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A Study of Demand Elasticities
for Irish Imports

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A Study of Demand Elasticities for Irish Imports

DERMOT McALEESE*

IN this paper an attempt is made to quantify the effects on import demand of changes in Gross National Product (GNP) and changes in the domestic price level relative to import prices (relative prices). The results are expressed in terms of GNP and relative price elasticities. The GNP elasticity of import demand is defined as the percentage change in import demand caused by a given percentage change in GNP. Thus a GNP elasticity equal to, say, 2 means that a 10 per cent increase in GNP leads to a 20 per cent rise in import demand. A similar definition, *mutatis mutandis*, applies to price elasticity.

Studies of Irish import demand have been carried out by Leser [10] in his 1967 ESRI paper, and Baker and Durkan [2] in three 1969 issues of the ESRI's *Quarterly Economic Commentary*. The valuable work of these authors is acknowledged frequently in the following pages. In general, the results here neither conflict with nor duplicate their findings, but, it is hoped, add to knowledge of import demand behaviour in a number of ways. Thus, Baker and Durkan, being concerned with short-term forecasting, are naturally much less interested in the individual coefficients and the theoretical implications, and correspondingly more concerned with the short-run predictive power, of their equations than the present author, whose aim is to supply estimates for medium and long-run forecasting purposes. Leser's approach is much closer to that of the present paper than is Baker and Durkan's. Our aggregate

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elasticities accord reasonably well with his (although our income elasticity is significantly higher), but the two sets of estimation equations (Leser's and ours) diverge in a number of important respects. Furthermore the divisions used in disaggregating total import demand in the present study namely, consumer goods (CG), materials for further production (MFP) and producers' capital goods (PCG) imports differ from those of Leser's paper.

Before becoming involved in the detailed arguments of the succeeding pages, it may be helpful to describe in plain language and with the minimum amount of qualification the major practical implications of the present study.

A remarkable feature of Irish imports is their sensitivity to changes in GNP. Thus our results suggest that, assuming all prices constant, a 4 per cent GNP growth rate implies an annual increase of approximately 8 per cent in total imports. Furthermore, it is shown that every increase of £10 in GNP tends to be accompanied by an increase in imports of £8. In technical jargon, the elasticity of Irish import demand with respect to GNP is 2, and the marginal propensity to import has a value of roughly 0.8. It is the high marginal propensity to import rather than the size of the import/GNP ratio *per se*, which is the crucial feature of the much-cited "openness" of the Irish economy. One implication of the foregoing is that substantial reductions in imports may be obtained simply by cutting down the growth rate of GNP. Only in rare instances would such a policy be desirable, but there can be no doubting its effectiveness in an Irish context.

Various explanations of the close correlation between imports and GNP are offered in the text. Three factors deserve special attention. First, the import content of domestically produced goods is high. Raw and semi-processed materials must be imported in the absence of domestic substitutes. Secondly, as GNP grows, the demand for the capital goods necessary to produce the additional output also increases, and few of these capital goods are manufactured domestically. Thirdly, as standards of living rise, demand for luxury consumer goods increases, many of which are supplied from abroad. Higher incomes also stimulate the demand for greater variety in consumer goods, a demand which cannot be satisfied by domestic producers. The practical importance of these considerations is confirmed by our empirical work. Import demand elasticities with respect to GNP are estimated for CG, MFP and PCG imports as 2.6, 1.8 and 2.0 respectively. The comparatively high elasticity of producers' capital goods may be noted. It suggests that, assuming all prices constant, the share of capital goods in total imports will increase over time.

We turn now to consider the influence of relative price on import demand. Relative rather than absolute price changes are chosen, since it is obviously impossible to estimate the effect on imports of a given percentage increase in, say, the domestic price level without knowing the behaviour of import prices. Thus an assumption of the approach adopted in this paper is that, if import and domestic prices are increasing simultaneously at the same rate, then import demand will not be affected.

Irish imports respond in a moderately sensitive fashion to changes in relative prices. Thus, a 10 per cent rise in domestic relative to import price tends to cause a 9 to 15 per cent rise in the volume of imports. Not all imports, however, react in the same way. PCG and MFP imports (with price elasticities of roughly -0.3) are much less sensitive to price changes than CG imports (with a price elasticity exceeding -1.5). This fact has important repercussions for economic policy. It indicates that the only section of import demand liable to be substantially influenced by a policy of domestic price stabilization is CG import demand. These amount to less than one quarter of total imports. However, there is some slight evidence that the price responsiveness of MFP imports may increase in the future.

The price of imports may be divided into two parts: (a) the foreign (c.i.f.) price of imports and (b) customs duties and special import levies added to foreign price.

Between 1956 and 1966, domestic prices rose at a much faster pace than the foreign price of our imports. Thus, the domestic wholesale price index rose by 33 per cent during this period compared with a 7 per cent rise in foreign prices. The causes of domestic inflation need not detain us here, but the small increase, both in absolute and comparative terms, of the foreign price of imports merits some attention. A detailed discussion of the reasons for the stability of this price index would carry us beyond the purview of the present study. In part, it may be explained by the type of goods we import, in part by the keenness of international competition, and perhaps also by the prevalence of "dumping" (i.e. selling abroad at prices below the domestic price) in international trade. What must be noted is that the competitive advantage thereby secured by foreign exporters appears to have been substantially negated by the imposition of tariffs during the first half of the decade. Thus if the price index of imports including customs duty is taken, we find an increase between 1956 and 1966 of almost 20 per cent in this index instead of the 7 per cent rise recorded when customs duty is ignored.¹ Putting it another way, domestic prices relative to foreign c.i.f. prices rose by 26 per cent over the decade but by only 15 per cent relative to foreign prices including customs duty. In the years ahead, it will not be possible to alleviate the pressures of foreign price competitiveness through protection. We shall have to rely either on devaluation or domestic price stabilization for such purposes.

In order to throw the above remarks about price and GNP elasticities of import demand into sharper focus, imports are projected over a ten-year period, 1966 to 1976, on the basis of the Third Programme's assumptions about GNP and industrial growth. Allowances are also made for the movement towards trade liberalisation by assuming a 40 per cent reduction in the relative price of CG imports, a 15 per cent price reduction in MFP imports and a 5 per

¹The two price indices are not strictly comparable, since one is a unit value index, the other a true price index. However the disparity in the behaviour of the two indices is sufficiently pronounced to justify our conclusion.

cent price reduction in PCG goods imports. As we emphasise in the text, these price assumptions are chosen rather casually as the conclusions are relatively insensitive to the precise magnitude of the relative price reductions postulated.

The Third Programme's assumptions about annual import growth rates imply a rise in total imports from £361m. to £830m. over a ten-year period.² Our projections, based on the import demand elasticities estimated in this study, suggest a rise from £361m. to somewhere between £740m. and £880m.³ The two projections therefore are quite compatible. Both indicate a more than twofold increase in import volume.

In the concluding section of this study, however, attention is drawn to the discrepancy between our projections regarding the composition of imports and those of the Third Programme. The latter assumes the following growth rates for the three components of total imports: PCG 6.8 per cent, MFP 7.0 per cent, CG 13.0 per cent. The corresponding percentages on the basis of our demand elasticities are 9.0, 7.0 and 11.0 per cent respectively. Thus our projections suggest a more rapid rise in capital goods imports and a less rapid increase in consumer goods imports. Recalling the low price elasticity of capital goods imports, the projections thus imply a pattern of imports which becomes progressively less amenable to relative price adjustments over time. In other words, if our projections are correct, the composition of imports will tend to be more heavily weighted towards goods with low price elasticities than is envisaged in the Third Programme.⁴

If the influence of GNP growth and prices are considered separately, we find that GNP exercises the predominant influence on import demand, with relative prices playing a subsidiary but yet not insignificant role. If relative prices remained constant (i.e. no allowances were made for trade liberalization) then total imports in 1976 would lie in the range £685m.—£760m. as against £740m. to £880m. when relative prices are allowed to fall. The "price effect", therefore, amounts to £55m.—£100m. or from £5m. to £10m. per annum. Thus it appears that reasonably significant savings in imports could be made by checking the rate of domestic inflation. The overriding influence of GNP growth and higher standards of living, however, suggest that substantial increases in exports and capital inflow will be necessary, if high growth rates are to be maintained.

Small countries typically tend to have low import price elasticities of demand. In these countries, the range of domestically produced goods is limited, thus

²It would have been just as easy to express the argument in terms of a four year period 1968-72, without thereby in any way affecting our conclusions. A ten year period is chosen in order to illustrate the results more sharply.

³As noted in the text, the range of possible values is made deliberately rather wide. The average of the upper and lower bounds yields what we might consider the most likely outcome. The most important task is to establish the order of magnitude of the import increase.

⁴We have assumed a price decrease of consumer goods imports of 40 per cent due to trade liberalisation. This probably overstates the true price decline to be expected. For example, tariffs are expected to decline only *vis-a-vis* the United Kingdom. Hence, we probably tend to exaggerate rather than underestimate the increase in CG imports. Our conclusions regarding the composition of imports are thus strengthened.

severely restricting the degree of substitutability between domestic production and imports. Ireland, as we have seen, is no exception to this rule. On the other hand, export demand elasticities for small countries tend to be larger than average on account of their low share in total export markets. Naturally the actual magnitude of the elasticity in any individual case depends on the type of goods exported, location of markets etc. Ireland's agricultural exports, for example, could not be described as price elastic, owing to the peculiar nature of the market for agricultural produce. Exports of finished manufactures, however, may be much more responsive to price. Import demand elasticities for finished manufactures of the largest trading blocs are estimated by Balassa [1] as follows:⁵

<i>US</i>	<i>UK</i>	<i>EEC</i>	<i>EFTA</i>	<i>Japan</i>
-4.12	-2.68	-3.09	-2.27	-3.09

Taken at their face value, these figures suggest that a fall of 10 per cent in Irish export prices of finished manufactures relative to corresponding international prices would lead to an increase in exports of over 20 per cent. In the absence of a detailed investigation of Irish export demand, this figure is necessarily somewhat arbitrary, suggestive rather than compelling. However, if Ireland's export demand elasticities for finished manufactures lie approximately within the range suggested by Balassa, the gains, in terms of increased exports, which might accrue as a result of keeping domestic price inflation below that obtaining in our export markets, emerge quite clearly. Prices, of course, are not everything—we need marketing expertise as well. Nevertheless the high price elasticities observed internationally for finished manufactures suggest that, for any given level of sales effort and quality of product, a fall in export prices relative to those abroad can yield substantial increases in exports.

Before concluding this introduction, certain limitations of this study should be mentioned. First, the import projections are expressed in constant c.i.f. prices, as are the Third Programme's. In order to convert the projections into current price terms, assumptions would have to be made concerning the future trend of total and disaggregate import c.i.f. prices, a task not undertaken here. Secondly, our treatment of the effects of trade liberalization takes no account of the "dynamic" effects of this policy, such as the stimulus given to greater efficiency and innovation by reducing tariff barriers. In other words, the comparative static approach of the present paper sheds useful light on, but makes no claim to providing a fully comprehensive evaluation of the likely consequences of free trade. Further research in this area is being carried out by the present author. Thirdly, the aim is to facilitate the making of useful medium-term (i.e. 4 years or more) import projections rather than short-run projections. It is, therefore, as yet too early to attempt a comparison between actual and projected imports.

⁵Balassa's elasticities refer to imports from all countries. Thus the U.K.'s elasticity of -2.7 indicates that a fall of 10 per cent of the average price of total U.K. imports of finished manufactures leads to a rise of 27 per cent of total U.K. imports.

The remainder of this study is divided into three parts. The first part presents the empirical results of our aggregate demand equation estimation. These results are compared with other attempts in the area.

The second consists of a discussion of three disaggregated import demand equations and an evaluation of the elasticities.

The third part provides a summary of the results and conclusion. Direct elasticity estimates are compared with indirect estimates. Forecasts based on the disaggregated equations are then compared with those based on the aggregate elasticities.

2. AGGREGATE IMPORT DEMAND

Aggregate import demand equations have been estimated using quarterly data of the period 1956-66. The choice of period was dictated primarily by the availability of data.⁶ Quarterly series for the disaggregated import values classified by use begin in 1956 and it is considered desirable for purposes of comparison between aggregate and disaggregate results to have both sets of equations covering the same period. At the time the equations were estimated, the latest available disposable income figure referred to 1966, so this determined the upper limit of our period. Only merchandise imports are considered, no account being taken of "invisible" imports such as profits sent abroad, expenditure by Irish tourists in foreign countries etc.

Imports rose rapidly over the decade, in current values increasing more than twofold, in constant prices increasing by rather less than this. It will be noted from Table 2.1, however, that the growth of imports did not proceed at a constant rate. Imports at constant prices grew by 23 per cent between 1956 and 1960, an average growth rate of 6 per cent per annum, but by 50 per cent between 1961 and 1966, an average growth rate of over 8 per cent.

TABLE 2.1 *Irish Imports 1956-66*

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
1. Value of Imports c.i.f. (£m. current)	182.8	184.2	199.0	212.6	226.2	261.4	273.7	307.7	349.3	371.8	372.6
2. Gross National Product (£m. current)	560.4	581.3	600.9	637.8	674.2	724.3	780.0	835.0	946.0	1,012.8	1,063.0
3. Imports as % of GNP, current values	32.7	31.7	33.1	33.3	33.6	36.1	35.1	36.8	36.9	36.7	35.0
4. Value of Imports at constant (1953) prices	172.3	164.6	185.9	203.2	212.2	242.7	254.4	281.2	316.5	329.0	329.7
5. GNP at constant (1958) prices	610.5	616.3	600.9	626.0	657.4	689.0	710.4	739.1	767.8	787.9	797.0
6. Imports as % of GNP, constant prices	28.2	26.7	31.0	32.4	32.3	35.2	35.8	38.1	41.2	41.8	41.4

Source: Computed from *Statistical Abstract and Review of 1968 and Outlook for 1969*.

⁶Choice of 1956 as a beginning year was made with some reservations in view of the drastic special import levies of that year. It is hoped that the price variable takes sufficient account of the import levies. See below, for a full discussion.

The behaviour of imports appears to have changed markedly after 1960. Not alone did imports in current and constant values rise at a faster rate than previously but, the share of imports in GNP also increased. From 1956 to 1960, the average import/GNP (both in current values) ratio was 33 per cent. For the succeeding six years, this figure rises to 36 per cent. If imports and GNP are expressed in constant prices, the rise in the import content of GNP strikes us much more forcibly. Thus, after increasing from 28.2 per cent in 1956 to 32.3 in 1960, the ratio then jumps to 41.2 in 1964, remaining at this level until 1966. Changes in this ratio underline clearly the fact that the sharp increase in imports relative to GNP after 1960 was not caused by a rise in c.i.f. import prices relative to the domestic price level (as measured by the implicit GNP deflator). In fact, import prices remained remarkably stable during the ten years under review. The import unit value index rose from 106 in 1956 to 113 in 1966—an increase of 7 per cent—as against a corresponding rise of 33 per cent in domestic prices.

Considering the percentage distribution of imports according to main uses, we find that the share of producers' capital goods in total imports has risen significantly, from 13 per cent in 1956 to 15.5 in 1966, at the expense of intermediate goods and unclassified imports (temporary imports and reimports). Apart from producers' capital goods, percentage shares have not altered as much as one would have expected in view of the undoubted changes in the structure of the economy.

There are, therefore, three aspects of aggregate import behaviour over the decade which require explanation

- (i) the rapid rise in imports, especially after 1960,
- (ii) the growth in the share of imports in GNP,
- (iii) the constancy of the composition of imports.

We defer discussion of the last aspect until later in this study, and for the time being concentrate on the first two aspects, namely, the overall and relative growth in import volume.

The Variables

The dependent variable chosen is value of total imports c.i.f. less unclassified imports deflated by an import unit value index.

Import demand is expressed as a function of relative prices and income, variously defined. Total population decreased by an insignificant margin over the decade—from 2.898m. in 1956 to 2.884m. in 1966—and population movements within the decade were sufficiently small to obviate the need to convert income and import data into *per capita* terms.

The price variable consists of an import price index (inclusive of customs duties) divided by a domestic wholesale price index (all items). By using a

price ratio, the important property of homogeneity is preserved.⁷ Although some authors form the price variable as the difference between the import and domestic wholesale price index, the price ratio appears to possess more intuitive appeal.

A number of "activity" variables are tested. Leser, following common practice, used the volume of transportable goods production. In the absence of quarterly income data, it must be granted that this series is probably the best single index to measure quarterly changes in real output and income. Irish industrial production, however, accounts for only about 30 per cent of GNP; and movements in non-industrial output must also be considered. Leser acknowledges this point and makes allowances for it. He finds that each 1 per cent increase in industrial production has been associated with, on average, a 0.48 per cent increase in GNP between 1953 and 1964. The figure for the industrial output elasticity which he estimates to be 0.78 is then divided by 0.48 to yield what he calls an "income elasticity of imports" of 1.61.

Rather than use this approach, annual real disposable income figures⁸ are taken and transformed into a quarterly series. This is done by superimposing on the annual year-to-year trend in disposable income the short-run fluctuations in the transportable goods index. The resulting series is a hybrid which incorporates the annual trend in disposable income with the quarterly fluctuations in the transportable goods industries sector.⁹ Allowances are also made for the varying percentage share of transportable goods in total output.¹⁰ The transformation, although arbitrary in its own fashion, avoids the rigidity involved in the assumption of a constant associative relationship between industrial production and GNP when deriving an income elasticity.

⁷Not all economists would consider this an advantage. Some argue that the assumption of no money illusion is unwarranted and favour the substitution of two separate variables—import and domestic—for the price relative. If money illusion is absent, then the coefficient of each price term ought to be the same. The view taken here is that the assumption is inherently reasonable, all the more so if long run reactions are under review—as is the case when specifying a distributed lag model.

⁸Disposable income figures are divided by the consumer price index to derive the real income series.

⁹The method of calculation is quite simple. For example, take the first two annual observations of the disposable income series and make a straight line interpolation between them. In order to do this, assume that the annual observations lie at the end of the second quarter of each year. From this interpolation, calculate values for the third and fourth quarters of the first year and for the first and second quarters of the second year. Straight line interpolation by itself is a very rudimentary way of converting an annual series into a quarterly series. As the second step, turn your attention to the quarterly series and calculate yearly averages of the observations of the transportable goods index. This gives annual averages for the first two years of this quarterly series comparable to the first two observations from the annual series. As the third step, interpolate between these new annual averages assuming that they again lie at the end of the second quarter of each year and calculate new quarterly values of the transportable goods index as done before for the disposable income series. As the fourth step, calculate the percentage increase or decrease of the original value of the transportable goods index over the new interpolated values. Using this percentage increase or decrease, the fifth step is finally to calculate quarterly values for the annual disposable income series. To do this, simply assume that the created quarterly value of the disposable income series has the same percentage increase or decrease over the interpolated quarterly value as does the transportable goods index.

¹⁰In fact, two synthetic disposable income series were calculated, one on the assumption that fluctuations in transportable goods output are fully reflected in disposable income, the other on the assumption that elements of disposable income other than that arising from production followed a smooth linear trend. The latter version invariably fitted that data better, which is what one would expect since services and government expenditure can be expected to be more stable from quarter-to-quarter than output of transportable goods industries.

Seasonal dummies are also included as explanatory variables. The results point to the existence of a distinct seasonal pattern, imports being exceptionally high in the second quarter and low in the third. The reasons for this are discussed later in the context of the disaggregated equations.

The Equations

The list of variables is as follows.

m = value of total merchandise imports c.i.f. (excluding unclassified items) deflated by the import unit value index
average value = £57.05m.

p = import price index (including customs duties) divided by the domestic wholesale price index (all items), base 1953 = 100
average value = 98.0

q = index of volume of production of transportable goods (base 1954 = 100)
average value = 137.3

y = real disposable income series in 1947 prices at annual rates (construction explained in text)
average value = £477.2m.

d_1, d_2, d_3 = seasonal "dummy" variables
1st quarter, $d_1 = 1, d_2, d_3 = 0$
2nd quarter, $d_2 = 1, d_1, d_3 = 0$
etc.

All variables are expressed in quarterly values. The raw data were obtained from successive issues of the *Statistical Abstract of Ireland* and the *Irish Statistical Bulletin*.

Fourteen equations were estimated, the best three of which are reported below.¹¹ Absolute values of t ratios are in parenthesis underneath the coefficient to which they refer.

$$(2.1) \quad m = -0.5154p + 0.2496y + 1.1580d_1 \\ \quad \quad \quad (33.4) \quad (16.87) \quad (0.84) \\ \quad \quad \quad -2.0452d_2 - 5.3569d_3 - 10.0275 \\ \quad \quad \quad (1.45) \quad (3.89) \quad (0.48) \\ R^2 = 0.96, \quad DW = 1.16, \quad SE = 3.07$$

¹¹"Best" in the sense that the signs of the coefficients conform to what we expect on the basis of economic theory (e.g. price coefficients ought to be negative), that the coefficients of the key economic variables have high t -ratios and that satisfactory levels of R^2 and, more important, of SE are achieved. The criteria cannot unfortunately be reduced to any simple mechanistic rule of thumb. A certain degree of judgement had to be exercised in choosing which equations to present in the text.

$$(2.2) \quad m = -0.3582p + 0.1378y + 0.4248m_{-1} \\
\begin{array}{cccc}
(2.31) & (3.04) & (2.59) & \\
-2.0772d_1 & -4.0471d_2 & -8.3645d_3 & +6.0460 \\
(1.16) & (2.68) & (4.85) & (0.30) \\
R^2 = 0.97, \quad DW = 2.00, \quad SE = 2.84
\end{array}$$

$$(2.3) \quad m = -0.2401p + 0.4029q + 0.5525m_{-1} - 1.9213d_1 \\
\begin{array}{cccc}
(1.49) & (2.27) & (3.41) & (0.88) \\
-4.9885d_2 & -8.4904d_3 & +25.5358 & \\
(3.32) & (4.23) & (1.34) & \\
R^2 = 0.96, \quad DW = 2.07, \quad SE = 2.99.
\end{array}$$

Equation (2.1) with imports regressed on price and disposable income fits the data quite well. Against this, the low value (1.16) of the Durbin-Watson statistic casts doubt on the validity of the specification of the equation.

The introduction of a new variable, lagged imports (m_{-1}), in equation (2.2) leads to a number of improvements. First, the autoregression problem disappears. Secondly, the standard error of estimate is reduced to 2.84 and the R^2 is raised to 0.97. Thirdly, the form of the equation becomes consistent with the distributed-lag hypothesis—a specification which has more appeal on economic grounds than “static” equations of the (2.1) type.¹² The instability of the constant term (and to a lesser extent, d_1) may be due to a structural shift in the demand function during the decade. This however is quite compatible with stable price and income slopes—the main concern of this study.

Multicollinearity, a familiar bugbear of time-series demand analysis, does not appear to have exercised its customary detrimental effect on the price and income coefficients. The income/price correlation coefficient (-0.7) has presumably been kept at a relatively low level by the use of quarterly data. However, the high correlation between income and lagged imports (0.95) would lead one to expect low t-ratios for their respective coefficients. This has not in fact happened, and both coefficients are significant at the 5 per cent confidence level and may, therefore, be used to calculate the elasticities. We take the view here that the standard errors should give ample warning of the imprecision attached to the coefficients of correlated independent variables.¹³

The effects of replacing disposable income (y) by the transportable goods industries index (q) can be observed in equation (2.3). The fit emerges as rather less satisfactory than (2.2) and the coefficient of price loses significance.

¹²But care must be exercised in interpreting the coefficient of m_{-1} . This coefficient could not be used to estimate a long-run elasticity according to the distributed lag hypothesis if lagged imports assumed explanatory power because, for example, (a) a lead relationship existed whereby last quarter's imports played an important role in determining the size of this quarter's imports or (b) high imports last quarter would lead to restrictive policies on the part of the government towards this quarter's imports. We assume that situations (a) or (b) do not occur to any significant extent.

¹³Although this view has the support of most authorities in the field, the contrary has been argued by Geary [8] who holds that the presence of correlation among independent variables vitiates the individual regression coefficients, regardless of the size of their standard errors.

For reasons already adduced, we tend to favour the specification of (2.2) on *a priori* grounds. It would appear, therefore, that our synthetic income variable provides a more adequate explanation of imports than the transportable goods industries index.

Each equation was run alternately in linear and log-linear form. The results were almost identical in terms of the conventional statistical criteria (R^2 , Durbin-Watson test, and standard error of estimate), but the log-linear elasticities tend to be higher than the linear.

Elasticities

Elasticity estimates obtained from both the linear and log-linear version of each equation are presented below.¹⁴ For purposes of comparison Leser's elasticities are also included. Considering only long run elasticities, a fairly consistent picture of import demand behaviour emerges.

TABLE 2.2: *Price and Income Elasticities for Aggregate Income*

Equation number	Price "Impact" long-run		Income "Impact" long-run	
Linear				
(2.1)	—0.89		2.09	
(2.2)	—0.62	—1.08	1.15	2.00
(2.3)	—0.41	—0.91	0.97	2.15
Log-Linear				
(2.1)	—1.38		1.94	
(2.2)	—1.02	—1.53	1.25	1.87
(2.3)	—0.64	—1.25	1.07	2.10
Leser	—1.38		1.61	

First, imports appear to be reasonably responsive to changes in price. The price elasticity of import demand appears to lie between -0.89 and -1.53 (the lowest and highest estimates respectively). This is an average elasticity. It does not imply that all imports respond with equal sensitivity to changes in price. (In the next section, price elasticities of different types of imports will be examined with a view to detecting any differential responses which may exist.) The elasticity suggests that a 1 per cent fall in import relative to domestic price leads to somewhere between a 0.9 and 1.5 increase in import demand. Both elasticities are used in our later calculations, the former being hereinafter referred to as the "lower bound" elasticity and the latter the "upper bound" elasticity.

¹⁴Long-run elasticities are derived by dividing the coefficient of price (income) by one minus the coefficient of lagged imports. Elasticities derived from linear equations are defined at the average value of imports and the independent variables.

Irish income elasticity of demand for imports emerges as extremely high regardless of the specification of the equation. Our lower bound estimate is 1.87 and the upper bound, 2.15. It will be noted that Leser's estimate of 1.61 falls significantly below our lower bound, but even his estimate substantially exceeds unity. Two conclusions follow. First, as real income grows—all other things (e.g. relative prices) remaining constant—the percentage rise in imports will exceed the percentage growth in income. Thus the import/GNP ratio in constant prices may be expected to increase over time. This does not, of course, necessarily imply an increase in the ratio in current prices. The second conclusion relates to the size of the marginal propensity to import in real terms.

Recalling the income elasticity formula $\left(\eta = \frac{dm}{dy} \cdot \frac{y}{m}\right)$, it follows that the marginal propensity is derived simply by dividing the elasticity value (η) by y/m . Thus if we assume an elasticity of 2.0, and a GNP/import ratio of 2.6 (the actual ratio in 1966), this implies a marginal propensity to import of 0.8.¹⁵ The marginal propensity is high by most standards and underlines the much cited "openness" of the Irish economy.

With the aid of the foregoing analysis, we are now able to indicate in rough terms the relative influence of price and income effects on total volume of imports. During the decade, the import/domestic price ratio fell by roughly 15 per cent and GNP rose by 31 per cent in real terms. If price elasticity is taken as -1.0 and income elasticity as 2.0, the fall in price leads to an increase of 15 per cent in imports, and the rise in GNP accounts for an increase of 62 per cent in imports. The combined effect is an increase of 77 per cent in import volume,¹⁶ over four-fifths of which is due to the change in GNP alone. Thus, most of the rise in imports during the period 1956–66 can be attributed to the growth of GNP. This much is probably well known already. However the results further indicate that the rapid rise in domestic relative to import prices played a small but yet significant part in explaining the rise in imports. It also emerges that the stimulus to the higher growth rate of imports after 1960 originated in the corresponding increased growth rate of GNP during this period. Whereas the import/domestic price ratio fell rather evenly throughout the decade, the GNP growth rate between 1956 and 1960 was only half that of 1960 to 1966.

The rise in the import/GNP ratio in current values may also be attributed to the high income elasticity of import demand combined with rapid growth of

¹⁵The assumption of the same elasticity of demand for GNP as for disposable income is legitimate since these two variables tend to grow at the same rate.

¹⁶A discrepancy exists between the "anticipated" 77 per cent increase in imports and the actual increase of 91 per cent. It is due partly to rounding errors and random elements in import demand. In part, the discrepancy may be attributed to the inherent crudity of the elasticity approach when used to analyse non-marginal changes in demand. This defect can be overcome by considering upper bound estimates of imports (based on the highest estimate of price and income elasticities) and lower-bound estimates of imports (based on the lowest price and income elasticities). In the present context, such an approach is unnecessary since the basic conclusion—that income effects account for the major part of import growth—remains unaffected, regardless of whether upper or lower bound elasticities are employed.

GNP itself. The fall in prices of imports relative to domestic prices by restraining the magnitude of the income effect in value terms acted as a dampening influence on the increase in the ratio. This explains why the import/GNP ratio rose much more dramatically in constant prices than in current prices.

Our results suggest that, as the economy grows, the import/GNP ratio will continue to rise. The ratio (38 per cent in 1966) is already rather high by international standards. Only two countries in Europe, Luxembourg (82 per cent) and the Netherlands (45 per cent), have an import ratio higher than Ireland's.

In view of the exceptional extent of our dependence on imports, care must be taken in extrapolating from past experience into the future. It is necessary, for example, not merely to quantify our income and price elasticities of import demand, but also to attempt an explanation of their respective values. To this end, we now turn by examining the composition of imports and the determinants of the demand for each constituent group.

3. DEMAND FOR IMPORTS CLASSIFIED BY USE

3.1 *Producer's Capital Goods (PCG) Imports*

Imports of producer's capital goods ready for use consist for the most part of machinery and transport equipment.¹⁷ Although PCG imports form a small proportion of total imports, this proportion has risen significantly, from 13 per cent in 1956 to 15.5 per cent a decade later (see Table 3.1). The increase would be more pronounced had an earlier base year been chosen—the percentage of PCG to total imports being 11 per cent on average over the four years prior to 1956. This change in the pattern of Irish imports can be explained by the important structural changes which took place over the decade. Between the years

TABLE 3.1: *Irish Imports 1956-66 Classified According to Main Uses*

Imports of Producers' Capital Goods

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
1. Value at current c.i.f. prices (£m.)	23.7	20.1	23.0	25.2	25.3	34.9	39.4	47.3	52.2	60.3	57.9
2. Price Index including customs duties (1953 = 100)	109.6	113.8	114.9	115.5	116.3	119.4	122.0	122.2	126.4	128.9	132.6
3. Value at 1953 prices (£ m.)	21.6	17.7	20.0	21.0	20.9	29.2	32.3	38.8	41.3	46.7	43.6
4. Value as percentage of Total Imports	13.0	10.9	11.6	11.8	11.2	13.3	14.4	15.4	14.9	16.2	15.5

¹⁷Live animals imported for breeding purposes are also included, but they form a negligible proportion of the total.

Materials for Further Production Imports

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
1. Value at current c.i.f. prices (£m.)	111.2	114.2	121.9	134.1	142.8	160.1	165.6	181.2	212.0	219.0	219.1
(i) for agriculture	8.7	10.8	12.2	13.3	11.8	13.4	15.8	16.9	16.5	17.8	15.2
(ii) Other	102.5	103.2	109.6	120.7	131.0	146.6	149.9	164.4	195.5	201.8	203.9
2. Price Index (1953 = 100) including customs duties	106.3	112.4	109.0	107.5	108.2	108.1	109.9	112.2	118.8	120.8	125.7
3. Value of Imports at constant (1953) prices	104.6	101.4	111.8	124.7	132.0	148.1	150.7	161.5	178.4	181.8	174.3
4. Value as percentage of Total Imports	60.8	61.9	61.2	62.2	63.1	61.2	60.5	58.9	60.7	59.1	58.8

Imports of Consumption Goods Ready for Use

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
1. Value at current c.i.f. prices (£m.)	41.0	41.6	44.0	45.0	46.4	52.8	57.4	65.2	71.2	80.0	84.2
Food, Drink and Tobacco	10.4	13.5	12.8	13.6	13.9	16.0	17.2	19.9	19.8	23.2	23.7
Other	30.6	28.1	31.2	31.4	32.5	36.8	40.2	45.3	51.4	56.8	60.5
2. Price Index including customs duties (1953 = 100)	116.5	123.2	120.0	116.0	114.6	118.0	119.5	121.1	123.9	126.3	130.0
3. Value as a percentage of Total Imports	22.4	22.6	22.1	21.2	20.5	20.2	21.0	21.2	20.4	21.5	22.6
Food, Drink and Tobacco	5.7	7.3	6.4	6.4	6.2	6.1	6.3	6.5	5.7	6.2	6.3
Other	16.7	15.3	15.6	14.8	14.3	14.1	14.7	14.7	14.7	15.3	16.2

Source: Irish Statistical Bulletin.

1956-58 and 1964-66, gross domestic fixed capital formation grew from 14 to 18 per cent of GNP. Machinery and transport equipment, in turn, accounted for roughly 40 per cent of total capital formation throughout the decade. The import content of machinery and transport equipment expenditure is high—certainly no less than 65 per cent—and appears to have been growing over the decade.

The increase in PCG imports did not follow an even trend over the decade. Table 3.1 indicates that these imports remained virtually constant between 1956 and 1960, but grew in the subsequent five years from £25.3m. to £57.9m. at current prices, and from £21.7m. to £43.6m. at 1953 prices. This reflects the remarkable upsurge in investment which occurred after 1960.

An examination of quarterly data (for which figures are not given here) reveals the presence of considerable fluctuations in import values from quarter to quarter. These fluctuations were not due to large price changes but in fact

arise from fluctuations in the volume imported. To some extent, they may be explained by the "lumpiness" of certain items of capital equipment. In particular, one might mention ship and aircraft purchases which, owing to the small size of the Irish economy, tend to occur at discrete intervals and make a noticeable impact on quarterly import figures for capital goods. To exclude them from the data was not feasible as purchases of new ships and aircraft are not distinguished from purchases of spare parts and accessories in published trade statistics.¹⁸

The Variables

The dependant variable is value of PCG imports deflated by the PCG import price index. This price index includes customs duties but, since tariffs are not generally placed on this type of import, there is no reason to doubt the appropriateness of the deflator.

It would be reasonable to expect a strong association between PCG imports and domestic investment. Unfortunately, no quarterly investment series exists for Ireland. Hence we are obliged to attempt to explain changes in PCG imports indirectly by choosing explanatory variables for direct investment. An immediate candidate for this task is total output for which we have a ready surrogate in the volume of transportable goods industries index.

Both the absolute level of output and quarter-to-quarter changes in output are used as "activity" variables.

The absolute level of output influences PCG imports via its effect on the flow of depreciation. Thus, we assume that a higher level of output implies larger capital stock which, in turn, involves increased expenditure on depreciation. More machines will have to be replaced each quarter, for example, which will necessarily involve a rise in PCG imports.¹⁹

Changes in output, on the other hand, affect PCG imports through the familiar accelerator mechanism. In its crude form, the accelerator hypothesis states that an increase in output raises the level of the desired capital stock, thereby inducing additional net investment. The validity and sturdiness of the accelerator mechanism has been demonstrated by numerous studies of investment demand. More sophisticated versions of the hypothesis, however, take account of variables such as the degree of capacity utilization and the availability and price of credit.

¹⁸Mr. J. Durkan of the Economic and Social Research Institute drew my attention to this point. Furthermore, he has succeeded in constructing a series for PCG imports which excludes as far as is possible the influence of new transport equipment. His equations, as a result, fit the data better and the standard error is reduced. However neither the income or price coefficients appear to be markedly influenced by Durkan's adjusted PCG import series. For this reason, it was not felt necessary to rerun the equations. In any event, the differences between Durkan's series and the one used here is, with the exception of three observations, quite small.

¹⁹Non-linearities may be introduced into a relationship of this type by technological progress, but it is assumed that its effects are not unduly large.

A credit availability variable should, in theory, be included in our estimation equations. But it is notoriously difficult to find an appropriate index for credit availability—especially in Ireland where many types of grants-in-aid and investment allowances are offered to entrepreneurs setting up new plants or modernizing old ones. A satisfactory credit price series is equally difficult to obtain. Nominal interest rate series are, for example, unsatisfactory. One reason is that, if the expected rate of inflation varies (as it very likely has done over the decade), then a discrepancy arises between nominal and real interest rates. Thus a 5 per cent nominal interest rate combined with an expectation of a zero rate of inflation is the equivalent of a 9 per cent nominal interest rate with a 4 per cent expected rate of inflation. Difficulties also exist in deciding which interest rate (long-run, short-run, etc.) to choose. For these reasons, we have refrained from inserting any credit variable. In the Irish context, this is not unreasonable since credit terms for investment in industry have probably tended to fluctuate much less than credit terms for consumption and non-industrial investment.

No capacity utilization series exists in published Irish statistics and time did not permit the construction of a surrogate.²⁰ We are thus forced to rely on a crude, but not necessarily inadequate, version of the accelerator hypothesis in so far as the activity variables are concerned.

In 1967, Eisner [6] put forward the view that investment reacts to changes in “permanent” output in much the same way as consumption responds to changes in “permanent” income. Current or past values of the explanatory variables then acquire relevance only in so far as they influence entrepreneurs’ expectations about the future. If we define “permanent” output as the weighted sum of past outputs, with weights declining geometrically, then an estimation equation identical in form to a distributed lag equation can be derived. Thus both hypotheses (Eisner’s and the Koyck distributed lag) may be tested simultaneously by a single reduced form equation.

Two kinds of price-effects on capital goods imports could on *a priori* grounds be distinguished: the effect of a change in the price of imported relative to domestically produced capital goods and the effect of a change in the price of capital goods (imported and domestic) relative to wages or other factors of production.

We would expect the responsiveness of import demand to a change in the foreign/domestic price ratio of capital goods to be exceedingly small since the type of capital goods imported is not typically produced in Ireland.

Economic theory distinguishes between investment of a “capital widening” and investment of a “capital-deepening” nature, the former being mainly responsive (via an accelerator-type process) to changes in total output, the latter to changes in relative factor prices. To take account of the latter influence, a variable consisting of the price of imported PCG divided by an index of earnings

²⁰Baker and Durkan of The Economic and Social Research Institute have experimented with a synthetic capacity utilization series. Their results to date suggest that the series is not significant. Elasticities calculated from their equations which include the capacity utilization variable do not differ significantly from ours.

of industrial workers was constructed and included as an explanatory variable. Although this variable is not wholly satisfactory—for example, no allowances are made for improvements in quality, and earnings are not always a faithful guide to changes in labour costs—the choice of data was dictated by availability rather than by what in theory might be desired.

Thus, two price variables were finally decided upon: (a) the ratio of price of imported PCG to industrial earnings (b) the ratio of price of imported PCG to the general wholesale price index. The last variable was designed to capture any price substitution effects between factors other than labour, and capital.

The Equations

As before, the variables are in quarterly terms. New variables are defined as follows:

m^1 = value of producers' capital goods (PCG) imports deflated by the wholesale price index of PCG imports. This series has been constructed from monthly data.

average value £7.47m.

p^1 = wholesale price index of imported PCG divided by the wholesale price index of total home production.

average value = 102.5

g = wholesale price index of imported PCG divided by the index of average earnings of industrial workers

average value = 80.40

The raw data were obtained from successive issues of the *Irish Statistical Bulletin*.

We begin with an equation in which PCG imports are expressed as a function of output and changes in output:

$$(3.1) \quad m^1 = 0.0741q + 0.0749\Delta q + 0.2255m^1_{-1} + 0.8101d_1 \\ \quad \quad (3.95) \quad (1.14) \quad (1.30) \quad (0.74) \\ + 1.1641d_2 - 0.4145d_3 - 4.7471 \\ \quad \quad (1.64) \quad (0.38) \quad (2.93) \\ R^2 = 0.84, \quad DW = 1.97, \quad SE = 1.23$$

This equation is also consistent with the Houthakker-Taylor hypothesis.

Although the fit is reasonably satisfactory, the low significance levels of the coefficients of m^1_{-1} and Δq suggest the need for further experimentation. Multicollinearity to judge from the correlation matrix of the independent variables, cannot be held responsible for the low t-ratios. A more likely explanation is the inadequate specification of the equation. We have already mentioned the possible influences of capacity utilization and credit availability. The lag-structure²¹ postulated by equation (3.1) may also be unsatisfactory. In this regard, it would have been useful to examine alternative lag-patterns. However, such a course was not feasible owing to the limitations of time and the large-scale computations associated with such investigations.

A compromise, therefore, is clearly necessary. It was found that PCG imports can be adequately explained in a statistical sense by the transportable goods industries index alone. In equation (3.2) below, the first-difference variable (Δq) is dropped from (3.1)

$$(3.2) \quad m^1 = 0.0741q + 0.2250m^1_{-1} + 0.7994d_1 + 1.1692d_2 \\
\begin{array}{cccc}
(4.23) & (1.36) & (1.37) & (2.13) \\
- 0.4242d_3 - 4.7474 \\
(0.61) & (2.98) & & \\
R^2 = 0.84, & DW = 1.97, & SE = 1.22.
\end{array}$$

The exclusion of Δq in this equation (and in all other equations, most of which are not reported here) exercises no perceptible impact on the remaining coefficients and statistical properties of the equation. However from a theoretical viewpoint, equation (3.2) suffers from the following drawback: if q remained constant we would *ceteris paribus* expect PCG imports to fall since they comprise elements of net investment and depreciation, the former being dependent on the rate of change of output. Despite this theoretical limitation, the best procedure henceforward appears to be to focus attention on the associative relationship between output and imports, excluding the first-difference of output variable.

Two price variables, g and p^1 , were tested, but neither exercises any noticeable influence on the fit of the equations:

$$(3.3) \quad m^1 = -0.0117p^1 + 0.0736q + 0.2205m^1_{-1} \\
\begin{array}{ccc}
(0.14) & (4.04) & (1.29) \\
+ 0.7935d_1 + 1.1545d_2 - 0.4248d_3 - 3.4273 \\
(1.34) & (2.04) & (0.60) & (0.37) \\
R^2 = 0.84, & DW = 1.96, & SE = 1.23
\end{array}$$

$$(3.4) \quad m^1 = -0.0310g + 0.0605q + 0.2216m^1_{-1} + 0.6848d_1 \\
\begin{array}{ccc}
(0.26) & (1.09) & (1.11) & (0.93) \\
+ 1.2021d_2 - 0.4818d_3 - 0.3206 \\
(2.11) & (0.65) & (0.02) \\
R^2 = 0.84, & DW = 1.98, & SE = 1.23.
\end{array}$$

²¹In terms of the Eisner hypothesis, read "weighting scheme" in place of "lag-structure".

Furthermore, it will be noted that neither price variable emerges with a significant *t*-ratio at the 95 per cent level.

All equations were run in log-linear and linear form. The two sets of estimates yielded much the same results. Equation (3.2) for example emerged as follows in logarithmic form: (for ease of comparison, the estimated standard error of the equation is expressed in natural numbers).

$$(3.5) \log m^1 = 1.3740 \log q + 0.2148 \log m^1_{-1} + 0.1397d_1 \\ (4.27) \quad (1.29) \quad (1.81) \\ + 0.1463d_2 - 0.0413d_3 - 5.2543 \\ (1.99) \quad (0.45) \quad (4.01) \\ R^2 = 0.84, \quad DW = 2.09, \quad SE = 1.03.$$

On statistical grounds, there is not much to choose between the linear and log linear versions, although the latter enjoys a slightly smaller standard error. A feature of both equations is the low significance of the coefficient of the lagged dependant variable. This coefficient is significant only at the 20 per cent level in the linear equation, and rather less significant in the log-linear equation. Hence, the long run elasticity estimates are less reliable than would ideally be desired.

The seasonal "dummy" values associated with all five equations reveal a tendency for imports to rise in the second and fall in the fourth quarter. This result accords with commonsense as spring is clearly a more suitable time for the building and installment of new plant and equipment than winter.

Elasticities

Output elasticities corresponding to equations (3.2) to (3.5) are set out below:

TABLE 3.2: *Output Elasticities for PCG Imports*

<i>Equation Number</i>	<i>"impact"</i>	<i>Long-run</i>
3.2	1.36	1.75
3.3	1.35	1.73
3.4	1.11	1.43
3.5	1.37	1.75

No meaningful elasticity can be derived from equation (3.1) owing to the inclusion of the Δq variable.

Despite the rather different specification of the equations, they yield quite similar elasticity estimates. Taking 1.43 and 1.75 as lower and upper bounds respectively, the elasticities indicate that every 1 per cent increase in GNP tends to be associated with a 2.3 to 2.8 per cent increase in PCG imports.²² In view of the heavy concentration of PCG imports in domestic investment, this high elasticity must primarily be attributed to the fact that investment has grown as a percentage of GNP. According to the *Third Programme* the rise in the investment/GNP ratio may be expected to continue. If this is so, then our results show that a corresponding increase in the PCG imports/GNP ratio may be anticipated.

Taking the 1966 PCG import/GNP ratio and an output elasticity of 3.0, the marginal propensity to import PCG goods emerges as roughly 0.2. As one would expect, the marginal propensity is low since PCG imports comprise such a small proportion of GNP. This does not in any way diminish the importance of output as a determinant of PCG imports. Relative prices fell over the decade by about 10 per cent, but the elasticities associated with them are extremely small (see next paragraph). It is clear, therefore, that the *primum mobile* of PCG import demand has been the growth of output.

Although the coefficients of the price variables possess little statistical significance, the price elasticities derived from the equations may still be of some interest and are recorded below.

TABLE 3.3: *Price Elasticities of Producers' Capital Goods*

<i>Equation Number</i>	<i>"impact"</i>	<i>long-run</i>
(3.3)	-0.16	-0.20
(3.4)	-0.33	-0.42

Taking the long-run elasticities, the results suggest that a 10 per cent rise in the price of all goods relative to PCG imports will cause a 2 per cent increase in imported PCG demand, and a 10 per cent rise in labour earnings will lead to a 4 per cent increase in demand.

3.2 *Materials for Further Production (MFP) Imports*

Materials for further production (MFP) imports constitute roughly sixty per cent of total imports. This percentage share has remained remarkably stable despite the important changes in economic structure and the large increase in total imports that took place during the 1956-66 decade (see Table 3.1). A slight downward trend, however, has appeared since 1960—from 63 per cent

²²Transportable goods industries output has grown on average 1.6 per cent for every 1 per cent growth in GNP. To convert elasticities pertaining to transportable goods into a GNP elasticity, one simply multiplies the former by 1.6.

in 1960 to 59 per cent in 1966—but trade statistics for 1967 and 1968 indicate that this trend has not been sustained.²³ MFP imports more than doubled in current values between 1956 and 1966 and have increased by 70 per cent at constant 1953 prices.²⁴

Materials imports are divided into two groups: materials for use in agriculture and materials for use in “other” activities. The agriculture sector absorbs about 7 per cent of total MFP imports. Firth’s [7] computations show that imports for use in the production of domestic capital goods amount to 12 per cent of total MFP imports for use in non-agricultural activities. Thus we may conclude that the major part (about four-fifths) of MFP imports are absorbed as direct or indirect inputs by the industrial consumer goods and export sectors.

Although MFP imports form the largest element in total imports, domestic MFP production exists on a large scale also. The major proportion of domestic MFP production originates in the agriculture sector—for example, inputs into the meat processing, brewing, fellmongery and tanning industries, etc. Many of these inputs have to compete with comparable products from abroad, although quotas have frequently been employed to limit the effectiveness of foreign competition. MFP goods are also produced by the industrial sector, for instance products of the mining, textile piece-goods, tanning, fellmongery, paper and paper products industries etc. appear in significant amounts as interindustrial flows. These products also compete with foreign products to a certain degree. Quantitative restrictions being much less common on non-agricultural goods, one might expect MFP imports of this type to react to relative prices, i.e. foreign price (including tariffs) relative to domestic price.

MFP imports include an extremely heterogeneous group of goods, some such as crude petroleum, unmanufactured tobacco, cocoa, jute, etc. having no domestic substitutes, others, particularly those at a higher level of fabrication, competing to a greater or less extent with domestically produced manufactures. A crude, but on the whole reliable, indicator of the presence of domestic substitutes is the existence of protective tariffs or quantitative restrictions on imports. On this criterion, most imports included in SITC sections 2, 3 and 4 do not compete with domestic producers, but a significant proportion of imports under the heading of sections 5 and 6, being subject to high tariffs and quotas, may be considered substitutable with domestically produced goods. Thus with the increased predominance of section 5 and 6 imports there are grounds for concluding that the share of MFP imports which compete with domestic sources has tended to increase over time.²⁵ It further emerges that price and output elasticities of demand for MFP imports constitute an average of widely divergent elasticities.

²³MFP percentage share in total imports was 59·8 per cent in 1967 and 60·2 per cent in 1968.

²⁴Owing to the inclusion of customs duties in the price deflator the increase in import volume is slightly overestimated by this constant price series. See below for further discussion of this problem.

²⁵This conclusion is tentative. Considerable specialization occurs within the same commodity groups for example. In the final analysis, the degree to which one commodity is substitutable for another can be discerned only by market behaviour. Furthermore physical similarity is not always the best criterion, since substitutable goods are often physically quite distinct.

The Variables

The choice of a dependent variable caused considerable difficulty owing to the absence of an appropriate price deflator for MFP imports in current values. Imports are valued c.i.f. exclusive of tariffs, but the MFP import price index includes tariffs and therefore, since tariffs varied over the period, the constant price series obtained by dividing value of imports by the price index does not correctly represent changes in volume. To avoid this difficulty, a dependent variable was constructed as follows: MFP imports were divided into three groups (a) basic materials (b) mineral fuels and lubricants and (c) other, and each was deflated by a corresponding unit value index which excludes tariffs. A defect of this procedure is that the unit value index used to deflate (c) includes consumer and capital goods imports and therefore is not really appropriate. As a countercheck, value of imports deflated by the price index including tariffs was also used as a dependent variable.²⁶ The two real import series, as it happens, do not differ greatly. The coefficients were found to be relatively insensitive to the choice of dependent variable.

The activity variable used is the output of transportable goods industries in volume terms. Although a good case could be made for employing an output of manufacturing industry variable instead of total transportable goods, MFP imports are also absorbed by the mining, quarrying and turf industries in the form of fuel requirements, spare parts for machinery, etc. Hence our decision in favour of the transportable goods index.²⁷

Transportable goods output should explain variations in the majority, of MFP import items. On the other hand, this output variable cannot, on *a priori* grounds, be expected to capture movements in (a) MFP imports for use in agriculture (comprising for the most part, animal feeding stuffs and fertilizers) and (b) unmilled cereals imports, which as Baker and Durkan note, depend more on the vagaries of the domestic harvest than on the volume of industrial output.²⁸ These two items typically add up to about 10-15 per cent of total MFP. A quarterly series for agricultural output, had it been available, could have been included in the equations to take account of variations in this portion of MFP imports. But no such series exists. Various possible surrogates, such as quarterly agricultural prices, were considered, but on closer investigation did not appear to have much to commend them. Alternatively, MFP imports of type (a) and (b) might be excluded from total MFP imports and the remainder used as the dependent variable. This is the course chosen by Baker and Durkan. A final expedient consists in assuming that variations in MFP imports follow a more or less random pattern around a trend and thus are taken care of by the

²⁶An effort was then made to neutralise the effects of tariff changes with the aid of a dummy variable but it turned out to be insignificant. This could mean, *inter alia*, that reductions in tariffs were not immediately reflected in lower prices to purchasers.

²⁷A comparison between Baker and Durkan's results, based on manufacturing output, and the results of this study suggest that it makes little substantial difference which output variable is chosen.

²⁸I am grateful to Messrs. Baker and Durkan and Professor R. O'Connor for drawing my attention to the problem raised by imports of this kind.

disturbance term and the output variable combined. This last expedient is the one here adopted. Comparison between our results and Baker and Durkan's reveals approximately the same elasticities with respect to output. Furthermore the Durbin-Watson statistic pertaining to our equations indicates the absence of serial correlation. Both pieces of evidence appear to favour the admissibility of our hypothesis.²⁹

In order to allow for the changing structure of MFP imports over the decade, a time trend was introduced but the results were unacceptable owing to the close correlation between time and the volume of output.

A relative price variable is included among the independent variables, constructed by dividing the MFP imports price index by a price index of home produced materials for use in industry. Unfortunately the two price indices cover a rather different basket of commodities. The home-produced MFP price index includes only those inputs originating in the agricultural sector, thus ignoring prices of intermediate inputs such as textile yarn, leather, etc. produced within the industrial sector. This is a serious defect, but no better alternative exists. One could argue, however, in defence of the index that many Irish intermediate goods industries (e.g. tanning and fellmongery, wood, some textiles) use domestic raw materials and to the extent that the price of their output is influenced by raw materials prices, the defects of the price variable diminish. Data problems of this nature are all too frequently encountered in studies of disaggregated imports.

The question whether or not to include seasonal dummies was also considered. On the one hand since none of the independent variables are seasonally adjusted it might be argued that their seasonal patterns ought to affect and explain the seasonality of imports. On the other hand, by including seasonal "dummies" in the estimating equation, we test the hypothesis that imports are subject to a seasonal pattern of their own, over and above that which can be explained by the quarterly fluctuations of the independent variables.

The Equations

The following notation is employed:

m^2 = value of mineral fuels and lubricants deflated by its import unit value index *plus* value of basic materials deflated by its import unit value index *plus* all other MFP imports deflated by "other items" unit value index.

average value = £36.19m.

²⁹The similarity between Baker and Durkan's elasticities and ours may also be due to a possible orthogonal relationship between quarterly industrial and agricultural output. This would imply that the addition of agricultural output in our equations would create no change in the value of the coefficients, but would simply raise the explanatory power of the equation and possibly reduce the standard error.

p^2 = MFP imports price index divided by home produced materials for use in industry price index.

average value = 114.3.

The data is expressed in quarterly terms and has been obtained from the *Irish Statistical Bulletin* and Leser [10].

Invariably we found that a distributed lag specification fitted the data more satisfactorily than the static form of the equation. Hence equations (3.6) and (3.7) include a lagged dependent term, together with price, output and seasonal "dummies", as an explanatory variable, in linear and log-linear versions respectively:

$$(3.6) \quad m^2 = -0.0291p^2 + 0.1234q + 0.5797m^2_{-1} + 0.0666d_1 \\ \quad \quad \quad (0.20) \quad (2.05) \quad (3.08) \quad (0.03) \\ - 3.6266d_2 - 3.1179d_3 + 3.5078 \\ \quad \quad \quad (2.36) \quad (1.99) \quad (0.22) \\ R^2 = 0.94, \quad DW = 1.98, \quad SE = 2.13.$$

$$(3.7) \quad \log m^2 = -0.1684 \log p^2 + 0.4947 \log q + 0.5680 \log m^2_{-1} \\ \quad \quad \quad (0.32) \quad (2.05) \quad (2.94) \\ + 0.0039d_1 - 0.1008d_2 - 0.0861d_3 - 0.8117 \\ \quad \quad \quad (0.07) \quad (2.11) \quad (1.79) \quad (1.53) \\ R^2 = 0.94. \quad DW = 1.93, \quad SE = 2.00 \text{ (natural numbers)}$$

Although all the coefficients have the "right" sign and plausible order of magnitude, the low t-ratio of price in both equations is a matter of concern. No strong evidence of multicollinearity appears in the correlation matrix to account for this phenomenon. The specification of the equations, however, might be criticised on the ground that there is no commanding *a priori* reason for including seasonals as independent variables. Seasonality in MFP imports could quite reasonably be regarded as being caused by seasonal trends in output and price variables. To test this hypothesis, seasonal "dummies" are excluded in equation (3.8) below:

$$(3.8) \quad m^2 = -0.0302p^2 + 0.1204q + 0.5797m^2_{-1} + 3.2794 \\ \quad \quad \quad (2.58) \quad (2.47) \quad (3.91) \quad (2.09) \\ R^2 = 0.92, \quad DW = 2.03, \quad SE = 2.46.$$

It is clear that the data prove consistent with the last view regarding the redundancy of seasonal terms. The coefficient of determination falls slightly and the standard error rises somewhat. But, against this, the coefficients of price, output and lagged imports all assume significance at the 95 per cent confidence level. It is, furthermore, interesting to note that the absolute value of all coefficients are little affected by the exclusion of seasonal "dummies". This follows as a result of the extremely low correlation between d_1, d_2, d_3 and the other predetermined variables. Estimation of log-linear versions of (3.8) yielded exactly equivalent conclusions and much the same elasticities for price and output.

Turning now to a different model, we note Boventer's [4] division of the effects of output variations on import demand into an "input" effect and an "inventory" effect. According to this theory, a rise in output leads to an increase in the demand for the raw materials embodied in that output (the "input" effect) and also to an increase in raw material inventories (the "inventory" effect). Decisions to add to or subtract from inventories may be expected to play an important role in quarterly MFP imports, although the longer the period covered the less important inventory effects should be relative to input effects. A first-difference-of-output variable is inserted in the equation, the theory being that input demand is a stable function of output whereas inventory demand should be a positive function of the change in output.³⁰ If one further argues that desired stock and flow relationships depend on permanent rather than current output and growth of output, then a lagged value of the dependent variable may be added. (It is clear that the equation then becomes exactly the same as the Houthakker-Taylor equation.) The estimates are as follows:

$$(3.9) \quad m^2 = 0.1241\Delta q + 0.1891q_{-1} + 0.3744m^2_{-1} - 3.0489$$

$$\quad \quad \quad (2.25) \quad \quad (3.13) \quad \quad (2.04) \quad \quad (1.13)$$

$$R^2 = 0.91, \quad DW = 1.80, \quad SE = 2.63.$$

The fit of equation (3.9) is satisfactory and the coefficients of all three predetermined variables are significant at the 95 per cent confidence level. Against this however, the SE compares unfavourably with that of equations (3.6) to (3.8). Following Boventer, lagged rather than current output (q) is used, although owing to the autocorrelation of output over time, we found that this does not alter the value of the output coefficient to any significant degree. The coefficient of Δq is small and positive, as might be expected. This shows that the level of output exerts the predominant influence on MFP imports, but that the rate of change in output adds a further impetus to import demand. A price variable was added to equation (3.9) without success, the coefficient having the "wrong" (i.e. a positive) sign.

³⁰If quarterly data on inventories were available, this could have been added as an independent variable in the MFP imports equation instead of change in output, since our immediate concern is with imports for inventory adjustment not total inventories.

Elasticities

Price and output elasticities corresponding to equations (3.6) to (3.8) are as follows:

TABLE 3.4: *Price and Output Elasticities of MFP Import Demand*

Equation Number	Price		Output	
	"Impact"	long-run	"Impact"	long-run
(3.6)	-0.09	-0.21	0.47	1.12
(3.7)	-0.17	-0.39	0.49	1.13
(3.8)	-0.09	-0.21	0.46	1.09

Long-run output elasticities all exceed unity, ranging from 1.09 to 1.13. Comparable elasticities from Baker and Durkan's study are in the range 1.16 to 1.26.³¹ Thus, a sensible lower bound to the MFP output elasticity would be 1.0, while 1.3 may be used as an upper bound. The corresponding lower and upper bound GNP elasticities are 1.6 and 2.1. Thus every 1 per cent increase in GNP tends to be associated with a 1.6 to 2.1 per cent increase in MFP imports.

The MFP import/GNP ratio has risen as a result of the growth in industry's share in total GNP. It may be observed, however, that despite the much slower growth rate in agriculture, MFP imports for use in the agricultural sector experienced no dramatic fall relative to other MFP imports. Nevertheless, provided the industrial sector continues to grow faster than other non-agricultural sectors, the increase in MFP imports relative to GNP should be maintained in the future.

A more or less proportional relationship between MFP imports and transportable goods is what one would expect. To explain the rise in this ratio, implied by an elasticity greater than unity, poses some difficulties. Perhaps structural changes within industry account for such a tendency. Data relating to this point are difficult to obtain, but such evidence as exists tends to support this explanation. For instance, the MFP imports/value added ratio in grant-aided industries—a relatively fast growing section of Irish industry—appears (at 64 per cent) to exceed the corresponding ratio for industrial production as a whole.³² One could also argue along behaviouristic lines that, as total output increases, manufacturers search for increasingly specialised types of material inputs which can be obtained at lowest cost from abroad. Regardless of the

³¹Since manufacturing output grows marginally faster than transportable goods output, a slight upward adjustment of these figures would be required to make them wholly comparable with our elasticities.

³²*Survey of Grant-aided Industries* [12, p. 49]. Value added expressed as a percentage of total MFP imports for industrial production equalled 66 per cent in 1965. Since not all MFP imports for non-agricultural uses are absorbed by industry, we can safely say that the true MFP import/value added ratio must be less than this.

plausibility or otherwise of these rationalisations, it is clear that the grounds on which we base our assumptions of a continuing rise in the MFP import/transportable goods output ratio are less firm than would ideally be desired.

MFP imports appear to be relatively insensitive to price changes—the long run price elasticity lies in the range -0.22 to -0.40 . This price elasticity estimate may be compared with the results of other studies. Reimer [11] finds a price elasticity of -0.15 for US imports of raw materials. This is, as the author admits, surprisingly low. The Brookings Quarterly model [5] produces an “impact” price elasticity for US imports of unfinished goods of -0.32 and a long-run elasticity of -0.68 . The unweighted average of Ball and Marwah’s [3] estimated US import demand elasticities for crude materials, semi-manufactures and crude foodstuffs is -0.66 . In the light of these estimates, an elasticity for Irish MFP imports of -0.2 to -0.4 is quite reasonable—one would certainly expect it to be lower than comparable US elasticities, since the range of domestically produced substitutes relative to imports is much larger in the US than in Ireland.

3.3 *Imports of Consumption Goods Ready for Use (CG)*

We come now to the final set of disaggregated equations—those concerned with imports of consumption goods ready for use (CG imports). Two characteristics of CG imports are of special interest. First, a substantial proportion of CG imports consist of what are popularly considered “luxury” goods. Hence special import taxes tend to be placed on these imports in times of balance of payment crises, the government’s action being defended on the grounds that CG imports are dispensable commodities, in no way essential to short-run economic growth. A second characteristic is the stimulus CG imports have given to policies of import substitution, since these imports are often easier to replace by domestic production than intermediate or capital goods imports. For these reasons, therefore, one would expect long- and short-run changes in commercial policy to have a much greater impact on CG imports than on other types of import.

CG imports account for one-fifth of total imports. This percentage share has not varied over the decade, despite significant oscillations in the level of protection. Between 1956 and 1960, CG imports grew by only ten per cent in value terms, as against an increase of eighty per cent in the succeeding five years, 1961-1966. In volume terms, the corresponding figures are eight and fifty per cent respectively. This rapid growth in imports since 1960 can in a large part be attributed to the rise in disposable income and personal expenditure during the sixties.

An important feature of CG import demand is its tendency in recent years to grow faster than total personal expenditure. Thus, the shares of CG imports in personal expenditure has risen from 9.7 per cent in 1956 to 11.4 per cent in 1966.

Two reasons for this increased share could be proposed. First, many imported consumer goods have expenditure elasticities greater than unity and hence a rise in their share of personal expenditure may be expected provided that output growth is not heavily skewed towards import substitution. Secondly, the relative cheapening of CG imports has encouraged expenditure on these goods.

The Variables

An appropriate dependent variable would be value of CG imports divided by a corresponding import unit value deflator. No such deflator was available, however, so a certain degree of improvisation was required. The food, drink and tobacco component of CG imports has been deflated by a food, drink and tobacco import unit value index. To this has been added the value of other CG imports deflated by the "other goods" import unit value index and the resulting series constitutes our dependent variable. This constructed series is not without its defects,³³ a fact which ought to be borne in mind when evaluating the econometric results later on.

Disposable income (whose derivation in quarterly terms has already been described in the course of our discussion of aggregate import equations) is here employed again as activity variable. A time trend was also included in a number of equations, but with predictably destabilising consequences (owing to multicollinearity) for the sign and significance of other coefficients in the equation.

The relative price variable was constructed as a ratio of price of CG imports (including customs duties and special import levies) to the price of home-produced consumer goods. A number of awkward problems arise in attempting to interpret the price coefficient and to derive a price elasticity on the basis of this coefficient.

First we note that changes in our price variable may occur for any of three reasons (i) a change in tariffs (ii) the imposition or revocation of special import levies (iii) a change in foreign c.i.f. relative to domestic price. From a purely behavioural point of view, there is no reason to believe that importers will react in an identical manner to each type of price change. Divergences between "tariff" and price elasticities are frequently referred to in the literature. A potential source of difficulty arises therefore in so far as movements in *one* price variable fail to distinguish between the different types of price change and the peculiar reaction of import demand to each. Attempts were made to circumvent this problem by including dummy variables to take account of tariffs and special import levies. These dummies were not significant.

Another potential problem is the influence of non-price factors such as import quotas. Quotas were applied to a limited range of CG imports (e.g. to footwear and certain textile articles) during the decade. Again, we attempted to make allowances for them by the use of dummy variables, but these variables

³³The food, drink and tobacco unit value index includes prices of live animals and other goods which do not belong to the CG group. Similarly, the "other goods" unit value index also contains a miscellany of commodities not belonging to the CG group.

were not significant—a fact which suggests that distortions arising on this score have less practical importance than was feared.

The equations were run with and without seasonals. On *a priori* grounds a strong argument could be made in favour of their inclusion since seasonal swings of consumer demand cannot be expected to relate closely to those of industrial output (on whose seasonal pattern our synthetic disposable income series is based). As we shall see, the addition of seasonals does indeed significantly improve the fit of the equation.

The price and availability of consumer credit would have been worth including as an independent variable, had such a series been readily available. Baker and Durkan in their study use bills, loans and advances as a surrogate, but with limited success. As the writers note, it is far from being an ideal surrogate. We are, therefore, obliged to leave credit factors out of account in our equations, trusting that the major portion of variations in CG imports will be explained by income, price and seasonal “dummies”.

The Equations

The following notation is used:

m^3 = value of food, drink and tobacco imports deflated by food, drink and tobacco import unit value index *plus* value of other CG imports deflated by “other goods” import unit value index.

average value = £12.23m.

p^3 = wholesale price index (including customs duties) of CG imports³⁴ divided by wholesale price index of home produced consumption goods. Both indexes base 1953 = 100.

average value = 101.6.

A large number of equations were estimated, three of which are presented below. Linear and log-linear versions were tried with rather similar results, although the linear versions in this instance proved slightly superior on statistical grounds. As usual the t-ratios are placed in parentheses beneath the coefficient to which they refer.

$$(3.10) \quad m^3 = -0.2410p^3 + 0.0521y - 10.1216$$

$$\begin{array}{ccc} (0.50) & (7.78) & (1.33) \\ R^2 = 0.82, & DW = 1.90, & SE = 1.27. \end{array}$$

$$(3.11) \quad m^3 = -0.1424p^3 + 0.0224y + 0.5774m^3_{-1} + 2.6473d_4 - 4.6232$$

$$\begin{array}{ccccc} (0.39) & (2.16) & (3.37) & (4.92) & (0.73) \\ R^2 = 0.90, & DW = 2.43, & SE = 0.94. & & \end{array}$$

³⁴This index also includes special import levies.

$$\begin{aligned}
 (3.12) \quad m^3 = & -0.500p^3 + 0.0273y + 0.4814m^3_{-1} - 1.9256d_1 \\
 & \quad (0.18) \quad (3.13) \quad (3.31) \quad (3.50) \\
 & - 1.8565d_2 - 3.5074d_3 - 4.2989 \\
 & \quad (4.44) \quad (7.88) \quad (0.57) \\
 R^2 = & 0.95, \quad DW = 2.22, \quad SE = 0.72.
 \end{aligned}$$

Equation (3.10) tests the "static" hypothesis that imports are a function of current income and price. The fit is not satisfactory. The addition in equation (3.11) of a lagged dependent variable (m^3_{-1}) and a fourth-quarter dummy (d_4) to take account of the surge in spending around Christmas contributed significantly to the explanatory power of the equation and also reduced the standard error from 1.27 to 0.94. In equation (3.12), allowance is made for seasonal variations in all four quarters. The resulting fit is superior to that of the first two equations, with three significant seasonal "dummies", highly significant coefficients of y and m_{-1} and a markedly lower SE. Unfortunately, the price coefficient displays disappointing evidence of instability in all three equations.

The low t -ratio of the price coefficient is surprising since reasonably close substitutes exist for many CG imports. The correlation matrix offers no compelling evidence of multicollinearity. Perhaps the problems associated with the use of one price variable and the difficulty of constructing a correct dependent variable series may be responsible for the low significance. Our experience is not, it may be added, without precedent. Taking the period 1948-61, Rhomberg and Boissoneault [8] in the Brookings study are unable to derive significant price coefficients for US imports of finished goods. However, despite the large standard errors of our price coefficients, it is not unreasonable to expect that the "true" elasticity lies somewhere within the range of our upper and lower bounds. The use of a range of values rather than one particular estimate serves the purpose of underlining the degree of uncertainty attaching to each individual estimate.

Elasticities

Price and income elasticities pertaining to each equation are recorded below:

TABLE 3.4: Price and Income Elasticities of Demand for CG Imports

Equation Number	Price Elasticity		Income Elasticity	
	"Impact"	Long-run	"Impact"	Long-run
(3.10)		-1.99		2.03
(3.11)	-1.18	-2.79	0.87	2.06
(3.12)	-0.41	-0.80	1.06	2.04

Three price elasticity estimates - 0.80, -1.99 and -2.79 are obtained. Leser [10] reports a price elasticity of -1.59 for food drink and tobacco imports and, in

this case, the price coefficient is significant at the 95 per cent level. In the light of this evidence, a price elasticity for all CG goods of -0.80 would appear to be rather low. On the other hand, an upper bound of -2.79 may be unduly high. In the circumstances, however, it seems best to consider a rather wide range of possible values. Hence we take -1.50 as the lower bound and -3.00 as the upper bound of CG price elasticities.

The coefficient of disposable income emerges as significant at the 95 per cent level in all equations. Income elasticities tend to be high, all lying within the range 2.00 to 2.10 , which implies a marginal propensity to import CG goods of roughly 0.2 in 1966. The hypothesis advanced at the beginning of this section, that growth of domestic supply has not obscured the influence of high expenditure elasticities, is thus confirmed.

It is a remarkable fact that, even with 1955 as a base year (i.e. before the heavy imposition of tariffs in 1956), prices of domestically produced CG have risen faster than the prices (including tariffs) of corresponding imported goods. Over the decade under review, foreign prices fell relatively by roughly 8 per cent. Given our price elasticities, this implies a rise in CG imports of 12.24 per cent. Although the influence of disposable income has of course, been predominant, price effects for this type of import have played a significant independent role. It further emerges that relative prices are a more important factor for CG imports than for MFP or PCG imports. Thus with the continuance of economic growth and past relative price trends, the share of CG imports in GNP (or disposable income) will likely maintain its present upward course.

4. CONCLUSION

Two issues are examined in this concluding section: (1) the rise in the import/GNP ratio, and (2) the implications for aggregate imports and for the composition of imports of the growth rates set by Ireland's *Third Programme of Economic and Social Development* [13]. Discussion of this last point necessarily involves an assessment of the usefulness of the combined disaggregate equations as compared with the aggregate equation. We end with a brief discussion of the methodology employed in this study.

4.1 *Imports and Gross National Product*

In a previous section, the rapid rise in the import/GNP ratio in real terms was adverted to. We are now in a position to analyse the forces underlying the rise in this ratio.

First, output/income elasticities significantly greater than unity are observed for each of the three import categories examined.

PCG imports displayed the highest degree of sensitivity to GNP with an

elasticity of between 2.3 and 2.8 (see Table 4.1) The major influence explaining this high elasticity has been the rapid increase, both absolutely and relative to GNP, of total investment. Three factors in turn may be cited as accounting for the upsurge in investment: (1) the growth of GNP, (2) the increased rate of growth of GNP (on which the demand for *net* investment ultimately depends and (3) a possible rise in the incremental capital-output ratio.³⁵

In the case of MFP imports, with an output elasticity in the range 1.6 to 2.1, quite distinct influences were at work. Most MFP imports being absorbed by industry, the primary cause of the high output elasticity is the disproportionately high growth rate of industry relative to other sectors of the economy. Thus, even supposing a demand elasticity of unity with respect to *industrial* output, the increased share of industry in GNP would itself imply an increase in the MFP import/GNP ratio. The fact that the industrial output elasticity may actually exceed unity (the range is 1.0 to 1.3, as Table 4.1 shows) suggests the presence of other positive influences on MFP import demand. What exactly these positive influences are is a matter of surmise. There is some evidence to suggest that the structure of industry has changed over the decade, in such a way as to increase the share of those enterprises with a high MFP import/value added ratio. Alternatively with the modernisation of Irish industry and the movement towards freer trade, increased intraindustry specialisation is to be expected. In other words MFP industries, in anticipation of freer trade, may "rationalise" production in such a way as to reduce the number and variety of products they manufacture. By concentrating on a few "lines" of a particular product, economics of scale are obtained and the industry's competitiveness

TABLE 4.1: *Price and Income/Output Demand Elasticities for Irish Imports*

Type of Import	Price		Output/Income†	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Producers' Capital Goods ready for use	-0.20	-0.42	GNP 2.30 (1.43)*	2.80 (1.75)*
Materials for Further Production	-0.22	-0.40	GNP 1.60 (1.00)*	2.10 (1.30)*
Consumption Goods ready for use	-1.50	-3.00	Disposable Income	2.00 2.10
Aggregate Imports	-0.92	-1.53	Disposable Income, GNP	1.87 2.15

†Total output (GNP) and disposable income elasticities are directly comparable since the two series remain in virtually fixed proportions (see text).

*Asterisk denotes elasticities with respect to output of transportable goods industries.

³⁵Evidence on this last factor is limited. But it appears that many of Ireland's fastest growing industries have an above average capital-output ratio. See *Survey of Grant Aided Industries* [12, p. 25].

strengthened. This type of policy inevitably implies a larger volume of imports (and very likely exports too).

Finally, income elasticities between 2.0 and 2.1 are found for CG imports. Intraindustry specialisation of the type referred to above may be partly responsible. But a more important factor explaining the high income elasticity is that most CG imports fall into the luxury class and have expenditure elasticities well in excess of unity. This holds even for imports of food, drink and tobacco, (normally considered a rather "inferior" class of commodities), because the individual items imported under this heading have high expenditure elasticities. A notable example is imports of fruit, processed and unprocessed, with an expenditure elasticity of 2.0.

Income/output elasticities greater than unity combined with a rapid growth of total output during the decade have therefore been the most important factors underlying the rise in the import/GNP ratio in real terms. The price factor has also been at work. It emerged that the fall in the aggregate import/general domestic wholesale price ratio reflects similar trends in the foreign relative to domestic price of each type of import. We found, however, that the price responsiveness of PCG and MFP imports is extremely low relative to CG imports. This is not surprising in view of the greater range of domestic substitutes from imported CG goods. The price sensitivity of CG goods led to an increase in CG import volume of somewhere between 12 and 25 per cent over the decade.

Turning now to imports/GNP in current values, this ratio was observed to increase less rapidly than the corresponding ratio with imports and GNP measured in constant prices. The phenomenon may be explained by considering the progress of foreign and domestic prices over the decade. The two price series rose, but foreign prices lagged behind domestic prices. Given an aggregate price elasticity greater than unity, the relative rise of domestic price alone (i.e. abstracting from income changes) would tend to increase the import/GNP ratio in current terms. Once the effects of income are introduced, however, the value of the extra imports induced by the growth of GNP is diminished relative to the value of the increase in GNP to the extent that import prices rise less than domestic prices. The fact that the import/GNP ratio has increased in current values indicates that the increase in import volume has been more than sufficient to compensate for the slower rise in import relative to domestic prices.

4.2 Aggregate and Disaggregate Elasticities

A major aim of this study has been the derivation of price elasticities for Irish import demand. Upper and lower bounds of these elasticities are given in Table 4.1. Producers' capital goods (PCG) and materials for further production (MFP) imports appear to be insensitive to price changes, owing to the absence of domestically produced goods comparable to those imported. The composition

of MFP imports, however, has altered substantially during the decade towards commodities of a more substitutable nature and hence we may tentatively expect the price elasticity of these imports to increase in the future. Consumer goods imports display much greater sensitivity to changes in price—the estimated elasticity lies between -1.50 and -3.00 —but it is regrettable that these estimates are from the statistical point of view the least reliable of all. Nevertheless, studies of the import elasticities of other countries (as well as Leser's study of Irish imports) point to rather high consumer goods price elasticities relative to the semi-manufactured goods and raw materials included in the MFP category.

By weighting each disaggregate elasticity by its share in total imports, we derive what Ball and Marwah [3] call a *composite* price elasticity of -0.54 as lower bound and -0.96 as upper bound. In view of the well-known downward aggregation bias, one might have expected this composite elasticity to exceed the directly estimated aggregate price elasticity. Such is not the case in this study; Table 4.1 shows the aggregate price elasticity to lie within the range -0.92 to -1.53 . Thus in the event of an overall decline in (relative) import prices of 10 per cent, the aggregate equation predicts a rise of 10 to 15 per cent in import volume as against the combined disaggregate equations' prediction of a rise of only five to ten per cent. A definitive resolution of these conflicting results is not, unfortunately, possible. However, in view of the high significance levels of the aggregate equations' price variable, the evidence weighs more heavily in favour of the aggregate elasticity estimate than the composite elasticity. This suggests that our lower bound price elasticity estimates for MFP and PCG imports are almost certainly too low whereas our upper bound estimates are considerably closer to the "correct" values.

Turning now to output/income elasticities, we have already noted that these are well in excess of unity for all components of imports as well as for aggregate imports. To convert transportable goods output elasticities into disposable income or GNP elasticities, a number of assumptions have been made:

- (i) that an increase in GNP of 4 per cent is associated with 6.5 per cent increase in industrial output (this assumption is borrowed directly from Ireland's *Third Programme of Economic and Social Development*).
- (ii) that, following the experience over the years 1960-66, each percentage increase in GNP is associated with approximately the same percentage increase in disposable income.

From these two assumptions, it follows that a 1 per cent rise in disposable income is accompanied by a 1.6 per cent increase in industrial output: thus each transportable goods output elasticity must be multiplied by a conversion factor of 1.6 to yield disposable income or GNP elasticities.³⁶

³⁶Since transportable goods output grows marginally faster than industrial output, a slight under-estimation of the GNP elasticity results. The bias is sufficiently small to justify ignoring it here.

Again a discrepancy arises between the composite income elasticity of 1.83 and 2.23 (lower and upper bounds respectively) and the aggregate elasticity of 1.87 and 2.15. In this case, however, the divergence is less pronounced and our confidence in our elasticity estimates correspondingly strengthened.

The distinction between the aggregate and combined disaggregate elasticities may be thrown into sharper focus by comparing the projected imports derived from these elasticities on the basis of certain assumptions about price changes and economic growth. The technique adopted is to use *Third Programme* assumptions about GNP and industrial growth rates. Certain plausible, although not carefully substantiated assumptions about price changes due to tariff reductions are then added. Finally, we assume, following the *Third Programme*, that all other prices remain constant. Import projections on the basis of disaggregate elasticities can then be compared with aggregate elasticity projections. Furthermore, both projections permit comparison with those of the *Third Programme*. For ease of calculation, a ten year projection period is chosen with 1966 imports taken as base year data. Clearly, the qualitative results of our comparisons are in no way affected by the choice of time-period.

We start with the assumption of a 4 per cent GNP growth rate and a 6.5 per cent growth rate for industrial output. This implies a total increase in GNP and disposable income³⁷ of 50 per cent over ten years and an increase of 81.3 per cent in industrial production.

Given that the Irish tariff *vis-a-vis* the UK will be eliminated steadily over the next few years, we may assume the following import (relative) price decreases: consumption goods 40 per cent, materials for further production 15 per cent, producers capital goods 5 per cent. The casual nature of these price assumptions must be stressed once again. As we shall see, none of the conclusions of the next few paragraphs depend crucially on these assumptions. The derivations of accurate projections of the consequences for import prices of the Anglo-Irish Free Trade Area Agreement is a separate issue in itself and requires detailed study.³⁸ However, it may be asserted that the assumptions here made are not by any means unreasonable, although doubtless tending to exaggerate rather than underestimate the true extent of the fall in price.³⁹

With these price and income/output assumptions, we are able to project imports over a ten-year period, distinguishing between import increases due to price effects and those due to income effects. The results are tabulated in Tables 4.2 and 4.3.

³⁷In fact the disposable income increase would be less than this, perhaps 48 per cent rather than 50 per cent, owing to the increased share of government taxes in GNP.

³⁸Considerable progress along these lines has already been made in connection with the author's investigation of the consequences of trade liberalization for the Irish economy.

³⁹First because tariff reductions apply only to Anglo-Irish trade and second because tariffs may not, for a number of reasons, be fully passed on to consumers of the protected commodity. Against this, the tendency observed over the last fifteen years for domestic prices to rise faster than import prices has not been taken into account. It is difficult to say whether or not it will be maintained in the future. Hence we follow the *Third Programme* in ignoring it.

TABLE 4.2: *Import Projections over ten years on the Basis of Aggregate and Disaggregate Elasticities (base year 1966)*

	Lower Bound Elasticities		Upper Bound Elasticities	
	Percentage Increase	Absolute Increase (£m.)	Percentage Increase	Absolute Increase (£m.)
<i>Disaggregate Projections</i>				
1. Producers' Capital Goods				
Increase due to price	1	0.6	2	1.2
Increase due to output	115	66.6	140	81.0
2. Materials for Further Production				
Increase due to price	3	7.2	5	11.0
Increase due to output	80	175.3	105	230.0
3. Consumption Goods ready for use				
Increase due to price	60	50.5	120	101.0
Increase due to income	100	84.2	105	88.4
4. Total Disaggregate		384.4		512.6
Total increase due to price		58.3		113.2
Total increase due to output/income		326.1		399.4
<i>Aggregate Projections</i>		390.1		491.1
Aggregate increase due to price*	18	65.0	29	104.7
Aggregate increase due to output/income	90	325.1	107	386.4

*NOTE: The average price change is defined as a weighted average of the price change of each import component, the weights being proportional to that component's share in total imports in 1966.

TABLE 4.3: *Actual and Projected Distribution of Imports according to Main Uses*

Description	Absolute (£m.)			Percentage Distribution		
	1966	End-period		1966	End-period	
		lower est.	upper est.		lower est.	upper est.
1. Producers' Capital Goods	57.9	125.1	140.1	16.0	16.8	16.0
2. Materials for Further Production	219.1	401.6	463.5	60.7	53.9	52.7
3. Consumption Goods ready for use	84.2	218.9	273.6	23.3	29.3	31.3
TOTAL	361.2	745.6	880.6	100.0	100.0	100.0

Upper and lower bound estimates of the rise in each import component are provided in Table 4.2. Comparing combined disaggregate with aggregate projections, we find almost identical lower bound estimates of total imports (£390.1m increase for aggregate as against £384.4m for combined disaggregate),

but slightly different upper bound estimates (491.1m as against £512.6m respectively).⁴⁰ An interesting feature of Table 4.2 is the close correspondence between the projected price effects of the aggregate and combined disaggregate equations. Furthermore, it will be noted that the influence of price on imports tends to be overshadowed by much larger increases in imports accounted for by output/income. Table 4.3 provides a summary of the projections for each import component. The results show that, if our underlying assumptions about income/output and price changes were correct, then the composition of imports could be expected to change quite markedly towards consumer and producers' capital goods at the expense of materials for further production. If the *Third Programme's* annual projected growth rates are converted into a total growth figure for ten years we may compare our projected imports with those of the

TABLE 4.4
Comparison of Disaggregate Import Estimates with Comparable Third Programme Estimates

	Total Percentage Growth over ten years (base 1966)		
	Combined Lower Bound	Disaggregate Upper Bound	Third Programme
1. Producers' Capital Goods	123	148	95 (6.8 per cent per annum)
2. Material for Further Production	84	111	97 (7.0 per cent per annum)
3. Consumption Goods ready for use	167	225	240 (13.0 per cent per annum)

Programme (see Table 4.4). It will be observed that our estimates suggest a substantially lower rate of growth of consumer goods imports, a higher growth rate of producers' capital goods imports and much the same expansion of MFP imports. The 13 per cent growth rate for CG imports projected by the *Third Programme* must certainly be called into question.

The disaggregate projections, therefore, suggest a rise in imports (at constant prices) from £361m. in 1966 to between £746m. and £881m. in 1976. An important implication of this import projection is that the import/GNP ratio in real terms will increase from its 1966 level of 38 per cent to between 48 and 56 per cent by 1976.

Three conclusions follow from the preceding paragraphs. First, the disparate estimates offered by the combined disaggregate and the aggregate equations arise because of differences in projected import increases arising from growth in GNP. In view of the significance of each income/output coefficient at the disaggregate level and the familiar limitations of aggregation, more confidence

⁴⁰The range of projected imports values is deliberately made rather wide, since our major concern is with the order of magnitude of the expected change in imports. Our best estimate of the increase in imports in constant prices would be the arithmetic average of the lower and upper bounds, i.e. about £450 m. To derive imports in current values, a separate set of assumptions about absolute changes in the absolute price of imports would be necessary. Such an exercise need not be undertaken here.

may be placed on the disaggregate than on the aggregate estimates. Secondly, the price effects correspond closely irrespective of which method of computation is chosen. The total price effect, in any event, amounts to only a small fraction (one-sixth) of the output/income effect. Hence, even with a large margin of error attached to our price assumptions, the results would not thereby be materially altered. Thirdly, our estimates permit an evaluation of the growth rates for each import category projected by the *Third Programme*. It is suggested that CG imports tend to be overestimated with a corresponding underestimation of PCG imports. The relevance of this to balance of payments policy requires no emphasis here.

Methodology

Throughout this paper, import demand functions are estimated by means of least squares regression. Other, "indirect" methods of obtaining elasticities are available, but they are used only in the absence of direct elasticity estimates and consequently require no analysis here.

Attention may be drawn to three problems commonly encountered in direct import demand estimation: (a) the inadequacy of data, (b) problems of estimation, (c) specification problems. We shall discuss them *seriatim*.

- (a) Quarterly models of import demand have the advantage of being less prone to multicollinearity than their counterparts based on annual data, but in practice they are often impossible to estimate owing to the absence of quarterly series for key independent variables. Many countries, for instance, lack quarterly GNP series. Equally inconvenient is the absence of reliable data on capacity utilization and inventories. These problems may be surmounted of course. In this study, for example, we show how a synthetic quarterly disposable income series may be constructed from annual data. Considerable progress has also been made in recent years devising models of import demand which include inventories in the structural equations but whose reduced form excludes this "unobservable" variable. Despite their ingenuity, however, these models are still rather unsatisfactory improvisations. Although Irish economists are by international standards, extremely well served by our statisticians, we venture to hope that in time an effort will be made to provide quarterly GNP, investment and inventory series for Ireland, the three series whose absence has been most keenly felt in the present study.
- (b) Problems of estimation continue to be debated, but the precise nature of the two major difficulties in this area—the simultaneous equation bias and the aggregation bias—are now more clearly understood than previously. The former bias has been associated historically with the price coefficient in an import demand equation. However, in the case of a

small country, the coefficient of income rather than price is liable to this type of bias. It is generally agreed that the distortions created by the simultaneous equation problem for a small country may effectively be minimized by choosing a quarterly rather than an annual model. Another source of bias is that created by aggregation. Disaggregation, in so far as it eliminates the aggregation bias, is desirable, but problems (and new biases) are created if cross elasticities of demand between the disaggregated components are high. It may be noted that the three disaggregated groups chosen in this study—consumer, intermediate and capital goods imports—are characterized by low cross elasticities of demand and consequently are not liable to criticism on this score.

- (c) There are many ways in which an import demand equation may be specified. Research in recent years has concentrated on models whose structural equations take expectations, level of stock, etc. into account, but yet whose reduced form is amenable to estimation by least squares with the aid of a comparatively small number of independent variables, for which data is readily accessible. Reduced form equations of two such models, the Houthakker-Taylor [9] and Turnovsky [14] were tried on Irish data. The results, however, were rather disappointing and hence are not reported here.

Remarkable progress has been made in the last two decades on the specification of lag structures. Distributed lag models, now a commonplace in econometric work, are used extensively in the present study. We have confined ourselves to using the simpler (Koyck) lag structure. The major disadvantage of this model is that the same exponentially declining reaction pattern is imposed on all the independent variables. Alternative lag structures (such as the Almon or inverted V) could be assumed, but none that at once so efficiently minimize the multicollinearity problem and at the same time are easy to compute. A detailed and comprehensive discussion of these and related issues cannot, however, be undertaken here.

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