances is available, this matter could usefully be investigated further.

With regard to prices the position seems even more complicated. At first sight the negative correlation observed throughout between imports and relative prices seems perverse, in that one might expect the value of imports to rise when home prices rise relative to import prices, and to fall when the relative price falls.

It is possible that the explanation is that the relative price index used forces into one series information on various types of price change, to each of which imports react differently. Thus it seems plausible that the value of imports would tend to rise in response to a rise in domestic prices, due to substitution; rise in response to a rise in import prices, due to the inelasticity of demand for imports; and fall (at c.i.f. values) in response to increased tariffs (which are included in the wholesale price index of imports).

If all these tendencies operate, but the second is stronger than the other two, it would account for the negative correlation observed in the analysis. It would be possible to test this hypothesis by further analysis, but this would be quite a major piece of work in its own right, and, given the reservations concerning the available price data, there is no guarantee it would be successful.

The variables which can most reasonably be regarded as casual, namely earnings, employment and agricultural prices, have not on this analysis been proved associated with consumer imports. It seems obvious that in some way they must be related, but the relationships are not sufficiently simple to be demonstrated by the methods adopted here. The explanation of this probably lies partly in the absence of stock data and partly in the phenomenon of variable time-lag effects. Thus a rise in, say, earnings is sometimes reflected in an immediate rise in consumer imports while on other occasions there may be a considerable delay before the effect is felt.

Although the direct link with earnings has not been established here, the most significant finding from a policy viewpoint is probably the nature of the association with the retail sales index and bills, loans and advances. In each case the vast majority of coefficients are considerably greater than unity. Even allowing for the tendency for the retail sales index to have understated the rise in consumption, it seems that when either total consumption or total credit is growing, imports of consumer goods are likely to be growing even more rapidly.

Turning to the utility of the analysis for forecasting purposes, the tests applied in §4.7 illustrate the dangers of relying too absolutely on econometric equations in making predictions. Although the fit and significance of all the selected equations are quite good, the results they give for two individual quarters are not very accurate.

However, this by no means implies that the equations, judiciously used, are of no benefit for predictive purposes. In the first place the two quarters tested are clearly atypical, and for more normal quarters rather better results could be expected. More important, one is seldom concerned with attempting to predict a single quarter. Applied to a period of three or more quarters, one can reasonably expect many of the errors to cancel out, as the analysis shows that the distribution of the residuals is fairly random. Thus a more accurate prediction for a year (the sum of four successive quarters) than for an individual quarter can be hoped for.

Further testing, as fresh data become available, is obviously desirable before too much reliance can be placed on any of the equations, but even at present there seems no reason why they cannot be applied in a tentative manner in making projections. Of course in actual forecasting, as distinct from testing a model by "predicting" the past, one does not know the actual value of the independent variables. The utility of models such as these lies in keeping forecasts consistent, and in formalising the probable effects of alternative assumptions concerning movements in a few key variables.