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by

C. E. V. LESER

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1. The Problem

In the economic development of any country except for very large and almost self-contained units, imports assume a key role, and the trend in imports demands constant attention. Indeed, one of the major problems of economic policy consists in the avoidance of an excessive level in the adverse balance of payments, without at the same time unduly restricting economic growth. These considerations are very apposite to a country like Ireland, which has since 1958 experienced an annual growth in its national product of about 6% in current and about 5% in constant prices—a high rate by the country's own standard of performance —and where, moreover, growth rates falling not much short of those recently experienced are envisaged to be maintained in the foreseeable future.

It is therefore proposed to study here briefly, firstly, the trend in imports of various broad categories in relation to other national aggregates in the post-war period; secondly, the factors bearing upon the level of imports, and their quantitative influence; and finally, some tentative conclusions upon future economic growth and the balance of payments. Econometric methods are used, but the statistical techniques employed do not go beyond single equation estimation by multiple linear regression, and any novelty that may be found in the treatment lies in the formulation of the model.

It may, of course, be argued that results derived from past experience are not applicable to the future since the underlying circumstances have materially altered or will do so in the near future. Against this, it may well be asked what the alternatives are? Experiences in other countries at a similar stage of economic development may be utilised, but there is of course no guarantee that they may be applied without serious modification. Or else, observed economic relationships for the past may be replaced by postulated intuitive economic relationships for the future; but intuition, a useful tool in conjunction with statistical experience, is not necessarily a good substitute for

it. Thus, when all is said and done, it may still be maintained that empirical relationships between economic variables at least provide a basis for analysis and prediction. Whilst they may not be used blindly and mechanically, they should still less be entirely disregarded.

Import functions have been constructed for other countries, in particular for the United Kingdom; among the studies made for that country, the very detailed analysis undertaken by M. FG. Scott (1963) and a study based on recent data by J. L. Bridge (1962) are of special interest. Rather than establishing definite conclusions, these studies highlight the difficulties of obtaining convincing evidence for quantitative relationships. This clearly applies to the present study as well, which must be considered as being in the nature of a preliminary investigation. Whilst some alternatives have been examined, there is further scope for a more detailed examination of alternative models and additional data which could be utilised. The results arrived at here may thus be considered as provisional ones, subject to modification in the light of further evidence.

2. The import content of market supplies

Imports are taken here in the widest sense of the word, as the item " Imports of goods and services " appearing in the national accounts, which includes invisible transactions. The value of imports in current prices is used so that the figures are influenced by price as well as quantity changes. The data for 1947-52 are taken from unpublished Central Statistics Office returns, the data for 1953-61 from Table A3 of " National income and expenditure 1961 " (p. 36); this also applies to the data for gross national product and other macroeconomic entities used.

To permit meaningful comparisons between different periods, imports are frequently expressed as a ratio of gross national product, to which they bear a relation although they do not form part of it. In the present study, a different procedure is adopted and imports are expressed as a percentage of " total market supplies " consisting of imports and gross national product. This total is equal to " total final demand", which is composed of personal

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expenditure (excluding direct taxes), public authorities' expenditure, gross domestic fixed capital formation, value of physical changes in stocks, and exports.

Alternatively, stock changes could have been excluded from final demand and treated as a means of meeting demand like imports and home production. This treatment would be appropriate if stock changes were believed to be largely accidental, whilst the procedure used here implicitly assumes that stock changes are largely the result of deliberate decisions. If data on desired stock levels were available, one could separate the two types of stock changes; but for the present analysis, this point is not considered to be of major importance.

The proportion which the total of imports bears to total market supplies will be denoted as "total import content of market supplies" or sometimes just as "total import content". The figures for each year from 1947 to 1961 are shown in table 1, together with comparable figures (from 1950 onwards) for an average of all European O.E.C.D. member countries (except Spain), 17 in number, at 1958 exchange rates.

The latter set of figures has been computed from data given in "O.E.C.D. General Statistics, November 1962" (p. X). The figures should not be taken as accurate to the last digit, but they have been worked out in this form for the purpose of further analysis.

TABLE 1: TOTAL IMPORT CONTENT OF MARKET SUPPLIES, IRELAND 1947-61 AND EUROPEAN O.E.C.D. MEMBERS COMBINED, 1950-61

Year	Total import content (%)	
	Ireland	17 European O.E.C.D. members
1947	31·36	
1948	29·92	
1949	27·52	
1950	31·03	17·84
1951	35·04	19·98
1952	29·05	18·29
1953	28·12	17·44
1954	27·74	17·90
1955	29·68	18·44
1956	27·15	18·70
1957	26·37	18·95
1958	27·12	17·68
1959	27·30	17·87
1960	27·63	18·75
1961	28·97	18·36
Mean (unweighted)		
1947–61	28·93	
1948–61	28·76	
1950–61	28·77	18·35

In addition to the annual figures, averages have been computed. For Ireland, averages have been worked out over the years 1948-61 as well as the full period, since the year 1947 had to be excluded for regression analysis; the average 1950-61 permits comparison with the O.E.C.D. figure.

It will be seen from table 1 that on the average over the post-war years, a little under 30%, or about two-sevenths, of total final demand in Ireland was met by imports and the remainder by home production (including net indirect taxation). Total import content showed large year-to-year fluctuations which were particularly marked in the early post-war years; it reached troughs in 1949, 1954 and 1957, with peaks in 1951 and 1955 in between. Whilst the total import content has risen in recent years, no long-term movement is discernible over the period as a whole.

The 17 O.E.C.D. members referred to include, of course, a number of countries which are far larger than Ireland and which have far more diversified economies. It is therefore not surprising that the total import content for Ireland should be above the O.E.C.D. average. The fluctuations shown by O.E.C.D. countries combined are also less pronounced than those for Ireland alone and, apart from the inflationary year 1951, the timing of ups and downs is different.

More remarkable than the differences between the two sets of figures is, however, the one feature which they have in common: the absence of any recognisable trend. This throws up the question whether the long-run constancy of the total import content is accidental, or whether forces are at work to correct any deviation from an "equilibrium". The question will be discussed later on in the light of some results obtained.

The total import content of market supplies in Ireland will now be further analysed by effecting a breakdown into six categories, on the basis of tabulations on "Distribution of imports according to main uses" in the "Irish Statistical Survey", the "Statistical Abstract of Ireland" and "Economic Statistics". The first five categories are familiar and self-explanatory, but the sixth is a residual obtained by difference; it consists mainly of invisible imports, but also contains a small amount of unclassified merchandise imports and some adjustments. All totals are expressed in terms of final demand, so that the percentages for the six categories add up to the percentage shown in table 1.

The picture revealed by tracing the course of the ratios over time shows substantial differences between the various categories. The salient features may be summarised as follows:

(a) Imports of materials for industry make up by themselves about 15% of total market supplies and thus about half the value of all imports of goods and services. This import content shows little

Year	Content of total market supplies (%) : imports of					
	Producers' Capital	Food, drink and tobacco	Miscellaneous consumer goods	Materials for agriculture	Materials for industry	Invisibles, etc.
1947 ..	2.70	2.89	5.46	0.46	15.32	4.53
1948 ..	2.85	2.44	4.95	0.66	14.86	4.16
1949 ..	2.51	1.89	4.64	0.72	13.72	4.04
1950 ..	2.67	2.18	4.85	0.87	16.61	3.85
1951 ..	2.44	3.14	5.71	0.97	18.91	3.87
1952 ..	2.88	1.94	4.34	0.82	14.81	4.26
1953 ..	2.86	2.06	4.15	1.01	14.21	3.83
1954 ..	2.89	1.85	4.17	1.23	13.66	3.94
1955 ..	2.64	2.03	4.54	1.28	15.13	4.06
1956 ..	3.08	1.35	3.98	1.13	13.32	4.29
1957 ..	2.55	1.71	3.56	1.37	13.07	4.11
1958 ..	2.81	1.56	3.80	1.49	13.38	4.08
1959 ..	2.79	1.56	3.60	1.52	13.84	3.99
1960 ..	2.62	1.51	3.52	1.28	14.43	4.27
1961 ..	3.34	1.60	3.68	1.34	14.94	4.07
Mean						
1947-61 ..	2.77	1.98	4.33	1.08	14.68	4.09
1948-61 ..	2.78	1.92	4.25	1.12	14.63	4.06

change in the long run but marked short-run fluctuations, which tend to dominate the movements in the total import content.

(b) Imported materials for agriculture form a relatively small proportion of market supplies in the neighbourhood of 1%. The proportion is subject to minor fluctuations, which are, however, over-shadowed by a marked rising trend.

(c) Imports of consumer goods, both of the food and non-food variety, tend to decline in importance over the period under consideration. Substantial short term variations are, furthermore, superimposed on the declining trend. On the average, the two categories together account for an import content of over 6%.

(d) Imported producers' capital and invisible imports amount to a little under 3% and about 4% of market supplies respectively. These proportions remain remarkably constant in both short and long run, and such fluctuations as there are do not synchronise with the general pattern.

3. Factors affecting the import content

In demand analysis, the traditional explanatory variables introduced are indicators of price and income, to which others are added as the case may be. In one sense, this is a demand study, and a price variable has been duly utilised, together with time which is explicitly introduced as a variable. The remaining factor chosen for the model may, however, be described as an income variable in a limited sense only.

The selected indicator of price is designed to represent relative price of imports, in terms of price of total market supplies, i.e. imports and gross national product combined. The two price series themselves are the implied deflators in the constant price figures in the national accounts, viz. the ratios between imports or final demand at current and at constant prices. Ratios of price indices for imports and gross national product could of course equally well have been used, but the present procedure facilitates the interpretation of the regression coefficients. A logarithmic transformation has been applied to the price ratio, and natural logarithms to the base e instead of 10 are used here and throughout the study, also to facilitate interpretation. As defined here, a value of +1% in the price variable indicates a ratio of almost exactly 1.01 between the price index number of imports and the total price index, both based on 1953 ; a value of −1% a ratio of about 0.99. The variable assumes the value 0 for 1953. Since the import content is derived from totals in current prices, we may expect to find a positive correlation with the price indicator (unless a price elasticity below −1 was anticipated); the opposite would be true if the import content was derived from constant price totals.

An indicator of income or output level may seem attractive at first sight as an explanatory variable, but there are weighty considerations against it. Economic growth and a rising standard of living may bring about changes in the pattern of final demand, but these do not necessarily imply a higher import content ; a trend towards a greater weight of services in personal consumption, for example, may act in the opposite direction. Nor need it be assumed, except perhaps in the case of agriculture, that an expansion of output necessitates technical changes involving relatively greater use of imported materials. Furthermore, whatever indicator of real income is used, there has undoubtedly

been some increase in the post-war period, whilst we have seen that the import content remained constant in the long run. If this upward trend had had any material influence on import content, it must have been counteracted by other powerful influences. It is believed that the net effect of the long-term growth on the import content was small and inevitably confounded with the effects of other long-term changes.

It is one thing to maintain that the level of final demand has no substantial effect upon its import content; it would be quite another matter to argue that the rate of growth had no such impact. There are, on the contrary, good reasons for the belief that in times of rapid growth, the import content will be higher than in times of slow growth or even decline. For rapid expansion inevitably produces bottlenecks in home production which cannot be quickly enlarged, and the gap is for the time being filled by imports; when the growth rate slackens, the original position may be largely restored. This applies particularly to capital goods and materials for further production.

An indicator of growth is therefore sought, to explain part of the variations in import content. Here, as in future, growth will not be measured in the customary way, based on gross national product or national income, but on total final demand. We shall speak simply of the growth rate when comparing totals for final demand in successive years. The logarithm of the ratio (multiplied by 100) is used instead of a percentage change, which facilitates splitting up value changes into volume and price changes.

On theoretical grounds, the real growth rate, measured in constant prices, might be believed to be the operative factor. It is, however, empirically found to be far less closely correlated with the import content than the growth rate in current prices. This suggests that price inflation produces, in this respect, similar effects as expansion in the volume of demand. The nominal growth rate in final demand is therefore chosen as independent variable.

Theoretically, it would be possible to introduce real growth rate and price changes separately into the model. In practice, this is unsatisfactory both from the statistical and the economic point of view, as it leads to results which are neither reliable nor readily acceptable. This approach, though attempted, has therefore been abandoned. There should be no objection to using current price data as a basis for measuring growth, if the definition is borne in mind when interpreting the results. In periods in which prices show year-to-year increases at a fairly steady rate, it matters little whether nominal or real growth rate is used as explanatory factor.

Counting in time, we are thus left with three factors, to which we look for an explanation of the changes in import content. The same three variables will be used in studying total import content as well as the six components investigated.

This has the technical advantage that the import functions derived are additive, that is to say, the six individual import functions add up to the total import function; and the more material advantage that comparison between the results for the various import categories can readily be made.

In algebraic language, we may write (with all values expressed in current prices, unless otherwise stated)

M for imports

Y for gross national product

$M_1, M_2, \ldots M_6$ for imports of each category

M_{-1}, Y_{-1} for imports and G.N.P. in the previous year

M', Y' for imports and G.N.P. at 1953 prices

T for the calendar year

y for total import content

$y_1, y_2, \ldots y_6$ for its components

x_1 for the nominal growth rate of final demand (or market supplies)

x_2 for the import price indicator

x_3 for time (1948=0)

Then we have the definitions

$$y = \frac{100M}{M+Y}$$

$$y_i = \frac{100M_i}{M+Y} \quad (i = 1, 2, \ldots 6)$$

$$x_1 = 100 \log_e \frac{M+Y}{M_{-1}+Y_{-1}}$$

$$x_2 = 100 \log_e \frac{M}{M'} \frac{M'+Y'}{M+Y}$$

$$x_3 = T - 1948.$$

The data for y and $y_1, \ldots y_6$ are shown in tables 1 and 2 respectively, the data for x_1, x_2, and x_3 are as follows:

4

TABLE 3: VALUES OF EXPLANATORY VARIABLES
IN STUDY OF IMPORT CONTENT, IRELAND 1948-61

Year	Nominal growth rate x_1	Relative import price indicator x_2	Time x_3
1948 ..	7·73	+2·09	0
1949 ..	4·13	−1·89	1
1950 ..	6·94	+3·19	2
1951 ..	11·36	+13·42	3
1952 ..	4·21	+8·58	4
1953 ..	7·86	0	5
1954 ..	0·16	+0·93	6
1955 ..	7·03	+1·45	7
1956 ..	−1·89	+0·77	8
1957 ..	2·59	+2·64	9
1958 ..	3·68	−4·59	10
1959 ..	6·30	−6·86	11
1960 ..	5·80	−5·37	12
1961 ..	7·96	−5·83	13
Mean 1948-61..	5·28	+0·61	6·5

The growth rate as defined here refers to the time between the preceding year and the current year, and it exhibits considerable fluctuations. It was negative between 1955 and 1956 and negligible between 1953 and 1954; also the periods 1948-49, 1951-52, 1956-57 and 1957-58 show a growth rate below the average for the period as a whole. Apart from 1950-51, the highest increase was observed between 1960 and 1961, closely followed by 1952-53 and 1947-48.

The relative import price somewhat fell between 1948 and 1949, then rose substantially till 1951, to return to a lower level in 1953. Another sharp fall occurred between 1957 and 1958; other changes were of a minor character.

Fortunately for the purpose of the present analysis, the two series are neither highly correlated with each other nor with time. This circumstance means that multiple regression analysis may be applied with some confidence, without having to fear that completely spurious results will be obtained.

4. The total import function

We may postulate a linear relationship between import content on one hand and growth rate, relative import price and time on the other, viz.

$$y = a + \beta x_1 + \gamma x_2 + \delta x_3 + \epsilon$$

ϵ being an error term. Estimates a, b, c and d for the coefficients may be obtained by the method of least squares. Then

$$y = y_c + u$$

where $y_c = a + bx_1 + cx_2 + dx_3$
and u is a residual.

The coefficient b is easily interpreted; it shows the sensivity of the total import content to changes in the growth rate. Thus, if the growth rate rises by 1%, the import content will tend to become $b\%$ higher. The coefficient d shows by how much the import content tends to increase or decrease each year, other things being equal.

The coefficient c is best interpreted after division by $\bar{y}$, where $\bar{y}$ represents the mean import content over the period 1948-61. It is shown in the appendix that $100c/\bar{y}$ represents the average price elasticity of expenditure on imports, i.e. the percentage by which the ratio of imports to G.N.P. in current prices tends to increase if the import price rises by 1% and the price of home produced goods remains constant; or more generally, the percentage by which this ratio increases if the import price rises by 1% more than the home production price. The more familiar price elasticity of import demand, which shows by how much real imports tend to fall in relation to real G.N.P., is then represented by the expression $100c/\bar{y} - 1$.

Computation gives the following results for the coefficients and their standard errors

$$a = 26.618 \pm 0.849$$
$$b = 0.3780 \pm 0.0884$$
$$c = 0.2316 \pm 0.0688$$
$$d = 0.0011 \pm 0.0916$$

Furthermore, if R denotes the coefficient of multiple correlation for y on x_1, x_2 and x_3, we have

$$R^2 = .822$$

that is to say, more than four-fifths of all variations in total import content are accounted for by the movements in the explanatory variables. This is a satisfactory fit, when it is borne in mind that the variable to be explained is a ratio and not a total. In a regression analysis between totals based on time series, it is of course easy to obtain values of R^2 in the neighbourhood of, say .99; but in such a case the high correlation mainly reflects the common upward trend. That consideration does not apply here.

The goodness of fit for individual years can be judged after computing

$$y_c = 26.618 + 0.3780x_1 + 0.2316x_2 + 0.0011x_3$$

and comparing the predicted value y_c with the observed value y. This is done in table 4.

TABLE 4: PREDICTED AND ACTUAL IMPORT
CONTENT, IRELAND 1948-61

Year	y_c	y	$u = y - y_c$
1948 ..	30·03	29·92	−0·11
1949 ..	27·74	27·52	−0·22
1950 ..	29·98	31·03	+1·05
1951 ..	34·02	35·04	+1·02
1952 ..	30·20	29·05	−1·15
1953 ..	29·59	28·12	−1·47
1954 ..	26·90	27·74	+0·84
1955 ..	29·62	29·68	+0·06
1956 ..	26·09	27·15	+1·06
1957 ..	28·22	26·37	−1·85
1958 ..	26·96	27·12	+0·16
1959 ..	27·42	27·30	−0·12
1960 ..	27·58	27·63	+0·05
1961 ..	28·29	28·97	+0·68
Mean	28·76	28·76	0

It can be seen that the import function correctly shows the direction of the change in import content between any two successive years, except from 1956 to 1957 and from 1957 to 1958. The greatest discrepancy is also found for 1957. This may be explained by the changes in tariffs and import restrictions taking place around that time; these undoubtedly effect the import content, but there is insufficient information available to permit their explicit introduction into the regression.

On the whole, however, the residuals are not large, and there is clearly no evidence for their being autocorrelated. The import function thus may be considered as acceptable, and the regression coefficients may be legitimately subjected to statistical significance tests as well as interpreted in economic terms.

The value of b is obviously highly significant, as it is more than four times its standard error, whilst the 1% point of Student's t, with 10 degrees of freedom, is 3.17. The growth rate thus appears to be established as a factor explaining variations in import content. Equally clearly, d is not significant, which means that there is no discernible trend. The last term in the import function, representing long term changes other than those explained by growth and price, is in fact negligible and might well be omitted. It has, however, been kept in to show that time as a variable has been investigated, and also because it will appear in the import functions for commodity groups.

The coefficient c differs significantly from 0, showing the price elasticity for imports to be clearly above —1. On the other hand, c is not significantly different from $\bar{y}/100 = 0.2876$, the value which it would assume if the price elasticity was 0. The possibility of a zero or even a positive price elasticity could therefore not be ruled out on purely statistical considerations; as however, it is not economically plausible, the regression estimate is preferable.

The estimated price elasticity works out as —0.195, i.e. a 10% increase in relative price brings about a 2% reduction in relative volume. The numerically low value of the elasticity may appear surprising, but it is probably explained by the fact that the differentials between price movements appear chiefly between entirely different types of commodities, rather than between good substitutes.

The other main result is that the import content (i.e. y) rises with the growth rate (i.e. x_1) but by less than 0.4% for every additional 1% of growth expressed in current prices. This effect may seem smaller than intuition might have led us to believe. At the 1961 level of relative import prices, this implies an import content of final demand amounting to 25.3% with no increase, 27.2% with a 5%

increase and 29.1% with a 10% increase in demand at current prices. E.g. a total final demand of £1,100 million, reached in 1962 by a 10% increase over the 1961 level, would mean £320 million in imports and £780 million in G.N.P.; if reached by a 5% increase, say in 1963 over 1962, it would mean £300 million imports and £800 million G.N.P.; if total final demand remained unchanged at that level for one year, imports should settle down to about £280 million and G.N.P. to £820 million.

If the formulation of the model is correct, then a further implication is that when relative import prices do not change and the growth rate remains constant, the import content will settle down at its appropriate level. Thus, imports and gross national product will tend to grow at the same rate.

In order to carry out a further test and possibly obtain corroborative evidence for these findings, the data for the European O.E.C.D. members combined for the years 1951 to 1961, which were shown in table 1, were subjected to a similar analysis as the Irish data, with data for the independent variables also derived from " O.E.C.D. General Statistics, November 1962 " (pp. X, XI).

The main difference from the Irish case is that a definite positive trend is obtained. Chiefly owing to the omission of the years 1948-50, a strong negative correlation between relative import price and time is observed, and the introduction of time into the regression materially affects the numerical values of the other regression coefficients. On the other hand, its introduction substantially improves the fit, raising the value of R^2 from .867 to .951. The latter value indicates a fit which is almost too good to be true even with only 7 degrees of freedom, since the import content itself before regression shows comparatively small variations. The regression equation can also be shown to give the right answer for the direction of change in import content between any two consecutive years. The estimated coefficients, with their standard errors are

$$b = 0.1181 \pm 0.0313$$
$$c = 0.1412 \pm 0.0446$$
$$d = 0.3952 \pm 0.1140$$

They are all significantly different from 0 at the 5% level, b also at the 1% level. c is not significantly different from $\bar{y}/100 = .1840$, thus the price elasticity not significantly different from 0.

We find that $100c/\bar{y} - 1 = -0.233$. This result, indicating a numerically low negative price elasticity, is almost the same as that obtained for Ireland. The import content is, however, far less sensitive to variations in the growth rate for the O.E.C.D. countries combined than for Ireland alone, a 1% increase in the growth rate only raising

	Producers' Capital	Food, drink and tobacco	Miscellaneous consumer goods	Materials for agriculture	Materials for industry	Invisibles, etc.
i	1	2	3	4	5	6
b_i	−0.0113	0.0694	0.0566	−0.0031	0.2858	−0.0194
c_i	−0.0081	0.0388	0.0386	0.0024	0.1573	0.0026
d_i	0.0134	−0.0333	−0.0851	0.0623	0.0339	0.0099
$\bar{y}_i$	2.78	1.92	4.25	1.12	14.63	4.06
$100 b_i/\bar{y}_i$	−0.41	3.62	1.33	−0.28	1.95	−0.48
$100 c_i/\bar{y}_i$	−0.29	2.02	0.91	0.21	1.07	0.07
s_{b_i}	0.0200	0.0123	0.0218	0.0113	0.0645	0.0123
s_{c_i}	0.0156	0.0095	0.0170	0.0088	0.0502	0.0095
s_{d_i}	0.0208	0.0127	0.0226	0.0117	0.0669	0.0127
R^2	.203	.920	.868	.818	.803	.267

the import content by 0·12%. All in all, the numerical results are somewhat different in the two econometric studies here undertaken; but the model appears a useful one, the variables chosen explaining a good deal of the changes in imports.

5. Results for different types of imports

In the same way as for total imports, estimated coefficients have been obtained for the relationships

$$y_{ic} = a_i + b_i x_1 + c_i x_2 + d_i x_3 \quad (i=1, \ldots, 6)$$

y_{ic} representing, apart from an error term, the components of total import content, x_1 the rate of increase in total final demand since the previous year, x_2 the relative price indicator for imports, and x_3 time. Multiple regression by least squares has been applied to the data for 1948-61, given in tables 2 and 3; and the main results are summarised in table 5.

The last row of figures, indicating goodness of fit, shows that a good explanation has been obtained for the variations in the proportion to final demand borne by imports of food, drink and tobacco, of other consumer goods, of materials for agriculture as well as for industry; the explanation is poor in the case of imported producers' capital and invisible imports. However, these two categories are precisely those for which there is little variation to explain. It may thus be stated that the value of imported producers' capital and that of invisible imports follow very closely the total level of final demand, with which they tend to remain in a fixed proportion (about 7% for both combined).

Among the other groups, the time trend is the only factor contributing significantly to an explanation for the changes in the case of imported materials for agriculture. The opposite is true with regard to imported materials used in industry; their

share in total final demand is significantly affected by growth rate and price ratio only. All three factors combined appear to be effective in determining the level of consumer goods imports, whether food, drink and tobacco or other goods.

To proceed to a discussion of the individual coefficients, the interpretation of b_i and d_i is fairly straightforward, but the interpretation of c_i, or the related expression $100 c_i/\bar{y}_i$, is more complex. This term depends both on the sensitivity of the price ratio for the particular commodity group concerned to a change in general price ratio; and on the sensitivity of expenditure, or inelasticity of real purchases, to changes in relative import prices. On theoretical grounds, one would not expect the latter to vary much from group to group. One would thus conclude that the changes in relative import prices were particularly marked in the field of food, drink and tobacco, and to a somewhat lesser extent in the field of miscellaneous consumer goods and materials for industry. In the remaining fields, changes in relative price were not noticeable; or if they were, their effect was compensated by considerable substitution.

From one point of view, it might have been more satisfactory to have used a separate price indicator in the import functions for each commodity group, instead of one and the same price variable for all import functions. This could not be done on the basis of the available published data; but it may be possible to do so later on in a more detailed study.

The sensitivity of the import content components to changes in the growth rate, measured by b_i or in relative terms by $100 b_i/\bar{y}_i$, also varies considerably from group to group. In relation to the size of the group, imports of food, drink and tobacco showed the highest degree of sensitivity, followed by materials for industry and miscellaneous consumer goods in that order. For imports of capital goods, agricultural materials and invisible items, variations

7

in their contribution to final demand are small and, if anything, appear to be anticyclical; that is to say, they are inversely related to the growth rate and the general trend in import content.

Finally, the result confirms the impression already obtained by inspection of a clear downward trend in consumer goods imports and an upward trend in materials for agriculture: over the period 1947–61, this was responsible for reducing the share of the former in final demand by almost two percentage points, and for raising the share of the latter by almost one percentage point. There also appears to be a tendency for imports of industrial materials, capital goods and invisible items to increase, but this is more doubtful and of little numerical importance.

The import functions may be written as follows:

$$y_{1c} = 2.759 - 0.0113x_1 - 0.0081x_2 + 0.0134x_3$$
$$y_{2c} = 1.743 + 0.0694x_1 + 0.0388x_2 - 0.0333x_3$$
$$y_{3c} = 4.480 + 0.0566x_1 + 0.0386x_2 - 0.0851x_3$$
$$y_{4c} = 0.731 - 0.0031x_1 + 0.0024x_2 + 0.0623x_3$$
$$y_{5c} = 12.811 + 0.2858x_1 + 0.1573x_2 + 0.0339x_3$$
$$y_{6c} = 4.094 - 0.0194x_1 + 0.0026x_2 + 0.0099x_3$$

Assuming the 1961 relation between import and other prices to be maintained, the equations may be written more conveniently as follows:

$$y_{1c} = 2.980 - 0.0113x_1 + 0.0134 (T-1961)$$
$$y_{2c} = 1.084 + 0.0694x_1 - 0.0333 (T-1961)$$
$$y_{3c} = 3.149 + 0.0566x_1 - 0.0851 (T-1961)$$
$$y_{4c} = 1.527 - 0.0031x_1 + 0.0623 (T-1961)$$
$$y_{5c} = 12.335 + 0.2858x_1 + 0.0339 (T-1961)$$
$$y_{6c} = 4.207 - 0.0194x_1 + 0.0099 (T-1961)$$

From these equations we can obtain the theoretical import content for any given growth rate, both by neglecting the trend and by including it for any given calendar year. The former gives the theoretically correct answer in the neighbourhood of 1961, and also for later years if it is assumed that the trend will no longer be operative; the latter set of figures assumes continuation of the trend.

Some illustrations are provided in table 6. The figures may be used to predict the value of various categories of imports at any given level of total final demand, e.g. imports of materials for use in industry may lie between £12 and £16 for every £100 of final demand, according to growth rate and assumption about trend.

6. Evaluation of results

From the statistical point of view the import functions constructed here can be considered as satisfactory, as they give, in most cases, a good fit

8

TABLE 6: THEORETICAL IMPORT CONTENT FOR NOMINAL GROWTH RATE 0%, 5% AND 10%, IRELAND 1961 ONWARDS

	Nominal growth rate		
	0%	5%	10%
Import content in absence of trend (%)			
Producers' capital	2.98	2.93	2.87
Food, drink and tobacco	1.08	1.43	1.78
Miscellaneous consumer goods	3.15	3.43	3.71
Materials for agriculture	1.53	1.51	1.50
Materials for industry	12.33	13.76	15.19
Invisibles, etc.	4.21	4.11	4.01
TOTAL	25.28	27.17	29.06
With continued trend after 10 years (in 1971)			
Producers' capital	3.11	3.06	3.00
Food, drink and tobacco	.75	1.10	1.45
Miscellaneous consumer goods	2.30	2.58	2.86
Materials for agriculture	2.15	2.13	2.12
Materials for industry	12.67	14.10	15.53
Invisibles, etc.	4.31	4.21	4.11
TOTAL	25.29	27.18	29.07

to the import contents of market supplies and therefore a *fortiori* a good fit to imports of various categories, which of course move upwards with the general level of prices and quantities produced and consumed. The question must, however, be considered how adequate they are likely to prove for application in future.

The coefficients showing the influence of nominal growth rate and of relative import prices are, at least as far as the total import bill and its chief components are concerned, plausible with regard to sign and order of magnitude. Whilst the coefficients are subject to error, as indicated by their standard errors or by confidence intervals constructed from them, one may reasonably have some faith in their applicability to future conditions.

The same cannot be said with regard to the coefficients of time in the equations, which represent historical trends but no more than that. The data are insufficient to establish the form of the trends, which may well follow a curve rather than a straight line and which do, in fact, represent the combined effect of a number of factors exercising a predominantly long-run influence. The evidence for a continuation of the observed trends for various types of imports is therefore fairly slender.

The question now arises: may we assume that the total import content will continue to show no long-term change? In other words, are there forces at work making for a long-run stability of the ratio between imports and gross national product; or is the stability observed between 1948 and 1961 purely a historical accident, caused by the cancelling out of upward and downward trends for import classes?

Whether the hypothesis of long-run constancy of the total import ratio is accepted is largely a matter of judgment. There are theoretical reasons for supposing that in the short run, forces are at work to redress the balance between imports and gross national product if it is upset. This is in fact implied in the specification of the present model, which suggests that, say, an exceptional rise in imports will bring about a rise in gross national product and vice versa. However, there is little theoretical justification for a belief that similar forces operate in the long run.

The possibility of a shift in the total import ratio will therefore be admitted. The excess of the observed over the computed 1961 figure suggests that the shift will be upward. Indeed, there is reason to suppose that the upward trend in imports of materials will continue though perhaps not to the same extent as previously for agricultural materials ; it is less plausible to assume that the downward trend in consumer goods imports, reflecting successful import substitution will continue, at any rate to the extent suggested by historical experience.

Whilst the import functions derived here in any event attempt to speak the truth and nothing but the truth, they cannot be expected to speak the whole truth. If they correctly assess the effect of some factors, they do not show the effect of variables which remained practically constant over the period of observation. The outstanding example are, of course, tariff rates. The effect of their gradual reduction cannot be quantitatively assessed yet and may indeed depend on price policy at home and abroad ; but there is every reason to suppose that they will tend to raise the import content of final demand, at least for a period.

There is also the possibility that structural alterations in the Irish economy will make for a higher content by shifting the emphasis towards industries requiring a high proportion of imported materials. To some extent this is already happening. The 36×36 input-output table for 1956, made available by the Central Statistics Office, gives some guidance on this point as it provides data for import content of industries.

By applying these data to the changes in gross output of various industries and services, it is estimated that the changes in industrial pattern by themselves had the effect of raising the imported materials content of production from 17·3% in 1953 and 17·6% in 1956 to 18·9% in 1960. The figures are not strictly comparable with those given in table 2 ; but the magnitude of their change would account for the upward trend in the data analysed here.

Furthermore, the input-output table permits us, after inversion of the matrix, to deduce, apart from direct imports, also the indirect import content of consumption, capital formation and exports separately. The matrix inversion was carried out on the Elliott 803 Computer at the Agricultural Research Institute, by the courtesy of Mr. F. O'Carroll. The result of interest here is a total import content of 42·6% for fixed capital formation, compared with 25·3% for consumption and 15·4% for exports. This indicates that a substantially higher rate of investment, at the expense of consumption or exports, would tend to raise the import ratio, other things being equal.

Of course, other things may not remain equal. Input-output analysis usually assumes that the technical coefficients, and in particular the import coefficient, for each industry remains unchanged, whilst actually these may be subject to substantial variations. It would be quite plausible to find that an increase in import content brought about by changes in pattern of production or final demand was at least partly offset by increased import substitution.

On balance, however, it would be prudent to assume that the figures given in table 6 somewhat err on the low side. A state of affairs in which total imports amounted, in the long run, to about 30% of total final demand, or, which is the same, to about £43 for every £100 of gross national product, would not be difficult to envisage.

7. Further implications

So far, no mention has been made of exports. Whilst the present study is mainly concerned with imports, nevertheless it is important to view the subject matter in a wider context and to consider some of the implications on the balance of payments.

No attempt has so far been made to construct export functions, as for example those given by J. L. Bridge for the U.K. (1962). Such functions depend heavily on external variables, that is to say, economic conditions abroad ; in the case of Ireland on conditions in the U.K. As far as the internal economy is concerned, exports may be considered rather more as determining factors for other economic aggregates than as being determined by them.

How did exports fare in the period under consideration ? In the same way as imports, exports and other components of final demand may be expressed as percentages of total final demand, and the figures are given in table 7.

The variations in the share of exports in total final demand are seen to be small ; and it can be shown that there is little association between the share and either the import content of market supplies or the growth rate. This, in fact, also

9

Year	% of total final demand				
	Personal consumption	Government consumption	Gross fixed capital formation	Stock changes	Exports
1947	57.6	7.9	6.5	+2.8	25.1
1948	56.3	8.0	7.8	+1.8	26.1
1949	56.0	7.4	9.9	+1.0	25.7
1950	54.8	7.4	11.1	+0.9	25.8
1951	53.2	7.8	11.8	+1.6	25.5
1952	53.2	7.9	11.8	−0.6	27.7
1953	53.1	7.9	11.0	+0.9	27.2
1954	54.2	7.9	11.7	−0.7	27.0
1955	54.5	7.5	11.6	+1.2	25.2
1956	55.9	8.1	11.7	−1.0	25.3
1957	55.6	7.8	10.0	−0.8	27.5
1958	56.6	7.8	9.6	−0.9	27.0
1959	54.2	7.7	9.2	+2.6	26.3
1960	54.4	7.6	9.2	+1.2	27.5
1961	52.9	7.6	10.1	+0.3	29.1
Mean 1947-61	54.8	7.8	10.2	+0.7	26.5

applies to all other components of final demand except stock changes which show a high positive correlation with import content and growth rate. This is not surprising.

The share of consumption in final demand is negatively correlated with the growth rate, pointing to consumption as lagging in rather than leading growth. This does not come as a surprise either, as growth in consumption must depend on growth in gross national product, at any rate in the long run. Although no complete model of the economy has been given here and no consumption function has been explicitly given, yet the existence of such a function, relating consumption to G.N.P. with some time lag, is implicitly assumed.

The problem of what determines growth is a much discussed and difficult one; a recent examination of the international differences in growth rates has been carried out by W. Beckermann (1962). Here the emphasis is placed on total final demand, which has not been introduced merely as a statistical device. It is understood that technical conditions for a growth in national product must be satisfied, but that growth does not happen automatically, unless there is confidence that the particular additional goods which can be produced will find a market at home or abroad.

The mechanism envisaged for an acceleration in the growth rate is an initial expansion in actual or potential exports or investment. This leads to a higher growth rate for imports than for output, which in turn means a slower growth of consumption; this acts as a brake on growth. An inflationary situation with a general price rise also appears to have a negative influence on real output growth and thus on future real growth.

A rapid growth in exports, bringing about a higher share of exports in final demand, will also raise the share of imports in market supplies, but to a lesser extent. The import content of market supplies will also tend to rise if there is a substantial increase in investment.

Thus, according to the origin of growth, the balance of payments may be favourably or unfavourably affected. There does not appear to be any automatic tendency for restoring the balance of payment to its equilibrium, at any rate in the short run. However, a substantial growth in capital formation is likely to be financed by net investment from abroad and by deliberate decision, thus in normal conditions not producing a balance-of-payments crisis.

8. Summary

(a) During the post-war period, out of every £7 of total final demand for goods and services, for the purpose of consumption, investment and exports, about £2 on the average have been met by imports; the remaining £5 by home production. These proportions have varied considerably from year to year but showed very little change in the long run.

(b) Imported consumer goods formed a declining proportion of total final demand, imported materials for agriculture an increasing proportion. There has been little change in the long run as regards the proportion of imported materials for industry, capital goods and invisible items. Imports of consumer goods, particularly food, drink and tobacco, and materials for industry showed marked short-term fluctuations in relation to final demand.

(c) Some of the fluctuations in the relative contributions of imports and home production are explained by relative price movements. When imports became relatively expensive, the response was to reduce imports in relation to gross national product to a slight extent in real terms, but in money terms their share increased quite substantially. The converse was true when imports became relatively cheaper.

(d) In times of rapid growth in the value of final demand, imports grew faster than gross national product, thus raising the import content of total market supplies by about 0·38% for each 1% that the growth rate exceeded its average; similarly in times of slow growth the import content declined. An increase in the general price level appears to have a similar effect as growth in real terms, perhaps owing to speculative influences.

(e) This association between growth rate and import content does not apply to imports of producers' capital, materials for agriculture and invisible imports. However, the remaining categories, viz. imports of industrial materials and consumer goods, account for the major portion of all imports, i.e. for more than one-fifth of total market supplies and for about three-quarters of the value of all imports.

(f) It cannot be taken for granted that the observed long-run constancy in the ratio of total imports to gross national product will continue in the future. Some increase in the import content of total market supplies may be envisaged. On the other hand, exports are also likely to form a somewhat higher proportion of total final demand.

(g) Any rapid increase in the ratio of imports to gross national product will tend to set forces at work which partly redress the balance by slowing down the growth of final demand through lagging consumption and thus reducing the rate of increase in imports.

(h) The impetus to growth is likely to come either from exports or from investment, particularly if accompanied by inflow of capital. According to which type of stimulus predominates, the effect on the balance of payments will be, in the traditional sense of the word, favourable or unfavourable. An "unfavourable" balance of payments does not necessarily have unfavourable consequences for the country's economy.

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APPENDIX: FORMULA FOR PRICE ELASTICITY

Write v, q and p for the value, quantity and price ratios between imports and gross national product, so that

$$v = \frac{M}{Y}, \quad q = \frac{M'}{Y'}, \quad p = \frac{MY'}{M'Y}$$

Then $y = \dfrac{100\,M}{M + Y} = \dfrac{100\,v}{1 + v}$

$$x_2 = 100 \log_e \frac{M(M' + Y')}{M'(M + Y)} = 100 \log_e \frac{p(1 + q)}{1 + pq}$$

$$\frac{\partial x_2}{\partial p} = \frac{100}{p(1 + pq)}$$

According to the regression equation

$$y = a + bx_1 + cx_2 + dx_3 + u$$

$$\frac{\partial y}{\partial p} = \frac{100\,c}{p(1 + v)}$$

Since $\dfrac{\partial y}{\partial v} = \dfrac{100}{(1 + v)^2}$

$$\frac{\partial v}{\partial p} = \frac{\partial v}{\partial y}\frac{\partial y}{\partial p} = \frac{c(1 + v)}{p}$$

$$\frac{Ev}{Ep} = \frac{p}{v}\frac{\partial v}{\partial p} = \frac{c(1 + v)}{v}$$

$$= \frac{100\,c}{y}$$

$$\frac{\overline{Ev}}{Ep} = \frac{100\,c}{\bar{y}}$$

and since $v = pq$

$$\frac{\overline{Eq}}{Ep} = \frac{100\,c}{\bar{y}} - 1$$

q.e.d.

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