

An Econometric Method For Forecasting the Demand for Food in Ireland in 1970

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Tá áthas orm páipéar a léigheamh ar mo chuid staidéar ar thalamhuíocht na hÉireann ós comhair Cumainn Staidrimh na hÉireann, agus ba mhaith lion nóta pearsanta a thabhairt ar dtúis. Mí Deire Fómhair, 1960, bronnadh orm scoláireacht ón Irish Dunlop Company, a lean ar feadh trí bhliain, agus ba é toradh na h-oibre go léir ná tráchtas darb' ainm dó "The Potential demand for Irish Agricultural Products in the next Ten Years", a thugas le scrúdú don Ollscoil Náisiúnta na hÉireann, Mí na Nollag, 1964. Insan bpáipéar seo leanas, déanfaidh mé iarracht ar na torthaí a thabhairt, maraon leis an módh oibre a thóg mé chun iad a fháil.

Ba mhaith liom a rá chomh fíor-bhuíoch is atá mé don Ollamh Seán Busteed, nach maireann, i gColáiste Ollscoile Chorcaí, a bhí mar Stiúrtóir ginearálta agam an fhaid is a bhí an tráchtas ar siúl, beannacht Dé lena anam uasal; don Dochtúir R. C. Geary, stiúrtóir na hInstitiúide Eacnamuíochotha i mBaile Átha Cliath; don Uasal G. T. Jones san Institiúid Eacnamuíochotha na Talamhuíochotha in Oxford; don Dochtúir R. O'Connor sa Phríomh-Oifig Staidrimh i mBaile Átha Cliath, don Uasal Seigeia Guidici in Oxford, agus don Uasal Dermot Harrington, den Roinn Staidrimh, An Foras Talúntais. Bhí an-chuid daoine eile a chabhruigh go mór liom le linn na h-oibre, nach bhfuil am agam chun iad a lú anois. Tá mé bhuíoch do Áine Ní Mhaidín, agus Céline Breathnach a dhein an clóscríbhinn don bpáipéar seo.

CÚNTAS GAIRID

Má's rud é go mbeidh an tír seo ag dul isteach sa Chomhargadh, tá sé soiléir gur mór an tioncur a bhéas ar ár dtalamhuíocht, agus mar sin deanaim iarracht sa pháipéar seo leanas ar thuairim a thabhairt i bhfigiúirí, ar an praghasanna a bhéas ann san limistéar sa bhliain 1970. Má éiríonn lena bhfuil beartaithe ag an Rialtas de réir an Dara Chláir Eacnamaíochta, agus ar an mbun go leanfaidh an laghdú daonra ar aghaidh, gheibhim cothrom an éilimh bia sa tír féin.

Dheineas staidéar ar an Household Budget Inquiry, 1951-52, agus Staidrimh an Mhargaidh tar éis an Dara Chogaidh Domhanda, chun a fháil amach cé'n tioncur a bhí ag ioncaim, daonra agus praghas ar éileamh (Caibidil a Trí). Ansin bhaineas úsáid as laisteacheas an éilimh maraon le hipitéis áirithe i dtaobh ioncaim agus daonra chun réamháisnéis do dhéanamh ar méid an éilimh sa bhaile (Caibidil a Ceathair).

Mar deireadh na h-oibre chuireas mo chuid torthaí i gcomparáid leis an staidéar a bhí déanta ag an Food and Agriculture Organisation sa Róimh, agus leis na breithe atá leagtha amach ag an Dara Clár Eacnamaíochta

anseo (Caibidil a Cúig). Siad na táirgí áta luaite agam ná: Mairteoil, Caoireoil, Muiceoil, Bainne, Uibheacha, Im, Arán, Plúr, Prátaí agus Biatas Siúicre.

SECTION I—INTRODUCTION

In the present decade, there are two major factors that can be expected to affect the demand for food in Ireland; the first is the country's becoming part of the European Economic Community, the second is the attainment of the target rate of economic growth aimed at in the official Second Programme for Economic Expansion. When the first of these events comes to pass, Irish consumers will be confronted by a completely new series of retail prices for food, and how they are likely to respond to these prices is the main question that the present paper attempts to answer. In addition, the demand for food on the home market can be expected to depend on the future level of (a) income, (b) population, and the combined effects of these variables on demand is the second question dealt with in the paper.

In a recent article, Mr. Vandome of Oxford points out that all econometric forecasting proceeds on the basic assumption that knowledge of the past and present is relevant to forecasting the future, and that the problem then is to make the most efficient use of the information available.¹ In general, it is wiser to use structural characteristics rather than simple trends and other derived and possibly spurious relationships.

In the present forecast, the basic variables are divided into two classes: (a) the independent variables like income, population and price which are caused by factors outside our model; and (b) dependent variables like quantity which are caused by factors within the model. The latter variables are then explained in terms of the former, by a series of equations. These equations are the structural characteristics mentioned in the last paragraph above. Next, we assume certain values for the independent variables (a) for the projected year, and from the equations already obtained, predict the values of the dependent variables (b). Since the prices will be determined by conditions within the E.E.C. as a whole, there is no possibility of consumption influencing price, that is, latter will always be an exogenous variable. In the study of demand, the Report on the Household Budget Inquiry 1951-52, together with the time series for quantity consumed given in the Irish Statistical Survey, while retail prices for food were relied upon to produce the results of Section III. Other main sources were the reports on the 1951 and 1961 Censuses of Population.

Unlike recent forecasts made by various authorities like the Food and Agricultural Organisation for European Countries,² and the Agricultural Economics Research Institute, Oxford, for the United Kingdom, I have not assumed that prices will remain constant in the future. Since the

¹ P. Vandome, "Econometric Forecasting for the United Kingdom"; Bulletin of the Oxford University Institute of Statistics, Vol. 25, No. 4 (November, 1963).

² F.A.O. Projections for 1970 (Commodity Review, 1962 Supplement).

entry of this country to the European Economic Community is so important for the future of Irish agriculture, and therefore the new series of prices confronting the home consumer, it seems more realistic to calculate the level of home demand given these new prices.

The base-period for the forecast has been taken as 1961. This may be compared with the forecasts by other authorities as follows:

Source	Country	Base-period		Period of forecast	
		Years	Length	Year	Span
A.E.R.I.	U.K.	1955-59	5	1965:1975	8:18
E.E.C.	E.E.C.	1954-58*	5	1965	9
		1955-57†	3		
F.A.O.	Europe	1957-59	3	1970	12
Programme	Ireland	1960	1	1970	10
Mine	Ireland	1961	1	1970	9

* For supply.

† For consumption.

One basic assumption has been that of constant elasticity throughout the period.

No allowance is made in the present forecast for any alteration in quality, since the dependent variable chosen throughout has been quantity, rather than expenditure.

Given the environment will remain the same in the future as in the past, the forecasts predict the levels of demand in 1970 based on a study of responses in the past.

SECTION II—THEORETICAL BACKGROUND TO THE METHODS

In Section III of this paper, two methods were adopted to assess the factors affecting the demand for food on the home market, namely, a cross-section study and the method of time series analysis. The results that these yielded for the income and price elasticity of demand were then used in Section IV, along with the increases in population and real income forecast independently in that section, to calculate the expected level of demand in 1970.

Consumption was taken as at equilibrium in the year of the last full Census, 1961, and the projections were made relative to that level. For the cross-section study, both the quantity of the food consumed and the expenditure on that item were taken separately as dependent variable, but in the final analysis, only the income elasticity of quantity was used for forecasting. The period of the data, about a year, was too short to allow for the effect of price, so that the burden of estimating this was placed upon the time series material.

In the absence of information on household income, I , in the cross-section inquiry, total expenditure per household on all goods and services,

Z , had to be used instead as the explanatory variable. The two elasticities are connected by the equation:

$$E_I Y = E_I Z \times E_Z Y, \quad (1)$$

where

$$E_I Y = \frac{\bar{I}}{\bar{Y}} \frac{\delta Y}{\delta I}; \quad E_Z Y = \frac{\bar{Z}}{\bar{Y}} \frac{\delta Y}{\delta Z}; \quad E_I Z = \frac{\bar{I}}{\bar{Z}} \frac{\delta Z}{\delta I};$$

with Y = quantity. Since total expenditure is known to be roughly proportionate to income throughout the range of its distribution in the Inquiry, from (1):

$$E_I Y = E_Z Y$$

One cannot in practice distinguish between the permanent and transitory components of income, although the ideal would be to calculate the elasticity of demand with respect to permanent income.³

The two methods, cross-section study and time series lead, as is well-known, to different estimates for the income elasticity of demand, and this discrepancy is due to:

- (i) A long-term shift in demand; and
- (ii) The introduction of new brands into the market over time.

Of the two estimates, the long-run effect is best represented by the one derived from the cross-section data. In the present paper, however, there was no choice but to use the cross-section study, since the final treatment of time series eschewed the effect of income.

The equation used for both the cross-section material in Section IIIA and for the time series in Section IIIB is the familiar Engel curve of classical theory. This equation involves the assumption of constant elasticity of demand regardless of the level of income, an assumption which appears warranted for Ireland, in which income per head has been low up to the start of the present decade. It is also legitimate to use this estimate for the purpose of forecasting, since the period is short and rate of increase in income postulated for the rest of the decade is moderate.

Over a longer period, and for a richer country, it would be preferable to use either the equation:

$$Y = a + b \log Z;$$

or

$$\log Y = a - b/Z$$

where either income elasticity of demand declines towards zero, or the quantity demanded approaches a "saturation" level, as income increases.⁴

Lastly, a note on the Analysis of Covariance applied to the cross-section study may be in order. Using this method, the income elasticity of expenditure for meat and all food, for (i) the five social groups and (ii) the four sizes of household have been calculated. In no case is there

³ M. Friedman, "A theory of the consumption function". Princeton University Press, 1957.

⁴ L. M. Goreux, "Income and Food Consumption", monthly bulletin F.A.O., Vol. IX, No. 10 (October, 1960).

Food and Agricultural Organisations: "Agricultural commodities: projections for 1970". Annex on methods 3: Demand tables M7-M8.

evidence of significant variation between groups, so there is at least some justification for the approach of Section IIIA, where the influence of social group was ignored.

SECTION III—THE RESPONSE OF IRISH DEMAND TO PRICE AND OTHER FACTORS

A. *The Analysis of Cross-section data*

An attempt is made in this Section to estimate income elasticity of demand for the major Irish agricultural products on the home market. At the time of writing, the only material suitable for cross-section study was the official Report of the Household Budget Inquiry for 1951/52.

A double classification of households by income per head and social group was available in Tables 8 and 8A of the Report, and these figures, together with the corresponding information on quantity in Table 35, formed the basic material for the present work. This double classification provided 20 observations in all, so that the regression coefficient of the dependent variable (expenditure or quantity) on income had 18 degrees of freedom. This procedure was better than using as basic data the single classification of Table 3 of the official Report, since the latter method would have yielded a regression coefficient of only two degrees of freedom, and therefore hardly significant. I have not tried to estimate the effect of social group on expenditure, either by adding an explanatory (dummy) variable to the equations, or by analysis of co-variance, and have thus assumed that the elasticity of demand does not vary significantly between groups.⁵

The following list gives the items considered, according to the official code numbers in Tables 8 and 8A of the Report:

Item	Code number
Butter	17
Margarine	18
Cheese	22
Liquid Milk	12
Eggs	23
Beef	24-25
Mutton	26
Pork	27
Rashers	28-33
Bread and Flour...	1-9
Oatmeal	96-97
Potatoes	55
Sugar	94

Two difficulties arose from the basic data of the Report, the first of which was the absence of specific data on the expenditure on beer and stout, as the end-product for malting barley. So far as wheat was concerned, bread and flour only were considered, and cakes and biscuits omitted from the scope of the study. (Table 35* does not give the quantities consumed for margarine, so that for this product, only the income elasticity of expenditure could be calculated.)

⁵ See the note in Section II.

*Of the official report.

Since no average income was published for each of the 20 groups of households, total expenditure has been used instead to represent income. In the Report, average size of household for each income/social group, was broken down into male and female earners, other male and female adults, children and domestic servants.⁵ For the purpose of this study, these figures had to be converted into four categories, namely, male and female adults between 20 and 65 years, old persons aged over 65 years, and children under 20. The convention of Table 1 below has then been adopted, whereby these different constituents of the household were given a system of weights appropriate to each item of food and to all expenditure.^{5a} None of these conventions rests on any proof or observation of Irish consumption patterns, but merely on commonsense, although Prais and Houthaker have done some research on the subject in Britain.⁶

A second refinement is that of allowing for the economy of scale in consumption, in the first column of Table 1. It seems reasonable to

TABLE I

ECONOMIES OF SCALE AND CONSUMER UNITS ADOPTED FOR CERTAIN
ITEMS OF FOOD, AND FOR ALL EXPENDITURE

Food	Economy of scale	Consumer units			
		Adults		Old persons	Children
		Male	Female		
Butter	0.90	1.0	0.8	0.80	0.70
Margarine	0.90	1.0	0.8	0.80	0.70
Liquid milk	0.90	1.0	1.0	0.90	1.10
Cheese	0.88	1.0	0.8	0.83	0.85
Eggs	0.95	1.0	0.8	0.80	0.85
Beef and veal	0.85	1.0	0.7	0.65	0.50
Mutton	0.85	1.0	0.7	0.65	0.50
Pork	0.85	1.0	0.7	0.65	0.50
Rashers, etc.	0.85	1.0	0.7	0.65	0.50
Bread and flour	0.85	1.0	0.8	0.80	0.70
Oatmeal, etc.	0.95	1.0	0.8	0.80	0.70
Potatoes	0.90	1.0	0.8	0.80	0.70
Sugar	0.95	1.0	0.9	0.90	0.80
All expenditure	0.87	1.0	1.0	0.80	0.70

SOURCE: These figures are based partly on those used for Britain in the U.S.D.A. Report (Table 1), and partly on conjecture of the pattern of consumption in Ireland.

assume that the economic efficiency of household management is greater for large households than for small, although of course this depends on the type of food concerned.^{6a}

^{5a} Wold, op. cit., chapter 14.5 has an alternative method.

⁶ Prais and Houthaker, "The analysis of family budgets" (1959).

^{6a} Goreux, L., "Income elasticity of the demand for food" (1959).

Finally, a set of approximate weights were constructed, corresponding to the frequency of households falling in each each income/group level (see the third column of Table 2). Since the official Report offers only partial information, individual frequencies have had to be conjectured,

TABLE 2

TOTAL FAMILY EXPENDITURE PER WEEK ON ALL GOODS AND SERVICES, FREQUENCY OF FAMILIES, AND STANDARD OF LIVING

	Total expenditure (sh.)	Standard of living (logs)	Frequency (000 families)
Group One ...	183	1.70	1
	249	1.83	10
	330	1.99	11
	366	2.12	33
Group Two ...	177	1.64	7
	199	1.77	8
	270	1.95	23
	383	2.16	14
Group Three...	156	1.56	12
	202	1.74	19
	230	1.87	20
	286	2.06	9
Group Four ...	126	1.50	34
	176	1.70	27
	198	1.84	25
	260	2.00	12
Group Five ...	70	1.49	28
	107	1.70	13
	176	1.88	7
	270	2.10	4

SOURCE: Total expenditure—H.B.I. Table 8.

Standard of living—calculated as the ratio between the first column and size of family (in general consumer units), raised to the power of the economy of scale, as given in the last row of Table 1.

Frequency—the results of conjecture, subject to the constraints in the official source.

subject to the given constraints.⁷ The analysis is then based on averages by groups of households, each average being taken as an observation repeated by the appropriate number of households. According to Prais and Aitchison, so long as the averages are weighted by the number of households per group, and the degrees of freedom refer to the number of groups, then the regression coefficient calculated from grouped data is

⁷ Household Budget Inquiry, 1951-52: Report, Tables VI, XII.

an unbiased estimate of that which would have been obtained from ungrouped data.⁸

The independent variable x in the regression for i th item is the standard of living, given in the second column of Table 2, and the dependent variable y_i the logarithm of either

$$\frac{\text{Total Family Expenditure on } i^{\text{th}} \text{ item}}{(\text{Family size in relevant consumer units})} S_i$$

or

$$\frac{\text{Total Family Consumption of } i^{\text{th}} \text{ item}}{(\text{Family size in relevant consumer units})} S_i$$

where S_i is the economy of scale. (See Tables 3 and 4 for the above data.)

The function fitted is then the conventional Engel curve, in which demand is assumed proportionate to the power of income, that is

$$Y_i = a_i x^{b_i}$$

$$\text{or } \log Y_i = \log a_i + b_i \log x;$$

so that the regression coefficient (that is, income elasticity) is calculated by the formula:

$$b_i = \frac{\Sigma f \log x \log y_i - \frac{(\Sigma f \log x)(\Sigma f \log y_i)}{\Sigma f}}{\Sigma f (\log x)^2 - \frac{(\Sigma f \log x)^2}{\Sigma f}}$$

where f is the frequency (Table 2), and the summation is over all 20 observations.

The results for the different foods are presented in Table 5. The remarkably low elasticity of demand for butter has also been noticed by Goreux of F.A.O. as too the high value for mutton. Pork seems a luxury food with high elasticity but, of course, its overall level of consumption at the time of the enquiry was very low. As in European countries bread and flour are looked upon as an inferior good, that is, with negative elasticity of demand; but unlike Europeans, Irish consumers do not regard margarine as an inferior substitute.⁹ The discrepancy between the elasticities of expenditure and quantity in Table 5 are of interest. Hermann Wold suggests two reasons why the latter tends to be smaller than the former:

- (1) As soon as a commodity becomes available in different varieties, the consumers react to an increase (or decrease) in income by shifting towards the more (or less) expensive qualities; hence the variations in demand will be smaller when measured in terms of quantity rather than in terms of expenditure.
- (2) The practice of price discrimination by monopolies, has the same effect.¹⁰

⁸ Prais and Aitchison, "The grouping of observations in regression analysis". *Review Int. Stat. Inst.*, 1954.

⁹ Compare the results of Dr. C. Leser in "Demand relationships for Ireland" (April, 1962, E.R.I.) based on somewhat different assumptions.

¹⁰ Wold, H., "Demand Analysis", chapter 14.3.

TABLE 3
TOTAL FAMILY EXPENDITURE PER WEEK ON CERTAIN ITEMS OF FOOD

Income Group and Social Group	Livestock products									Crops			
	Butter	Mar-garine	Liquid Milk	Cheese	Eggs	Beef	Mutton	Pork	Rashers	Bread & Flour	Oatmeal	Potatoes	Sugar
Group One ...	Shillings per week									Shillings per week			
	8.7	0.7	10.4	0.5	5.4	8.2	4.2	0.5	7.3	8.6	1.1	4.2	2.0
	10.2	0.7	11.3	0.4	7.0	9.3	5.6	0.7	9.8	7.9	0.9	4.2	2.0
	9.0	0.9	10.9	0.6	7.7	10.2	5.8	1.0	9.6	7.3	1.2	3.8	2.1
	7.1	0.8	9.0	0.6	7.6	9.3	6.9	1.2	9.2	6.2	0.9	3.0	2.0
Group Two ...	10.0	0.6	9.9	0.4	4.8	7.4	2.0	0.3	6.7	9.8	0.6	4.6	2.0
	8.4	0.7	10.7	0.4	5.4	8.2	3.4	0.6	8.0	7.3	0.8	3.5	1.9
	7.4	0.8	9.2	0.6	6.7	8.6	4.8	0.8	9.1	6.7	0.8	3.3	1.8
	6.5	0.8	8.2	0.6	7.1	8.3	5.5	1.1	8.2	5.6	0.9	2.5	1.7
Group Three ...	10.5	0.6	9.7	0.5	5.0	7.6	2.0	0.5	6.5	10.0	0.6	4.8	2.1
	9.8	0.6	9.6	0.7	6.0	8.9	3.1	0.7	8.5	8.9	0.7	4.3	2.1
	8.0	0.6	8.8	0.6	6.4	8.7	4.0	1.2	10.0	7.6	0.7	3.6	1.8
	6.6	0.7	7.3	0.7	7.0	9.5	4.3	1.5	8.7	6.1	0.6	2.9	1.6
Group Four ...	9.4	0.5	7.8	0.3	3.7	7.1	1.2	0.3	7.6	10.0	0.5	4.3	2.0
	8.8	0.6	8.2	0.5	5.5	8.8	2.4	0.6	8.8	8.9	0.4	4.0	1.9
	7.4	0.6	7.0	0.5	5.7	9.1	3.3	0.7	8.9	7.4	0.4	3.5	1.8
	6.1	0.6	6.4	0.4	6.1	8.8	4.4	0.9	8.7	6.2	0.5	2.9	1.4
Group Five ...	5.0	0.2	4.2	0.2	2.2	3.2	0.9	0.1	3.7	5.2	0.3	2.3	1.1
	5.3	0.4	4.8	0.3	3.5	4.5	1.9	0.3	5.7	5.1	0.3	2.4	1.3
	6.4	0.6	6.1	0.3	4.6	5.7	3.5	0.6	7.1	6.0	0.6	3.6	1.7
	4.9	0.7	6.4	0.4	5.6	6.6	5.1	0.8	6.7	5.0	0.4	2.3	1.8

SOURCES: H.B.1; Tables 8 and 8A.

- NOTES: (i) Rashers: This is the sum of the three items—rashers; bacon, ham and pigs' heads; sausages, black and white puddings, as given in the source.
- (ii) Oatmeal: This refers to oatmeal plus breakfast cereals.
- (iii) Bread and Flour: This is the sum of the three items—batch and fancy bread; other bread; flour; as given in the source.

TABLE 4
TOTAL FAMILY CONSUMPTION PER WEEK OF CERTAIN ITEMS OF FOOD

Income Group and Social Group	Livestock products								Crops			
	Butter	Liquid Milk	Cheese	Eggs	Beef	Mutton	Pork	Rashers	Bread & Flour	Oatmeal	Potatoes	Sugar
	lbs.	pints	lbs.	no.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Group One	2.8	27.6	0.2	17.7	3.6	1.5	0.1	2.1	31.2	1.2	27.6	4.9
	3.4	29.6	0.2	22.5	3.8	2.1	0.2	2.8	26.9	0.9	28.7	5.0
	3.0	26.3	0.3	24.1	4.0	1.9	0.3	2.7	23.6	1.0	26.1	4.7
	2.4	21.8	0.3	21.8	3.6	2.2	0.3	2.6	18.4	0.6	19.9	4.1
Group Two	3.4	25.1	0.2	14.7	3.6	0.7	0.1	1.9	34.6	0.7	32.4	5.3
	2.8	24.1	0.2	16.3	3.4	1.2	0.2	2.6	24.2	0.7	23.6	4.6
	2.4	22.3	0.3	19.5	3.6	1.6	0.2	2.5	20.9	0.7	21.8	4.1
	2.2	19.2	0.2	20.1	3.2	1.9	0.3	2.3	17.0	0.6	17.3	3.6
Group Three	3.5	24.4	0.2	15.6	3.4	0.8	0.2	1.9	35.2	0.6	33.1	5.4
	3.2	24.0	0.3	18.1	3.8	1.2	0.2	2.5	31.1	0.6	28.2	4.8
	2.6	21.2	0.3	18.7	3.6	1.4	0.4	2.9	24.8	0.5	24.6	4.0
	2.1	18.1	0.3	19.9	3.8	1.5	0.4	2.4	19.1	0.4	20.2	3.4
Group Four	3.1	19.5	0.1	11.5	3.3	0.5	0.1	1.8	35.4	0.6	28.6	5.0
	2.9	20.3	0.2	16.2	3.9	0.9	0.2	2.5	29.3	0.5	26.3	4.5
	2.4	17.2	0.2	16.9	3.8	1.1	0.2	2.5	24.9	0.4	23.6	4.0
	2.0	14.8	0.2	17.2	3.7	1.5	0.3	2.4	19.8	0.4	19.6	3.2
Group Five	1.6	11.1	0.1	7.2	1.7	0.3	0.0	1.0	18.4	0.4	15.8	2.7
	1.7	12.8	0.1	11.1	1.9	0.7	0.1	1.6	17.4	0.4	16.9	2.8
	2.1	15.6	0.2	14.8	2.8	1.2	0.2	2.0	21.4	0.7	27.9	3.5
	1.6	15.3	0.2	16.5	2.8	1.6	0.2	1.8	16.0	0.3	15.7	2.9

SOURCE: H.B.I., Table 35.

- NOTES: (i) Beef: This is the sum of the two items beef and veal; corned beef, as given in the source.
(ii) Rashers: This is the sum of three items—rashers; bacon and ham; sausages.
(iii) Oatmeal: Since in the published source, no account is taken of other breakfast cereals, this item is not the same as the corresponding item in Table 3 above.
(iv) Margarine has had to be omitted since the source merely includes it with other fats.

TABLE 5

ESTIMATES FOR THE INCOME-ELASTICITY OF EXPENDITURE AND QUANTITY CONSUMED

Food	Income-elasticity of	
	Expenditure	Quantity
Butter	0.08	0.08
Margarine	0.69	n.c.
Liquid milk	0.43	0.38
Cheese	0.67	0.67
Eggs	0.79	0.72
Beef	0.47	0.31
Mutton	1.28	1.16
Pork	1.33	1.29
Rashers	0.42	0.45
Bread and Flour ...	-0.04	-0.15
Oatmeal	0.63	0.26
Potatoes	0.02	0.02
Sugar	0.26	0.14

SOURCE: Calculated as explained in the text.

B. *The Analysis of Time Series*

The data used for the time series analysis was the annual series for the weekly quantity of foodstuffs consumed per head, as published for the period 1947-64 in the official journals, "The Irish Statistical Survey", "National Income and Expenditure" and the "Irish Trade Journal". (Table 6 below.)

These figures are calculated by the C.S.O. as follows:

Creamery butter: from C.I.P. data, less exports, adjusting for changes in stocks.

Farmers' butter: from output data, less exports.

Margarine, Bread, Flour: from C.I.P. data.

Liquid Milk, Beef, Mutton, Pigmeat: from output data.

Cheese, Sugar: from C.I.P. data, less exports.

Eggs, Potatoes: from output data, less exports, less quantity sold to industry.

The item "Flour" refers to household flour; the item "Eggs" to shell eggs only and excludes eggs sold for manufacture. The item "Pigmeat" may be broken into Bacon, Fresh Pork and Pork Sausages for the years 1947-50 (unpublished data collected by the C.S.O.), but since then no such information is available, and one must be content with the broader definition for the purpose of demand analysis.

As will be seen from the above notes, the foods in these figures are not quite the same as those used in the cross-section study, but however, they are near enough to justify comparison.

Table 7 below gives the data for retail prices over the period 1947-64, as well as the consumer price index to base August 1947 = 100. The price

TABLE 6
AVERAGE WEEKLY CONSUMPTION PER HEAD OF CERTAIN ITEMS OF FOOD, 1947-64

Year	Livestock products									Crops			
	Butter		Mar- garine	Liquid Milk	Cheese	Eggs	Beef	Mutton	Pigmeat	Bread	Flour	Potatoes	Sugar
	Cr'mery	Farmers											
	ozs.	ozs.											
1947	5.2	5.0	1.6	5.1	0.7	4.1	16.7	4.4	11.9	3.1	3.0	9.3	11.8
1948	6.6	4.7	0.8	5.3	0.6	4.1	14.6	4.0	11.8	3.5	2.0	9.2	15.0
1949	7.7	4.5	0.7	5.3	0.4	4.4	11.5	3.2	14.5	3.5	2.3	8.9	14.2
1950	8.6	4.2	0.8	5.5	0.6	4.9	10.1	3.1	13.8	3.5	2.1	8.9	18.6
1951	8.8	3.8	0.9	5.5	0.5	5.5	12.1	3.0	12.6	3.6	2.1	8.8	19.9
1952	9.0	3.7	0.9	5.5	0.4	5.2	10.7	4.0	13.0	3.4	2.2	8.7	21.1
1953	8.4	3.0	1.4	5.9	0.6	4.8	9.8	4.0	14.1	3.3	2.1	7.2	21.4
1954	8.5	2.9	1.4	6.2	0.6	5.4	9.1	4.2	15.0	3.3	2.0	7.3	19.7
1955	8.9	2.9	1.5	6.4	0.6	5.6	9.7	5.0	15.5	3.3	2.0	7.3	19.2
1956	9.0	2.9	1.5	6.4	0.6	5.6	10.0	5.6	14.6	3.2	2.0	7.1	22.1
1957	8.4	2.9	1.6	6.6	0.6	5.5	10.2	5.7	15.0	3.0	1.9	6.8	20.6
1958	8.2	2.8	1.8	6.6	0.6	5.6	10.0	6.0	14.2	3.0	1.7	6.4	20.3
1959	8.8	2.8	1.9	6.7	0.8	5.6	9.7	7.1	15.1	2.9	1.7	6.8	20.2
1960	8.2	2.7	2.1	6.9	0.8	5.3	10.0	7.2	14.6	2.8	1.7	6.7	20.3
1961	8.1	2.7	2.0	7.0	0.9	5.2	10.4	7.2	15.4	2.8	1.6	6.6	21.4
1962	8.2	2.7	2.0	7.0	1.0	5.2	10.8	7.6	15.7	2.8	1.6	6.6	18.6
1963	8.6	2.2	2.1	7.0	1.1	5.0	11.5	7.7	16.0	2.8	1.6	6.5	20.0
1964	8.5	1.8	2.3	7.0	1.1	4.9	11.1	7.5	17.3	2.7	1.5	6.4	17.8

SOURCE: Irish Statistical Survey, 1950-60; calculated from I.T.J., December, 1964-65.

TABLE 7
ANNUAL AVERAGE RETAIL PRICES OF CERTAIN ITEMS OF FOOD, AND CONSUMER PRICE INDEX, 1947-64

Year	Consumer price index (Aug. '47 =100)	Livestock products									Crops			
		Butter		Mar-garine	Liquid Milk	Cheese	Eggs	Beef	Mutton	Pigmeat	Bread	Flour	Potatoes	Sugar
		Cr'mery	Farmers											
		per lb.	per lb.											
		d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
1947	100	31	31	18	7.5	23	43	23	29	35	6.6	43	25	5.5
1948	99	32	—	22	8.4	26	49	24	29	35	6.1	34	25	4.0
1949	100	32	—	20	8.4	26	46	24	29	36	6.2	34	23	4.0
1050	101	32	—	18	8.3	26	43	24	30	37	6.2	34	27	4.0
1951	109	34	—	23	8.8	27	47	26	32	43	6.4	34	24	4.0
1952	118	41	—	20	9.8	30	54	28	35	46	7.9	44	24	5.2
1953	125	49	44	19	10.3	32	53	32	37	48	9.5	54	26	6.9
1954	125	49	43	19	10.4	34	48	33	38	46	9.1	51	28	7.0
1955	128	45	40	19	10.7	34	53	38	40	45	9.0	50	36	7.0
1956	134	45	40	19	11.0	34	50	37	38	46	9.0	50	32	7.0
1957	140	50	42	20	11.4	34	47	37	39	46	11.2	72	30	7.4
1958	146	50	44	20	11.4	35	50	39	40	47	14.4	90	44	7.5
1959	146	52	44	20	11.6	34	49	42	39	48	14.5	90	39	7.5
1960	146	54	46	20	11.9	37	48	42	39	49	14.9	94	27	7.5
1961	150	55	46	20	12.0	39	50	41	39	49	15.2	98	38	7.5
1962	156	54	46	21	12.3	39	48	42	40	48	16.0	100	39	8.2
1963	160	55	47	21	12.8	39	56	43	41	49	16.2	101	35	8.4
1964	171	56	48	22	13.7	41	49	51	45	51	17.6	108	40	9.6

SOURCE: Consumer price index: 1947 (unpublished figure supplied by C.S.O.) 1948-64, I.T.J., December 1962-64.
Annual prices: Calculated from quarterly data, published in I.T.J., June and December, 1947-64.

of Beef used is the average of the price of two cuts, Sirloin and Shoulder; for Mutton it is that of Leg of Mutton; and for Pigmeat that of Streaky Bacon. The retail price given for each year is finally the simple average of the four quarterly prices as published.

The observations for both quantity and price are, therefore, at annual intervals, even though it is known that some products exhibit seasonal variation within the year in both their consumption and price. Unfortunately, while the latter are accurately recorded by the C.S.O., the same cannot be done for the former. Eggs spring to mind as an obvious example of this phenomenon. While retail prices are observed only at the centre of each quarter, information on quarterly quantity relates only to the supplies of eggs to registered wholesalers. Hence, a time series analysis of such data would merely result in the measurement of a quasi-supply curve. Finally, in the annual series actually used in this analysis, one might be inclined to weight the quarterly prices by the quantities sold (to wholesalers) in order to arrive at a price variable—but as this procedure might result in multicollinearity between the dependent and independent variables, it has been preferred to use only the simple unweighted average as for other products.

Two approaches were considered in the analysis. In the first, total national consumption of the various foods was chosen as the dependent variable, and regressed on three independent variables population, national income and price. Where obvious substitutes in consumption existed as in the case of butter and meat, the price of the substitute was included as an extra explanatory variable. Income and price variables were deflated by the index of consumer prices to express them in real terms, and the assumption made was that Q_i , the annual consumption of the i^{th} food, was of the form:

$$Q_i = a_i Z^b Y^c P_i^d P_j^e$$

where Z and Y are population and national real income, respectively, P_i the real price of the i^{th} food, P_j that of a substitute and a_i, b_i, c_i, d_i and e_i constants to be determined.

The results were, however, unsatisfactory for almost every product, and in scarcely any case did it appear that the effect of price was significant. Since the population data are subject to an unknown margin of error, and in any event the income effect had already been estimated in the cross-section study (a much more suitable source for the purpose of forecasting), a second approach was adopted instead.

This time, consumption per head was made the dependent variable (Table 6) and the two possible independent variables were real retail price and trend. For each food except Farmers' butter (for which insufficient data on price was available), the real retail price P_i was taken as the first of these explanatory variables; and where the diagrams of Figures 1-4 showed the existence of trend, that is, in the case of Liquid Milk, Mutton, Bread, Flour, Potatoes and Sugar, this was added to the equation. For

FIG. 1: TOTAL HOME CONSUMPTION OF BREAD
FLOUR AND POTATOES 1947-64.

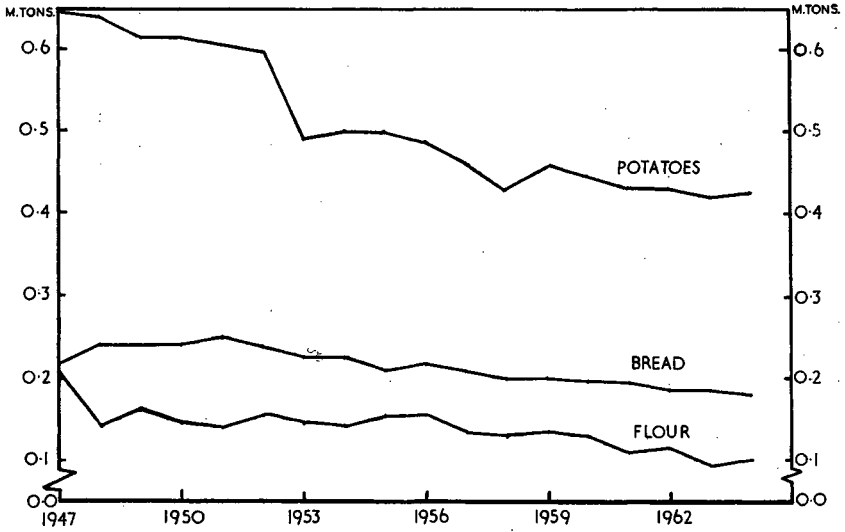


FIG. 2: TOTAL HOME CONSUMPTION OF LIQUID MILK
1947-'64.

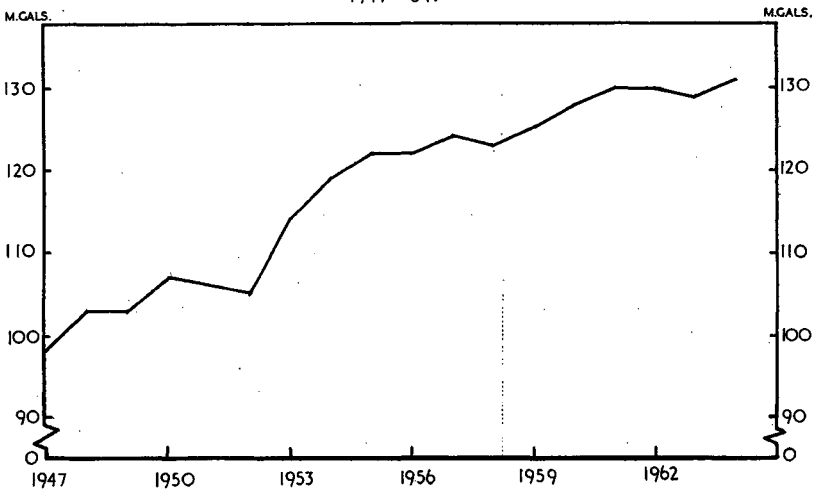


FIG.3: TOTAL HOME CONSUMPTION OF CREAMERY BUTTER,
MARGARINE AND CHEESE 1947-'64.

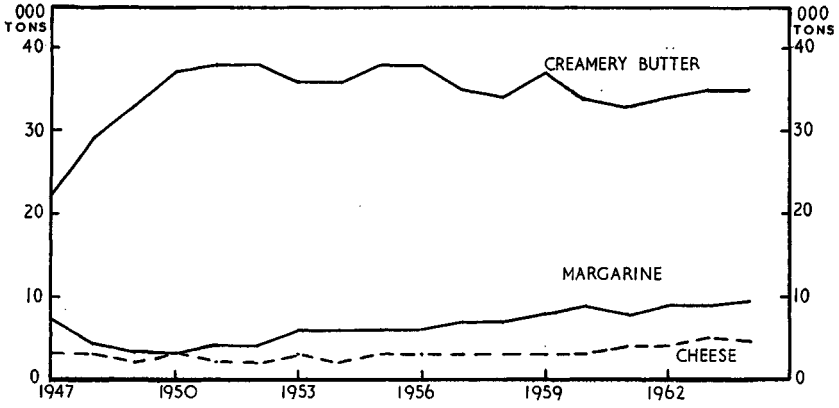


FIG.4: TOTAL HOME CONSUMPTION OF BEEF, MUTTON
AND PIGMEAT 1947-'64.

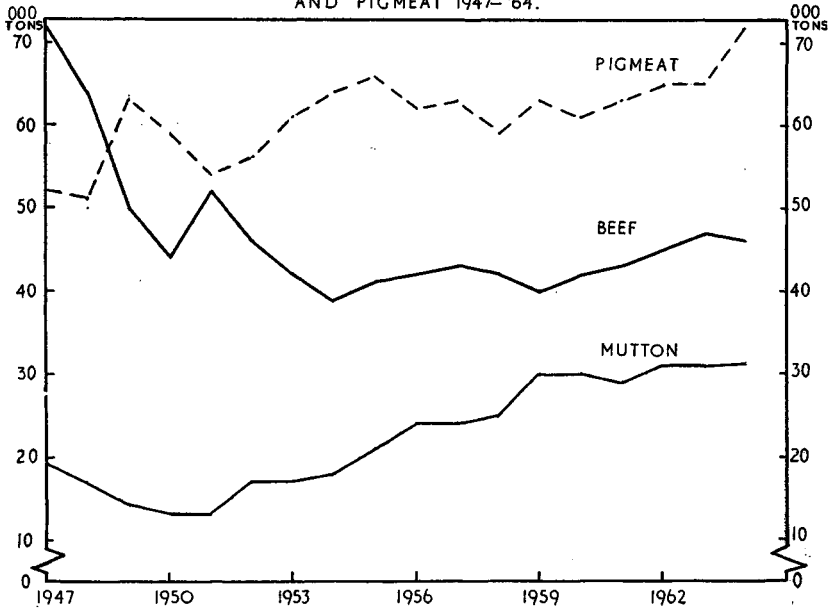
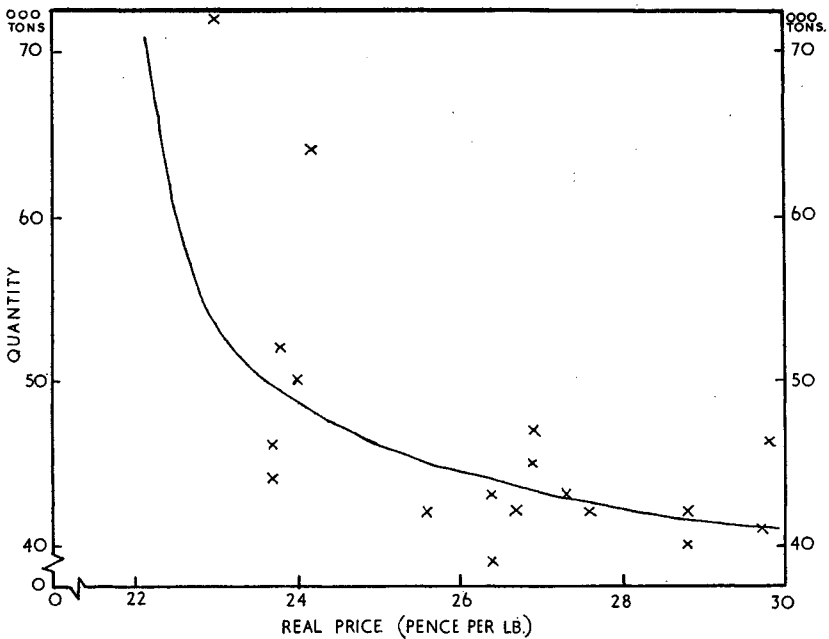


FIG.5: RELATION BETWEEN THE DEMAND FOR BEEF
AND ITS PRICE 1947-64.

Margarine only, the price of a substitute was considered. (It was ignored for other products, on account of results in the first approach.)

This means that in general, the assumption was made that q_i , the annual consumption per head, was of the form:

$$q_i = a_i P_i^{b_i}$$

where a_i and b_i are constants to be determined; and for the products listed in the preceding paragraph,

$$q_i = a_i P_i^{b_i} T^{c_i}$$

where T is the trend term, taking the value 1 in the year 1947, 2 in 1948 and so on; and c_i is another constant.

It seems empirically speaking wise in the Irish data to include this trend term as a (rather vague) expression for change in consumers' tastes, despite the arguments of Hermann Wold on the subject.¹¹

These two equations reduce by logarithms to:

$$\log q_i = \log a_i + b_i \log P_i$$

and

$$\log q_i = \log a_i + b_i \log P_i + c_i \log T$$

so that the estimate b_i is the (constant) elasticity of price and c_i that of trend.

¹¹ Wold, H., op. cit., chapter 15.3.

Table 8 gives the resulting equations for the 13 foods considered. The first and third columns are the estimates b_i and c_i mentioned in the basic assumptions, the fourth the constant in each and the final column is the

TABLE 8
DEMAND RELATIONS FOR CERTAIN ITEMS OF FOOD, 1947-64

Dependent variable Consumption of	Co-efficient of independent variable			Constant (log a_i)	R^2
	Own price (b_i)	Substitute price	Trend (c_i)		
Creamery butter ...	0.74 (0.43)	—	—	-0.53	0.16
Farmers' butter ...	—	—	-0.31† (0.03)	1.76	0.86
Liquid milk ...	—	—	0.13† (0.01)	1.55	0.89
	-0.67* (0.28)	—	0.13† (0.01)	2.95	0.92
Cheese ...	-2.34 (1.53)	—	—	7.13	0.13
Eggs ...	-0.32* (0.14)	—	—	2.80	0.24
Beef ...	-1.05* (0.38)	—	—	5.81	0.32
Mutton ...	-4.45† (0.74)	—	—	16.47	0.69
	-3.17† (0.82)	—	0.16* (0.06)	11.90	0.78
Pigmeat ...	-0.81† (0.23)	—	—	5.55	0.45
Bread ...	-0.41† (0.04)	—	—	1.99	0.88
	-0.47† (0.06)	—	0.02 (0.02)	2.06	0.90
Flour ...	—	—	-0.19† (0.02)	1.03	0.80
	-0.13 (0.10)	—	-0.16† (0.03)	1.47	0.82
Potatoes ...	—	—	-0.16† (0.02)	2.34	0.84
	-0.11 (0.11)	—	-0.16† (0.02)	2.70	0.86
Sugar ...	—	—	0.16† (0.03)	2.61	0.60
	-0.27 (0.21)	—	0.18† (0.04)	3.00	0.64
Margarine ...	-2.00† (0.25)	—	—	5.84	0.81
	-2.64† (0.49)	-0.50 (0.72)	-0.13 (0.10)	9.63	0.83

* Significant at the 5% level.

† Significant at the 1% level.

SOURCE: Calculated from Tables 6 and 7 as explained in the text.

coefficient of determination, the measure of closeness of fit for the relation.

Results on the whole show a surprisingly good fitting, the only exceptions being the simple quantity/price assumptions for Creamery butter, Cheese, Eggs and Beef. For the first of these, price elasticity had even the wrong sign, but its size was not significant. The only elasticities that seem dubious are those for mutton and margarine—when more observations come to hand, perhaps better estimates for these will become possible. The marked trend effect from the calculations confirms the graphic analysis of Figs. 1, 2 and 4 for Potatoes, Flour, Milk and Mutton.

Finally, it may be of interest to compare the first column in Table 8 with similar results for the United Kingdom over a pre-war period of about equal length, calculated by Professor Stone of Cambridge from the time series analysis (Table 9). For eggs and flour, the Irish elasticities are smaller in magnitude, for pigmeat about the same, but for the others greatly in excess.

TABLE 9

PROFESSOR STONE'S ESTIMATES FOR THE PRICE ELASTICITY OF QUANTITY CONSUMED IN UNITED KINGDOM, 1920-38

Food			Elasticity
Eggs	...	...	-0.43
Beef	...	...	-0.11
Mutton	...	...	-0.56
Bacon and ham	...	...	-0.70
Pork	...	...	-0.67
Bread	...	...	-0.08
Flour	...	...	-0.79

SOURCE: Stone, R. "Measurement of Consumers' Expenditure in the U.K., 1920-38", Vol. I, Table 106.

NOTE: The figures for beef and mutton refer to home produce only.

SECTION IV—A FORECAST OF THE LEVEL OF DEMAND IN 1970

A. *Forecast of Prices*

Since the new members of the European Economic Community are unlikely to have joined in time to influence very much the target wholesale prices fixed by the community, it seems reasonable to expect that these will be based on national prices for the present members, as well as the expected relation between overall supply and demand in 1970. These wholesale (and their associated retail) prices will, therefore, be determined independently of economic forces in the Irish market, and may be taken to be purely exogenous variables.

The wholesale prices have been forecast from several sources, including Mr. Raymond Crotty's recent work for the Irish Creamery Milk Suppliers'

Association, the Department of Agriculture survey of the dairying industry, the official White Paper on the E.E.C. and Mr. Attwood's paper to the Statistical Society. Certain retail prices given in Table 10 below were then calculated as follows:

- (1) *Liquid Milk*: Since increasing margins in distribution have been noted in recent times, this margin was expected to rise from 28.4 pence per gallon in 1961 to 34.5 pence by 1970.
- (2) *Eggs*: Since the retail price in 1961 (Table 7 below) stood at 49.8 pence per dozen, that is, 41.5 shillings per great hundred, this means that the margin was 13.2 shillings. Assuming that this margin remains rigid, the retail price should rise to about 42.9 shillings by 1970, that is, an increase of 3.4 per cent.
- (3) *Beef and Pigmeat*: Since the retail prices of Table 7 refer only to certain cuts, roundabout means have had to be adopted to arrive at a retail price for all beef and pigmeat corresponding to the wholesale price of 1961. The margins suggested by the O.E.E.C. for marketing and processing have therefore been used.¹²

TABLE 10
FORECASTING THE LEVEL OF WHOLESALE AND RETAIL PRICES, IN
ENLARGED E.E.C., 1961-70

Product	Wholesale			Product	Retail		
	1961	1970	1961-70 increase %		1961	1970	1961-70 increase %
	<i>d. per gal.</i>				<i>d. per lb.</i>		
Milk			30.0	Margarine ...	20	24	20.0
	<i>sh. per qt. hnd</i>			Liquid Milk	12.0	15.0	25.0
	Eggs	28.3		29.7	5.0	Eggs ...	49.8	51.5	3.4
Beef Cattle ... Sheep ...	<i>£ per head</i>		30.0 n.c.	Beef ... Mutton ...	<i>d. per lb.</i>		21.7 3.0
	58.1	75.5			41.0	51.5	
	6.45	n.c.			39.0	40.2	
Pigs	<i>£ per cwt. dwt.</i>		-1.0	Pigmeat ...			-0.8
	11.5	11.4			49.0	48.6	
	<i>sh. per cwt.</i>				Bread ...	15.2		16.7	10.0
Wheat ...	29.2	32.7	12.0				

SOURCE: As explained in text (partly calculated from Mr. E. Attwood: "Ireland and the European Agricultural Market", 1963).

¹² O.E.E.C. "Marketing and distribution margins" (1960), Table 28.

B. *The Forecasts of Real Income and Population in 1970*

It is impossible to be certain about future trends in the Irish population. To forecast the growth of population in any country is difficult, but to do so for a country in which emigration is at a high level is doubly so.¹³ In recent articles, Mr. Garrett Fitzgerald suggests that, if the official hopes of the Second Programme be realized, the population should rise to as much as 2,925,000 by 1970.¹⁴ (2,974,000 in 1971, according to the Central Statistics Office.)

It is hard to see that the implications of the programme justify such optimistic forecasts of population, and moreover that the future decline in numbers engaged in agriculture will be made good by more employment opportunities in industry, especially since protection from the latter will be completely removed with our accession to membership of the European Economic Community. (Membership of the Anglo-Irish Free Trade Area beforehand will partially remove protection too.) While slight rises have occurred of late, these seem to be of a temporary nature, and not sufficient to arrest the continued overall decline of population, expected to be at the same rate of 0.5 per cent per year as in the last decade.

Since it was intended to apply the scheme of consumer units in Table 1, it was necessary to forecast the 1970 population divided into four constituent units, old people (aged over 65 years); children (under 20) and male and female adults (aged 20–65 years). The first step was to project the proportion of old people in the population, based on the data for the last century. By 1970, this proportion is expected to be the highest ever recorded for the country, namely, 11.6 per cent. From this, and the level forecast for total population already, the actual number of old people was calculated. The second assumption was that the slow increase in numbers of children would be slightly checked. Finally, the number of adults (the constituent about which there is most uncertainty, on account of emigration) was obtained as a residual. (The sex-ratio is taken to remain close to 1 : 1). The resulting breakdown is shown in Table 11, along with the 1951 and 1961 data for comparison.

The scheme of Table 1 was then applied in turn to the data of Table 11 in each year, in order to translate the effect of declining population on the number of consumer units particular to each food (Table 12).

The forecasts for the 1970 level are summarized in Table 13. These give the number of general consumption units and real income in total and per unit expected at the end of the decade. It is assumed that income is a purely exogenous variable, so that its level can be forecast independently of the volume of demand for food. Instead of national income, the variable actually used is total personal expenditure on consumer goods and ser-

¹³ See the Report of the Commission on Emigration and other Population problems (1954).

¹⁴ Fitzgerald, Mr. G., *Irish Times*, November, 1963 and May, 1965. "Second Programme for Economic Expansion, chapter 2, paragraph 25. Leser, Dr. C., "Recent demographic developments in Ireland", paper read to S.S.I.S.I., May, 1965; also *Irish Statistical Bulletin*, June, 1965.

TABLE 11
BREAKDOWN OF POPULATION, 1951-70

	1951	1961	1970
	(000)	(000)	(000)
Children ...	1,096	1,111	1,100
Male adults ...	789	698	641
Female adults ...	759	694	640
Old people ...	316	315	312
Total ...	2,961	2,818	2,693

SOURCE: For 1951-61: Annual Reports for the Census, C.S.O.
For 1970: Forecast as explained in the text.

TABLE 12
TOTAL NUMBER OF GENERAL CONSUMPTION UNITS, AND OF PARTICULAR CONSUMPTION UNITS FOR CERTAIN ITEMS OF FOOD, 1961 AND 1970

	1961	1970
	(000)	(000)
Population ...	2,818	2,693
General consumption units	2,422	2,301
<i>Particular consumption units:</i>		
Bread		
Flour		
Potatoes	2,283	2,173
Butter		
Margarine		
Sugar ...	2,496	2,378
Liquid Milk ...	2,898	2,772
Cheese ...	2,458	2,347
Eggs ...	2,449	2,338
Beef		
Mutton	1,945	1,842
Pigmeat		

SOURCE: Calculated by applying the scheme of consumer units in Table 1 to the data of Table 11.

TABLE 13

PROJECTED INCREASE IN NUMBER OF GENERAL CONSUMPTION
UNITS, AND REAL INCOME, 1961-70

1961 level:		(000)
Number of consumption units	...	2,422
		(£m)
Income, at 1953 prices	... ..	446.7
		(£)
Income/unit, at 1953 prices	... ..	184.4
1961-70 increase:		% compound p.a.
Number of consumption units	...	-0.6
Income, at 1953 prices	... (L)	+2.0
	(H)	+3.6
Income/unit, at 1953 prices	... (L)	+2.6
	(H)	+4.2
1970 level:		(000)
Number of consumption units	...	2,301
		(£m)
Income, at 1953 prices	... (L)	533.8
	(H)	613.4
Income/unit, at 1953 prices	... (L)	232.6
	(H)	267.3

SOURCE: Consumption units, as in Table 12.

Income (L) F.A.O. Projections, Table M2.

(H) Second Programme, Table 4.

And "National Income and Expenditure", 1962, Table A9.

NOTE: (L) and (H) refer to the low and high growth rates respectively.

vices, as the most appropriate to a study of the demand for food. Two hypotheses were made about its level in 1970; the first (marked L) corresponds to that made by the F.A.O. experts in their recent study;¹⁵ and the second (marked H) to the target growth aimed at by the Programme for Economic Expansion. The difference between the two rates of growth is of the size approved by the F.A.O. experts.

C. The Forecast of Home Demand in 1970

The method for projecting consumption in Table 14 is as follows. The increase in quantity consumed is called ΔC , and μ , θ and η are the elasticities of demand with respect to price, trend and income, respectively. The method may be illustrated for the product Liquid Milk (one of the more complicated cases).

First, the price elasticity of quantity consumed is:

$$\mu = -0.67$$

from the time series analysis (Table 8). As stated in Table 10, retail price is expected to rise by 25 per cent, so that the ratio between 1970 and 1961 is

$$\frac{P_1}{P_0} = 1.250$$

¹⁵ F.A.O. Projections, Table M2.

Similarly, the trend elasticity is, from the same equation in Table 8,
 $\theta = 0.13$.

Since the value of the dummy variable for trend will have risen from $t_0=15$ in 1961 to $t_1=24$ in 1970, then

$$\frac{t_1}{t_0} = 1.6$$

The percentage increase due to both in consumption per unit, is by the basic assumption of the analysis,

$$\begin{aligned}\Delta c/\text{unit (both)} &= 100 \times \left\{ \left[\frac{P_1}{P_0} \right]^\mu \left[\frac{t_1}{t_0} \right]^\theta - 1 \right\} \\ &= 100 \times \{ (1.25)^{-0.67} (1.6)^{0.13} - 1 \} \\ &= -8.5\%.\end{aligned}$$

Finally, the income elasticity of demand is $\eta=0.38$, from the cross-section study (Table 5). From Table 13, real income per consumer unit is expected to rise from

$$x_0 = \text{£}184.4$$

in 1961 to either

$$x_1 = \text{£}232.6 \text{ or } x_1 = \text{£}267.3$$

by 1970, depending on whether the low or high hypothesis of economic growth is accepted. Hence the percentage increase in consumption per unit over the period comes from the analogous formula:

$$\begin{aligned}\Delta c/\text{unit (income)} &= 100 \times \left\{ \left[\frac{x_1}{x_0} \right]^\eta - 1 \right\} \\ &= 9.1\% \text{ on the low hypothesis; or} \\ &= 15.2\% \text{ on the high hypothesis.}\end{aligned}$$

The total increase in consumption per unit is therefore:

$$\begin{aligned}\Delta c/\text{unit (all)} &= \Delta c/\text{unit (both)} + \Delta c/\text{unit (income)} \\ &= 0.6\% \text{ on the low hypothesis;} \\ &= 6.7\% \text{ on the high hypothesis.}\end{aligned}$$

From Table 12, the actual level of consumption per unit in 1961 was:

$$\frac{130,000,000}{2,898,000} = 44.8 \text{ gallons.}$$

Hence, consumption per unit is expected to increase to either $44.8 \times (1.006) = 45.3$ gallons or $44.8 \times (1.067) = 48.0$ gallons.

The total consumption for 1970 is last obtained by simply multiplying these figures by the number of appropriate units expected in that year (Table 12):

$$2,772,000 \times 45.3 = 126 \text{ million gallons;}$$

or

$$2,772,000 \times 48.0 = 133 \text{ million gallons.}$$

SECTION V—CONCLUSIONS

A. Summary of Results and Comparison with F.A.O. Projections

The two key tables of the paper are Tables 10 and 14, in which future price is forecast and the demand expected at this price. Needless to say, any other set of prices may be substituted for those of Table 10, and the

TABLE 14
FORECAST LEVELS FOR CONSUMPTION IN 1970, ON THE INCOME, PRICE AND TREND ASSUMPTIONS

	Mar- garine	Butter		Liquid Milk	Cheese	Eggs	Beef	Mutton	Pigmeat	Bread	Flour	Potatoes	Sugar
		Cr'mery	Farmers										
$\Delta C/\text{unit (price)}^\mu$	—2	—	—	—0.67	—	—0.32	—1.05	—3.17	—0.81	—0.41	—	—	—
$\Delta C/\text{unit (trend)}^\theta$	—30.6	—	—	—	—	—1.0	—18.6	—	0.7	—3.8	—	—	—
$\Delta C/\text{unit (both)}^\theta$	—	—	—0.3	0.13	—	—	—	0.16	—	—	—0.19	—0.16	0.16
$\Delta C/\text{unit (both)}^\theta$	—30.6	—	—13.5	—	—	—	—	—	—	—	—8.5	—7.2	7.7
$\Delta C/\text{unit (income)}^\eta$	n.a.	0.08	0.08	0.38	0.67	0.72	0.31	1.16	0.45	—0.15	—0.15	0.02	0.14
$\Delta C/\text{unit (income)}^\eta$	n.a.	1.9	1.9	9.1	16.8	18.1	7.4	30.8	11.0	—3.4	—3.4	0.5	3.3
$\Delta C/\text{unit (all)}^\eta$	n.a.	3.0	3.0	15.2	28.3	30.7	12.2	53.9	18.2	—5.4	—5.4	0.7	5.3
$\Delta C/\text{unit (all)}^\eta$	—30.6	1.9	—11.6	0.6	16.8	17.1	—11.2	28.9	11.7	—7.2	—11.9	—6.7	11.0
$\Delta C/\text{unit (all)}^\eta$	—30.6	3.0	—10.5	6.7	28.3	29.7	—6.4	52.0	18.9	—9.2	—13.9	—6.5	13.0
1961 total C	000 tons	000 tons	000 tons	m. gals.	000 tons	m. doz.	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons
	8.3	33.0	11.7	130	3.8	63.8	42.6	29.4	63.4	196	110	432	88.2
	lbs.	lbs.	lbs.	gals.	lbs.	doz.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
C/unit 1970 C/unit	L	8.1	32.4	11.4	44.8	3.5	26.0	49.1	34.0	73.0	192	107	424
	H	5.6	33.0	10.1	45.3	4.0	30.4	43.6	43.9	81.5	178	94	395
	H	5.6	33.4	10.2	48.0	4.4	33.7	46.0	51.8	86.8	174	92	396
Total C	000 tons	000 tons	000 tons	m. gals.	000 tons	m. doz.	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons
	L	5.4	32.1	9.8	126	4.2	71.1	35.8	36.1	67.0	173	91.2	383
	H	5.4	32.5	9.9	133	4.6	78.8	37.8	42.6	71.4	169	89.2	384

SOURCE: μ (price elasticity): Table 8.
 $\Delta C/\text{unit (price)}$: from μ , Table 10 and the text.
 θ (trend elasticity): Table 8.
 $\Delta C/\text{unit (trend)}$: from θ and the text.
 $\Delta C/\text{unit (both)}$: the sum of the relevant increments, or in the case of Milk and Mutton, from Table 10 and the text.
 η (income elasticity): Table 5.

$\Delta C/\text{unit (income)}$: from η and Table 13.
 $\Delta C/\text{unit (all)}$: the sum of all increments.
1961 total C: calculated from Table 6.
C/unit: from total C and Table 12.
1970 C/unit: from the previous row and $\Delta C/\text{unit (all)}$.
Total C: from C/unit and Table 12.

NOTE: *Pigmeat*—the income elasticity used is that of Rashers.

calculations re-worked using the price elasticities of Table 8. The fact that they are based on data for consumption per head does not prevent their being used in the method of Table 14.

A comparison is made with the predictions of the F.A.O. experts in Tables 15 and 18. It should be noted, however, that the latter calculations are made on different assumptions about population and income growth (Table 16), assume constant prices, and use wider categories for food-stuffs (Table 17).

There are only five products for which I expect consumption to to increase, namely, Cheese, Eggs, Mutton, Pigmeat and Sugar; for Liquid

TABLE 15
MY FORECASTS FOR CONSUMPTION PER UNIT AND TOTAL
CONSUMPTION 1970, RELATIVE TO 1961 LEVEL

	C/Unit Index (1961=100)		C Index (1961=100)	
	(L)	(H)	(L)	(H)
Bread	93	91	88	86
Flour	88	86	83	81
Potatoes	93	94	88	89
Sugar	111	113	106	107
Creamery butter ...	102	103	97	98
Farmers' butter ...	88	90	84	85
Margarine	69	69	65	65
Liquid milk	101	107	97	102
Cheese	117	128	111	121
Beef	89	94	84	89
Mutton	129	152	123	145
Pigmeat	112	119	106	113
Eggs	117	130	111	123

SOURCE: From Table 14.

TABLE 16
THE ASSUMPTION MADE BY F.A.O. FOR FUTURE GROWTH IN IRELAND

	Compound increase per cent p.a.	
Population ...	0.0	
	(L)	(H)
Income per head ...	2.0	3.0
Total income ...	2.0	3.0

SOURCE: F.A.O. Projections Table M2.

TABLE 17

F.A.O. ESTIMATES FOR INCOME ELASTICITY OF QUANTITY DEMANDED

Cereals	...	...	...	-0.40
Sugar	...	...	...	0.10
Fats and oils*	...	...	...	0.02
Milk and products	...	...	...	-0.01
Meat	...	...	...	0.50
Eggs	...	...	...	0.40

* Includes butter.

SOURCE: F.A.O. Projections Table M4.

TABLE 18

F.A.O. FORECASTS FOR CONSUMPTION PER HEAD IN 1970, EXPRESSED AS INDICES OF THE 1958 LEVEL

	Index (1958=100)	
	(L)	(H)
Cereals	92	89
Sugar	102	103
Fats and oils*	101	101
Milk and products	100	100
Meat	112	118
Eggs	109	113

* Includes butter.

SOURCE: F.A.O. Projections Table M5.

Milk the level should remain much the same and for all others a decline is expected. The two main reasons for decline are the higher retail price in the accession to the E.E.C. and the natural tendency to eat less of the cheaper starchy foods like flour and potatoes, with increased prosperity, as has been observed in other countries. In only one case was the expected decline in population important—hence if an alternative assumption be adopted in Section IVA, say of a slight increase in population, the consumption of only one food, creamery butter would be materially affected.

The reasons for decline are as follows:

Margarine: Higher price (the only factor considered).

Creamery Butter: Fall in population.

Farmers' Butter: Negative trend.

Beef: Higher retail price.

Bread: Higher price and negative income elasticity.

Flour: Negative trend.

Potatoes: Negative trend.

It may be of interest to convert the demand measured at the retail level in wholesale units, so as to indicate the requirements in terms of agri-

culture. This has been done for seven of the foodstuffs in Table 20, using the conversions of Table 19. Since free importation from member countries will be permitted, it does not follow, of course, that these represent even the minimum supply levels for Irish farmers.

Finally, it is a simple matter to calculate the 1970 level of total expenditure on the foods listed (Table 21) and to compare it with the level in the base year.

TABLE 19

LIST OF EQUIVALENTS USED TO CONVERT RETAIL TO WHOLESALE UNITS

1 lb. Butter	=	2.36 gallons Milk
1 lb. Cheese	=	1.15 gallons Milk
1 ton Beef	=	4.69 Cattle
1 ton Mutton	=	46.30 Sheep
1 ton Pigmeat	=	14.50 Pigs
1 ton Sugar	=	7.70 tons Sugarbeet

TABLE 20

FORECAST DEMAND AT WHOLESALE LEVEL FOR CERTAIN PRODUCTS

	(L)	(H)	Units	Product
Creamery Butter ...	169	171	m. gals.	Milk
Farmers' Butter ...	51.4	52.2	m. gals.	Milk
Cheese	10.4	11.9	m. gals.	Milk
Beef	168	178	000	Cattle
Mutton	1,670	1,970	000	Sheep
Pigmeat	970	1,040	000	Pigs
Sugar	719	729	000 tons	Sugarbeet

SOURCE: Calculated from Tables 14 and 19.

NOTE: The estimate for Pigs on the optimistic hypothesis is by remarkable coincidence practically the same as the figure quoted in the official predictions! ("Second Programme", ch. 1, para. 138; "Agriculture in the Second Programme", ch. 11, page 116.)

B. Note on the Second Programme for Economic Expansion

Although the writers of the Second Programme for Economic Expansion do refer on occasion to the F.A.O. Study, their emphasis in the Report lies almost entirely on the side of Supply rather than Demand, and they do not attempt to give a quantitative estimate for the level of the demand on the home market. It is hoped that the present paper may be of assistance in filling this gap in the official projections.¹⁶

¹⁶ "Second Programme", chapter 1, paragraphs 11-13, 138, and "Agriculture in the Second Programme", chapter 2, pages 32-38; chapter 9, page 93; chapter 11, page 116 and chapter 15, page 138.

C. *Suggestions for Future Research*

Three topics seem worthy of further research:

- (a) Another attempt at measuring the seasonal pattern of demand for products like Eggs, Mutton, and Pork when improved data become available;
- (b) What qualification should be made on the estimate for income-elasticity and its effect on 1970 consumption seeing that rural households were excluded from the ambit of the Household Budget Inquiry. Presumably their income-elasticity would be lower than that for urban households; of their future decline in proportion of the total population there can be no doubt.
- (c) It would be most useful, though naturally harder, to estimate the price and income elasticities for Irish products in the principal export markets. A tentative effort made by the writer for the exports of Beef Cattle over the period 1908-60 (from all Ireland to Britain) was probably too ambitious to have succeeded. One should test, for example, whether the correlation observed for pre-war years by Keith Murray¹⁷ between stores and fat cattle still exists. His relation in terms of the feed crops in Britain is certainly no longer true.

DISCUSSION

Dr. David Simpson: I should like to join Mr. McGilvray in deeply regretting the absence of Dr. Conrad Leser this evening. The subject under discussion is one to which he has contributed much, and his comments on this occasion are badly missed.

TABLE 21
FORECAST RETAIL EXPENDITURE ON CERTAIN FOODS, 1970,
COMPARED WITH 1961 LEVEL

Food	1961	1970 (L)
	£m.	£m.
Margarine ...	1.5	1.2
Liquid Milk ...	26.0	31.5
Eggs ...	13.2	15.3
Beef ...	16.3	17.3
Mutton ...	10.7	13.6
Pigmeat ...	29.0	30.4
Bread ...	13.9	13.4
Flour ...	7.2	6.6
Total ...	117.8	129.3

SOURCE: Calculated from Tables 10 and 14.

NOTE: Only the products for which 1970 price has been forecast are included in the above.

¹⁷ Murray, K., "Factors affecting the prices of Livestock in Great Britain". Clarendon Press, Oxford, 1931.

It is with great pleasure that I second the vote of thanks to Dr. Hart for his paper. The work which he reports is interesting and valuable, and efforts in this direction cannot be too strongly supported. None of the criticisms of his paper which I have to make should be taken to detract in any way from my appreciation of his efforts.

My first comment concerns the form of function he fits to obtain his elasticity estimates. While this may be "the familiar Engel curve of classical theory", I think it is not a form which is widely used in empirical studies. In particular, I suspect that it lacks the property of additivity. I should like to ask Dr. Hart whether he would consider fitting alternative forms of the Engel function, and comparing the resulting estimates.

Secondly, there is the fundamental problem, mentioned by Mr. McGilvray, of using cross-sectionally estimated elasticities in intertemporal projections. Cross-section and time-series estimates of the income elasticity of demand are not only empirically but conceptually different. Recent work by Houthakker and Taylor has shown how intertemporal projections of consumer expenditures may be made without cross-section analysis.

There is, thirdly, the difficulty which arises when attempts are made to estimate a demand curve from time-series data. This is illustrated clearly in Fig. 5 of Dr. Hart's paper, which shows the quantities and prices of beef sold over the period 1947-64. In order to fit the demand curve—in this case a power function whose index is the price elasticity to be estimated—it is necessary to assume that the curve has not shifted throughout the 17-year period, and that the scatter of observed points has been generated solely by shifts in the supply curve plus errors. Taking Dr. Hart's estimate of the income elasticity of demand for beef (Table 5), and assuming a 30 per cent increase in income in the period, however, it is clear that each point on the demand curve would have shifted upwards by 9 per cent.

This difficulty is not peculiar to Dr. Hart's paper, but it illustrates the care which must be taken in attempting empirical estimates of price elasticities from time-series data.

Finally, I did not notice that the standard errors were shown for the parameters estimated by Dr. Hart. Will he tell us how many of his estimates of income elasticity and price elasticity are significant?

In conclusion, may I congratulate Dr. Hart on the ingenuity of his methods of projection, and thank him once more for his efforts.

Dr. Hart: I wish to thank all those who contributed to the discussion, and will reply in order to the different points raised. It is true of course that the (double-logarithmic) Engel curve is not additive, as is the semi-logarithmic, but this was not a practical consideration in my analysis—it was chosen because of my conviction that over the total period the elasticity could be assumed constant. (Mr. Donal Murphy has compared the fit from alternative forms in his recent thesis on the Household Budget Inquiry). The standard errors of the price elasticities are to be found in Table 8; those for income were not calculated because of the limited computing facilities available at that particular time.

There was no evidence in the time series analysis of much substitution between the different meats, as suggested by Dr. Smith, e.g. a rise in the relative price of mutton to beef does not affect consumption of the latter; hence I omitted these cross-effects as calculated from Table 8. Regarding the possible existence of trend in Figure 5, this was not very marked, as may be seen by marking in dates next to the points (from Tables 6 and 7). I cannot agree with him on the validity of the inter-country comparisons in which overall elasticity of the demand for food is related to the level of national income (as published in the F.A.O. for example) since there is no common method in each country for computing these, and even if there were, one cannot argue that Ireland will follow the example of more prosperous countries (and India that of Ireland) as if these were homogeneous data.

In reply to Dr. MacCarthy, it is true that my population projections are somewhat pessimistic—the difficulty of there being no breakdown by age group in the population for intercensal years led me to make the simplest assumption possible. Mr. Linehan suggested that I apply the method of the paper to forecasting, with reference to the 1951 base-level, the size of demand in 1961 and compare the estimate with actual experience. I have done this for Liquid Milk, using the data of Tables 1, 5, 7, 8, 11 and 13 to forecast an increase of 31.2 per cent in consumption per unit over that decade, i.e. from 34.9 to 45.8 gallons—whereas actual consumption in 1961 was 44.8; so for this example, the method is highly successful, with an error of only 2 per cent!

In reply to Mr. J. F. Donovan, changes in marketing methods such as the promotion campaign of the Pigs and Bacon Commission were not taken into account in the forecasting method, nor is this the practice in any models used in the United States or Britain that I have seen—since the projections are made in quantity rather than money terms, this factor would not matter as much as the economic variables.

Finally, I wish to defend the techniques of regression analysis in spite of Dr. O'Connor's comments. It is true that it cannot foresee the effects of possible changes in technology and State policy in the future—but it can of course do so in the past (by means of dummy variables); and at least the latter is unlikely to be a stumbling block in the case of forecasting the demand for Irish foodstuffs, since the last Consumer subsidy ceased in 1952 and is unlikely to be re-introduced.

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ERRATUM TO 1964/65 JOURNAL

The following corrections should be made to "Input-Output Table for 1956"; facing page 64 of the 1964/65 *Journal*, Vol. XXI, part III.

<i>Row</i>	<i>Column</i>	<i>Printed figure</i>	<i>Correct figure</i>
25	10	0.135	0.138
Total Interindustry Input	18	2.725	2.925
24	25	0.672	1.672
Wages, etc.	30	20.205	20.275
Total Primary Input	31	9.351	9.381
10	44	32.034	32.084