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ESTIMATING QUARTERLY NATIONAL ACCOUNTS

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INTRODUCTION

This paper contains estimates of quarterly national accounts for Ireland for the period 1963 to 1977. It summarises the work in this area so far completed in the Research Department in the Central Bank of Ireland. In the first section of the paper is a brief summary of the historical development of national accounts and the reasons for estimating quarterly accounts. Section 2 outlines some of the shortcomings in estimating the accounts. Section 3 proposes an estimation method which involves the use of indicator variables, lists quarterly national accounts variables in order of priority of need and then discusses the derivation of indicator variables for the national accounts variables. Section 4 discusses the results of estimating the main aggregates which are shown in Appendix 3. Section 5 contains a short evaluation of the estimates, proposes the direction of future work and discusses immediate uses to which the national accounts estimates will be put.

1. HISTORICAL DEVELOPMENT OF, AND REASONS FOR ESTIMATING, QUARTERLY NATIONAL ACCOUNTS

Historical Development

The United States (US) began to produce official quarterly accounts on a regular and systematic basis in 1942, although there were previous unofficial annual accounts produced. They were first published in the Survey of Current Business, August 1942, by the Bureau of Foreign and Domestic Commerce. Developments in the United States since 1942 can be characterised by refinements in definitions and presentation. It is interesting to note that the United States first published accounts on a quarterly basis and there was no intermediate stage where they produced annual accounts. Canada began to publish quarterly accounts in 1953. In 1957 and 1958 the United Kingdom and Japan, respectively, began publishing quarterly accounts, although the United Kingdom had been publishing a series for consumers' expenditure for ten years before this. In 1965 Norway began to publish and in the same year West Germany began to publish half-yearly accounts officially, although in West Germany's case unofficial estimates had been published by the Berlin Institute since 1950. At present, the following OECD countries produce quarterly accounts: Canada; Italy; Finland; Sweden; United Kingdom; United States; West Germany; Austria; and Australia.

Prior to the official estimates for Ireland, private estimates for annual national accounts were compiled by Dr T. J. Kiernan for 1926. Others were made by Professor Duncan for 1929 and some later years. The first official annual national accounts'

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estimates for Ireland were published in a white paper in 1946 and covered the years 1938 to 1944. A second set was published in 1951, also in a white paper, and covered the years 1938 and 1944 to 1950. Thereafter, official estimates were published with other data in the Irish Statistical Survey. This was re-named National Income and Expenditure in 1959 and the contents were slightly modified. National Income and Expenditure continues to be published today. In 1969, official estimates were revised back to 1947. The 1976 National Income and Expenditure included national accounts from 1970 to 1976 on the new European System of Accounts (ESA)[1] basis. At the moment, a full set of annual national accounts data on the new ESA basis are available from 1960 to 1979[2], the 1960 to 1970 data being published for the first time in 1977. Some limited data are available in Department of Finance, *Review and Outlook for 1980.* People deserving particular mention during the period since the 1940s include Dr R. C. Geary, who was involved in the initial development of Irish National Accounts - see, for instance, Geary (1944) and Dr M. D. McCarthy who, as chairman of the United Nations (UN) Statistical Commission, was also involved in the revision of the UN System of National Accounts. Some quarterly national accounts estimates were produced by Stronge (1972) and quarterly income data were produced by McAleese (1970) for import elasticities. There are no immediate plans by the Irish Central Statistics Office to produce quarterly accounts.

Reasons for Estimating Quarterly National Accounts

The arguments for producing annual national accounts have been given elsewhere and will be dealt with very briefly here. (See, for example, US Bureau of Economic Analysis (1976).) Many of the variables used in economic theory have their measured counterparts in the national accounts, and whereas theoretical models have their uses in giving the signs and, in some cases, the orders of magnitudes of parameters, the national accounts will contribute in the estimation of the values of these parameters and thus of the models. Estimated models have two main uses: first they allow for the testing of theories, and second they allow for policy simulation and forecasting.

At the moment, national accounts are available on an annual basis. The last, though incomplete, set of published national accounts are for 1980. Institutions such as The Economic and Social Research Institute, the Central Bank and the Department of Finance are attempting to discover what is happening in the economy in 1981 and also what is going to happen in 1982. To do this, they are using within-year information on variables such as retail sales, cement sales, houses completed, exports and imports, etc. Using this information, they update their previous estimates of national accounts variables, consumption, investment, exports and imports, etc. In effect, they are estimating partial national accounts for sub-annual periods and projecting their estimates to the end of the year, given certain assumptions, exogenous information and implicit models of the economy which remain unwritten, differ for different institutions and vary over time.

The whole exercise described above is informal, in the sense that no relationship has been estimated between the annual national accounts and the partial indicators for sub-periods. Estimating quarterly national accounts might first formalise the above exercise and could then be used to estimate a quarterly model of the economy.

The following are some reasons why a quarterly model is more desirable than an annual one. Most econometric models are short-term. It could be argued that annual data would not capture short-term effects. In particular, monetary orientated models are usually more meaningful when estimated quarterly, since disequilibrium in the monetary sector tends to work itself out in a shorter time period than a year. Hence, for example, annual data convey little information about the transmission mechanism of credit policy. Another reason is that the relevant monetary variables are available at least quarterly so there is a great loss of information in the monetary sector, if annual information is used

to estimate it. A quarterly model has four times the number of observations as an annual one. This improves the degrees of freedom problem, though not by a factor of four. (Additional parameters for seasonality and autocorrelation have to be estimated.) This is very important in the case of Irish econometric models where, at the moment, only 19 useful observations are available on an annual basis.

2. SOME SHORTCOMINGS IN ESTIMATING QUARTERLY NATIONAL ACCOUNTS

The shortcomings of estimating national accounts at all are numerous: see, for instance, Jazi (1963) and Broderick (1968). This paper deals only with the problems which are caused by the fact that we are dealing with accounts on a sub-annual basis. The shortcomings can be divided into two broad sets.

The first set which is discussed below embraces those which arise because data are being produced on a sub-annual basis. The second set relates to the paucity of information that is available for Ireland on a quarterly basis, and how this information can be used to estimate quarterly accounts. This is discussed in Section 3.

Timing problems may occur because:

(i) transactions are recorded at different times in different books;
(ii) transactions may be recorded on a payments rather than on an accruals basis.

The fact that goods may be in transit and thus not be recorded as received by the purchaser while they are recorded as having been sent by the sender is a problem which increases the shorter the time period taken. This is why the problem is much more serious for quarterly than for annual data, since the goods in transit are a greater proportion of total transactions on a quarterly basis.

In the accruals *versus* payments case, the principles of national accounting would demand that an accruals method of recording should be used, though some countries still use payments, and they are used in part of the Irish national accounts; for instance, government expenditure data in the Irish national accounts are on a payments basis. The longer the time period taken the smaller is the proportional discrepancy between the payments and accruals figures. This is why it is felt that the problem is not that important in annual data.

The Valuation of Agricultural Output

Problems arise in national accounting when the production cycle becomes longer than the period of the national accounts. These problems would be most evident in the case of agricultural output; in particular, crops output and cattle output. The problem reduces to one of valuing work in progress which, in turn, reduces to trying to determine how much of the margin between sales and cost of sales should be allocated to a farmer's labour costs and how much to profit. Once the allocation is made, the labour costs are added to the rest of work in progress in the quarter in which the costs are incurred while the profit is allocated to the quarter in which the sale is made. The problem of allocation is particularly difficult in the case of the farmer who is both a worker and an entrepreneur.

If the practical problem of allocation can be solved, no theoretical problem remains. However, having said this, it is still questionable as to what use can be made of the quarterly data on agricultural output since it has been argued that the decision-making process depends on annual and not quarterly data. However, this argument could not be made for all variables. As has already been argued in Section 1, the effects of credit policy are at a much shorter periodicity than a year. Also, industrialised countries produce quarterly accounts because decisions in the industrial sector are based on sub-annual data. As Ireland is becoming more industrialised, the argument for producing quarterly accounts

becomes stronger.

Seasonality

Most economic time series that are available on a quarterly basis contain an element of seasonality. The question arises as to whether quarterly accounts should be estimated, including or excluding the seasonal element. One of the reasons for this question is that when making up the national accounts variables, some of the elements have to be interpolated using annual data and thus do not contain the seasonal element. The argument is thus made that to add up things consistently, all the other elements should exclude seasonality and this is the way the series should be produced. It is the author's opinion that it is wrong to do this since there is a danger that elements of the series other than seasonality might be lost. Leaving the seasonal element in may also give some extra information of the relationships between series. For these reasons, it may be better to wait until modelling the relationships before trying to model specifically for seasonality.

As has been stated, the shortcomings mentioned above, especially the first two, would be present no matter how great the information set. The shorter the period covered, the greater the proportion the value of stocks and work in progress to the total flow, and also the greater the problem would be where recording is on a payments, rather than an accruals, basis. Nothing much can be done about these problems at present, in the case of Ireland. Also, countries still find it worthwhile to produce quarterly accounts despite these shortcomings being present.

3. QUARTERLY ACCOUNTS ESTIMATES

This section first discusses the general problem of estimation given a set of indicator variables to which national accounts variables are related. It then proceeds to identify which quarterly national accounts variables are most likely to be needed first. Finally, indicators are derived for these variables.

The Problem of Estimation

The national accounts variables on an annual basis are available from 1960, in both current and constant terms on the new (ESA) basis, in the publication *National Income and Expenditure 1977* (CSO) - henceforth called NIE. The estimates of quarterly national accounts included in this paper will be consistent with the annual values published in NIE. That is, the annual data will be used as a bench mark for the quarterly data: the quarterly estimates will sum to the annual values and the quarterly changes in stocks will sum to the annual changes in stocks. Using the annual data as a bench mark assumes that the annual data are more accurate than the quarterly estimates. Of course, when revisions occur in the annual data, which is very likely, especially in the case of more recent data, corresponding revisions will have to be made to the quarterly accounts.

As was stated earlier in setting out reasons for estimating quarterly accounts, indicators have been used informally up to now. By using annual data as a bench mark, extra information is being added to the indicators. How this information can best be grafted onto the indicators to produce quarterly accounts is discussed below. Using the annual data as a bench mark does not assume that the annual data is census information which, in a lot of cases, it is not. It only assumes that the annual information is more accurate than quarterly. Even when annual accounts are being prepared, more accurate information of greater periodicity than a year can be used to correct annual estimates. The process of tying more accurate information to less accurate information is a general practice in estimating national accounts - see, for example, US Bureau of Economic Analysis (1976). The method of tying this information differs from country to country.

However, the method described below, and used in this paper, has the advantage of being set out explicitly and has some desirable properties.

The general methodology used is described in detail in O'Reilly (1975) and may be summarised as follows: for most national accounts variables (Z) information is available on a quarterly basis in the form of indicator variables (W). It has been shown in Chow and Lin (1971) that best linear unbiased estimates (BLUE) of the quarterly national accounts variables, using indicator variables, can be obtained by regression methods.

Chow and Lin postulate the following relationship

$$Z = W\beta + U \tag{1}$$

where Z is a 4n x 1 unknown vector of national accounts variables
W is a 4n x p known matrix of indicator variables
U is a random vector with unknown covariance matrix V
(i.e., $E(UU') = V$)
β is a p x 1 vector of unknown parameters.

Let D = $\begin{bmatrix} 1111 & 0000 \ldots\ldots & 0000 \\ 0000 & 1111 \ldots\ldots & 0000 \\ \vdots & \vdots & \vdots \\ 0000 & 0000 \ldots\ldots & 1111 \end{bmatrix}$

be an n x 4n matrix of ones and zeros as set out. Then[3]

$$Z^a = DZ = DW\beta + DU = W^a\beta + U^a \tag{2}$$

and $E(U^aU^{a'}) = D\,V\,D'$.

Let A be a 4n x n matrix; then a linear estimator of Z say $\hat{Z}$ is:

$$\hat{Z} = ADZ = AZ^a = AW^a\beta + U^a. \tag{3}$$

In order that the linear estimate be unbiassed the following condition must hold

$$E(\hat{Z} - Z) = 0 = E[A(W^a\beta + U^a) - (W\beta + U)] \tag{4a}$$

$$\rightarrow AW^a - W = 0 \text{ and } \hat{Z} - Z = AU^a - U$$

$$\rightarrow COV(\hat{Z} - Z) = E(AU^a U)\,(AU^a - U)'$$

$$= AV^{aa}A' - AV^{ao} - V^{oa}A' + V \tag{4b}$$

where $V^{aa} = EU^aU^{a'}$; $V^{ao} = EU^aU'$; $V^{oa} = E(UU^{a'})$.

To find the BLUE $\hat{Z}$ we minimise the trace of (4b) with respect to A subject to $AW^a - W = 0$.

It can be shown that the resulting estimator is:

$$\hat{Z} = W\hat{\beta} + (V^{oa}V^{aa})^{-1}\hat{U}^a \tag{5}$$

where $\hat{\beta} = (W^{a'}V^{aa-1}W^a)^{-1}\,W^{a'}\,V^{aa-1}Z^a$

and $\hat{U}^a = Z^a - W^a\hat{\beta}$.

As can be seen, the estimate in (5) consists of two components, the $W\hat{\beta}$ where $\hat{\beta}$ is the generalised least squares estimator of β on an annual basis and $(V^{oa}V^{aa})^{-1}\hat{U}^a$ is the distribution of the annual residual accross the quarters. If the vector U has a $\sigma^2 I$ covariance matrix then it can be shown that the BLUE for the quarterly values for $\hat{Z}$ is:

$$\hat{Z} = W\hat{\beta} + \hat{U} \tag{6}$$

where $\hat{U}$ is .25 times the annual error estimated using ordinary least squares regression with annual observations, and β is the least squares estimation of $\hat{\beta}$ using annual observations Z^a and W^a.

If the variance-covariance matrix of U is not $\sigma^2 I$ then it is impossible to obtain a BLUE for $\hat{Z}$ since it requires knowledge of V which is not available. Estimates of V may be obtained on making simplifying assumptions about its structure. This would involve assuming simple heteroscedasticity and autocorrelation structures for V. This was not done this time when estimating quarterly values for $\hat{Z}$. Instead, the following procedure is followed. A discussion of the procedure and why it was adopted follows its description.

It is proposed that if indicators (W) exist, the four quarterly values for the indicators are added together in the case of flow data. Let us call the annualised indicator matrix W^a. This annualised matrix is regressed against Z^a using ordinary least squares and the following estimated equation results:

$$Z^a = W^a\hat{\beta} + \hat{U}^a. \tag{7}$$

If the $\hat{U}^a$ are shown to be first-order autocorrelated (using the Durbin-Watson (DW) statistic) the residuals are interpolated using the Boot, Feibes and Lisman (1967)[4] methods (BFL method) producing a $\hat{U}$ series on a quarterly basis. If the series were not shown to be autocorrelated the $\hat{U}$ series is produced by dividing $\hat{U}^a$ by four for the year in question. The estimated quarterly values for Z are thus obtained by

$$\hat{Z}_{tj} = W_{tj}\hat{\beta} + \hat{U}_{tj}. \tag{8}$$

$t = 1, N$ where N is the number of years

$j = 1, 4$ relates to the quarters in year t

The four quarterly values for $\hat{U}$ series add to the $\hat{U}^a$ for any particular year - this is ensured in the methodology underlying the BFL method. This in turn ensures that the quarterly values of $\hat{Z}$ add to the annual values Z^a.

Where no quarterly information is available this means that, by definition

$$Z^a = U^a$$

and U is then estimated by the BFL interpolation method.

The BFL method is a general method of distributing the annual series across the year when there is evidence that V does not have a simple homoskedastic and non-autocorrelated structure. When the DW statistic indicates that the annual residuals are not first-order autocorrelated, BLUE estimates are provided on the assumption that U is spherical.

To elucidate further on the technique used, the following is an example of how the annual national accounts variable for the value of taxes on expenditure (TXEXVA) was estimated on a quarterly basis (TXEXV). One quarterly indicator was devised[5] for this variable (ITXEXV). This variable was annualised by adding together the four quarters (ITXEXVA) and then regressed against the national accounts variable TXEXVA. The following was the result:

$$\text{TXEXVA} = 15.075 + 1.1834\text{ITXEXVA} + \hat{U}^a. \tag{9}$$

$$(4.2)^6 \qquad (129.7)$$

$$R^2 = .999 \qquad DW = 1.35$$

Since the DW statistic is in the doubtful region, it was decided to derive the quarterly value for $\hat{U}$ by using the BFL interpolation technique on $\hat{U}^a$. Thus the quarterly value TXEXV was estimated as follows:

$$\text{TXEXV} = 15.073/4 + 1.1834\text{ITXEXV} + \hat{U}. \tag{10}$$

It can be seen from the above result that although the annual national accounts value

is a bench mark, we can still evaluate how well the indicator performs in predicting TXEXV, at least on an annual basis. The R^2 statistic indicates the size of annual errors and the t statistics indicate the usefulness of the indicator. Using the annual error the quarterly values will be corrected to agree with the annual total. The less the degree of correction for error needed the better the indicator. How various indicators perform is discussed in the results section of the paper. The assumptions underlying the use of the indicators is that the behaviour of the relationship between the indicator and the national accounts variable is no different on a quarterly basis than it is on an annual. The indicators have been picked in most cases on the basis of part-whole relationships. For example, retail sales should be a subset of total consumers' expenditure. No attempt has been made to use leading indicators and causal relationships have been avoided. Because of this, the stability of the relationship whether quarterly or annual, depends very much on whether the balance of the national accounts variable - not covered by the indicator - does or does not behave in a radically different way on a quarterly basis than it does annually. The estimates, when the full Chow and Lin method is applied, will be asymptotically unbiased and will be the best *linear* estimate. Better non-linear estimates may exist but no further investigation is made in this paper of non-linear estimation techniques.

Since we are talking about part-whole relationships, it seems reasonable to assume that linear estimates would be adequate. The properties of the estimates while the BFL method of distribution of the errors is being used are unclear. The assumptions in using the BFL method are that the errors can be fitted to a polynomial of a degree two or less and the parameters of the polynomial are estimated using the data in hand. As has been stated, the method is not completely consistent with the Chow and Lin method since it does not explicitly take account of the structure of the V matrix; also OLS estimates are used for $\hat{\beta}$. On the other hand, it is very hard to see how assumptions can be made about the V matrix without quarterly data. Also, the BFL method is easier to operationalise. Perhaps evidence from OLS annual residuals on both heteroscedasticity and autocorrelation could be used to build up a structure for V and a generalised least squares estimate could be obtained. The author is working on a computer program which will estimate quarterly accounts using the general Chow and Lin method. The residual vector will be assumed to have an ARMA - Box Jenkins (1970) - type structure and if no information is available in the form of indicators, a polynomial of up to the third degree will be fitted to the data again assuming an ARMA type structure for the residuals. When this program is in operation, it will be necessary only to feed in the total matrix of indicator variables and the program will output the quarterly accounts. However, for the present the regression/BFL method is used.

National Accounts Variables to be Estimated

Before a list of national accounts variables can be derived, the uses to which these variables are to be put have to be taken into account. The main uses cited in Section 1 were: model building and current analysis and forecasting in the economy.

An outline model of the expenditure side of the economy is specified in Appendix 1. Specifying a model of the economy is useful, not only in setting priorities as to what variables are necessary for estimating a model, but the same variables would also be used extensively in current analysis and forecasting in the economy since the institutions involved in this area would be implicitly doing the analysis within the framework of model specified in terms of national accounts variables.

Only the expenditure side of the model is specified for the moment since indicators are more readily available on this side. The definitions of the national accounts variables correspond to annual national accounts counterparts. Where a national accounts variable is defined, the number of the item in NIE is given in brackets. The behavioural equations in the appendix are shown in general functional form. It is not considered necessary to go

into too much detail concerning the structure of the model since it is used only as a guide to what national accounts variables are to be estimated. A full model when it is estimated could include simultaneous relationships, other exogenous variables and will give specific detail on dynamic relationships.

On examining the model, it can be seen that the following national accounts variables need to be estimated. The variables correspond to Tables A5, A6, A8 and portions of Tables A11, A12 and A25 of NIE. As can be seen from the list, the expenditure approach is adopted as the method of estimation[7].

National Accounts Variables to be Estimated[8]

Consumption Variables

CNDV	:	the value of consumption of non-durable goods (NIE, items 1-5, 8; Table A11)
CDV	:	the value of consumption of durable goods (NIE, items 6, 7; Table A11)
COV	:	the value of other consumption (NIE, item 55 *less* CNDV *less* CDV)
CV	:	the value of total consumption (NIE, item 55)
CND	:	the volume of consumption of non-durable goods (NIE, items 1, 5, 8; Table A12)
CD	:	the volume of consumption of durable goods (NIE, items 6, 7; Table A12)
CO	:	the volume of other consumption (NIE, item 64 *less* CND *less* CD)
C	:	the volume of total consumption (NIE, item 64)

Investment Variables

KDV	:	the value of investment in dwellings (NIE, item 1, Table A13)
KRV	:	the value of investment in roads (NIE, item 2, Table A13)
KOBV	:	the value of investment in other building and construction (NIE, item 3, Table A13)
KTAV	:	the value of investment in agricultural machinery and transport equipment (NIE, items 4, 5, Table A13)
KOV	:	the value of total investment *less* investment in machinery and equipment (NIE, item 57 *less* KOMV)
KOMV	:	the value of investment in other machinery and equipment (NIE, item 6; Table A13)
KV	:	the value of total investment (NIE, item 57)
KOM	:	the volume of investment in other machinery and equipment (NIE, item 6, Table A14)
KO	:	the volume of total investment *less* other machinery and equipment (NIE, item 66 *less* KOM)

K : the volume of total investment (NIE, item 66)

Government Expenditure

GOVV : the value of current government expenditure (NIE, item 56)

GOV : the volume of current government expenditure (NIE, item 65)

Exports of Goods and Services

XV : the value of merchandise exports (NIE, item 1, Table A25 - credit)

XSV : the value of exports of services (NIE, item 59 *less* XV)

TOTXV : the value of exports of goods and services (NIE, item 59)

X : the volume of merchandise exports (XV deflated by unit value index for exports)

XS : the volume of exports of services (NIE, item 68 *less* X)

TOTX : the volume of exports of goods and services (NIE, item 68)

Imports of Goods and Services

IMV : the value of merchandise imports (NIE, item 1, Table A25 -debit)

IMSV : the value of imports of services (NIE, item 60 *less* IMV)

TOTIMV : the value of imports of goods and services (NIE, item 60)

IM : the volume of merchandise imports (IMV deflated by the import unit value index)

IMS : the volume of imports of services (NIE, item 69 *less* IM)

TOTIM : the volume of imports of goods and services (NIE, item 69)

Changes in Stocks

STKV : the value of physical changes in stocks (NIE, item 58)

STK : the volume of physical changes in stocks (NIE, item 67)

Net Factor Income from Abroad

NFIV : the value of net factor income from abroad (NIE, item 62)

NFI : the volume of net factor income from abroad (NIE, item 71)

Expenditure on GNP

YV	:	the value of expenditure on gross national product (NIE, item 63)
Y	:	the volume of expenditure on gross national product (NIE, item 72)

Disposable Income

TXEXV	:	the value of taxes on expenditure (NIE, item 26)
CGEECV	:	the value of Central Government *plus* EEC subsidies (NIE, item 30; Table A19)
OSUBSV	:	the value of other subsidies (NIE, item 27 *less* CGEECS)
SUV	:	the value of total subsidies (NIE, item 27)
DEPV	:	the value of provision for depreciation (NIE, item 24)
STKAPV	:	the value of adjustment for stock appreciation (NIE, item 21)
GTIIV	:	the value of government trading and investment income (NIE, item 85)
NDIV	:	the value of national debt interest (NIE, item 86)
CGTIV	:	the value of central government transfer payments (NIE, item 145)
OTIIV	:	the value of other transfer income (NIE, item 87 *less* CGTIV)
TIV	:	the value of transfer income (NIE, item 87)
UPRV	:	the value of undistributed profits (NIE, item 89)
TIMSV	:	the value of taxes on income and wealth *less* social insurance contributions (NIE, item 92 *less* item 7; Table A18)
SIV	:	the value of social insurance contributions (NIE, item 7; Table A18)
TPYV	:	the value of taxes on personal income and wealth (NIE, item 92)
YDV	:	the value of disposable income (NIE, item 90 *less* NIE, item 92)
YNSV	:	the value of GNP less stocks (NIE, item 63 *less* item 58)

Other Variables Not Estimated Here But Which Are Needed For A Quarterly Model

XM	:	the volume of exports of manufactured goods (SITC 5 - 8, Trade Statistics of Ireland). The volume is obtained by deflating the value by the unit value index for manufactured goods
XO	:	X - XM
XMV	:	the value of manufactured goods (SITC 5 - 8, Trade Statistics of Ireland)
XOV	:	XV - XMV

IMM	:	the volume of imports of manufactured goods (SITC 5 - 8, Trade Statistics of Ireland). The volume is obtained by deflating the value by the unit value index for manufactured goods
IMMO	:	IM - IMM
IMMV	:	the value of imports of manufactured goods
IMOV	:	IMV - IMMV
YM	:	income from manufacturing (output in manufacturing used as a proxy)
M3	:	money supply
R	:	prime interest rate
IDA	:	IDA grants
DCR	:	domestic credit
E	:	exchange rate
γ_i	:	final demand weights

Deriving Indicator Variables

Listed below are the indicators derived to estimate the various national accounts variables. Where BFL appears opposite a national accounts variable it denotes that no information was readily available and the BFL interpolation technique was used. Other quarterly national accounts are obtained by aggregation or as a residual. This is denoted by setting out the national accounts identity by which it was derived.

Appendix 2 lists the sources and methods in deriving the indicators. Three technical papers have already been written in deriving them: O'Reilly (1980a); O'Reilly (1980b); and O'Reilly (1981). This Appendix therefore does not go into the estimation of the indicators in depth but only gives a flavour of the problems involved.

By examining the list it should be clear why indicators were chosen. As can be seen, most gaps in information occur in the components of disposable income, undistributed profits being the most important category without information. Indicators for disposable income need to be obtained if quarterly national accounts are to be improved. Obtaining indicators for changes in stocks was also a difficult task. Attempts were made to devise indicators using half-yearly agricultural stocks information and CII/ESRI industrial surveys. However, regression results using these indicators were not very good. Because of this, more indirect information on milk delivered to creameries, cattle exports and imports of materials for further production had to be used. Section 4 discusses how the indicators performed.

National Accounts Variable

Consumption		*Indicator*
CNDV	:	(CDV + CNDV) - CDV
CDV	:	The Index of Value of Retail Sales for Consumer Durable Goods (RETCDV)
COV	:	BFL
CV	:	CNDV + CDV + COV
CND	:	(CD + CND) - CD
CD	:	The Index of Volume of Retail Sales of Consumer Durable Goods (RETCD)
(CD + CND)	:	The Index of Volume of Retail Sales - All Businesses Combined (RET)
CO	:	BFL
C	:	CND + CD + CO

Investment

KDV	:	The Value of Dwellings Completed (HV)
KRV	:	BFL
KOBV	:	The Value of Cement Sales (CEMV)
KTAV	:	BFL Seasonal Factors for KOMV (SKOMV)
KOV	:	KDV + KRV + KOBV + KTAV
KOMV	:	The Value of Production of Machinery and Equipment (QV) The Value of Changes in Stocks of Home Production of Other Machinery and Equipment (DELSTV) The Value of Exports of Other Machinery and Equipment (XMACHV) The Value of Imports of Other Machinery and Equipment (MMACHV)
KV	:	KOV + KOMV
KO	:	The Volume of Cement Sales (CEM) The Number of Dwellings Completed (H)
KOM	:	The Volume of Production of Machinery and Equipment (QV) The Volume of Changes in Stocks of Machinery and Equipment (DELST) The Volume of Exports of Machinery and Equipment (XMACH) The Volume of Imports of Machinery and Equipment (MMACH)
K	:	KO + KOM

Government Expenditure

GOVV	:	Indicator for the Value of Central Government Wages, Salaries and Pensions (GSALV) Indicator for the Value of Other Current Payments by Central Government (GOCPV) Indicator for the Value of Central-Government Transfers to Local Authorities (GLATV)
GOVV	:	Indicator for the Volume of Central Government Wages, Salaries and Pensions (GSALV) Indicator for the Volume of Other Current Payments of Central Government (GOCP) Indicator for the Volume of Central Government Transfers to Local Authorities (GLAT)

Exports of Goods and Services

XV	:	The Value of Total Merchandise Exports (XV)
XSV	:	XV The Value of Receipts of Hotels and Guest Houses for non-Residents (HGV)
TOTXV	:	XV + XSV
X	:	The Volume of Total Merchandise Exports (X)
XS	:	X The Volume of Receipts of Hotels and Guest Houses for non-Residents (HG)
TOTX	:	X + XS

Imports of Goods and Services

IMV	:	The Value of Merchandise Imports (IMV)
IMSV	:	IMV
TOTIMV	:	IMV + IMSV
IM	:	The Volume of Merchandise Imports (IM)
IMS	:	BFL
TOTIM	:	IM + IMS

Changes in Stocks

STKV	:	The Value of Changes in Cow Numbers (DELCOV) The Value of Imports of Materials for Further Production (IFPSV) The Value of Cattle Slaughtered at Meat Export Premises (TCTSV)
STK	:	The Volume of Changes in Cow Numbers (DELCO) The Volume of Imports of Materials for Industry (IFPS) The Volume of Cattle Slaughtered at Meat Export Premises (TCTS)

Net Factor Income

NFIV	:	BFL
NFI	:	BFL

Remainder of the Value of Disposable Income

TXEXV	:	The Value Indicator for Taxes on Expenditure (ITXEXV)
CGEECSV	:	The Value Indicator for Central Government plus EEC Subsidies (IECGSUV)
OSUBS	:	BFL
DEP	:	BFL
STKAP	:	BFL
GTII	:	BFL
NDI	:	BFL
CGTIV	:	The Value Indicator for Central Government Transfer Payments (ICGTIV)
TIMSV	:	The Value Indicator for Taxes on Personal Income and Wealth *less* Social Insurance Contributions (ITIMSV)
OTIIV	:	BFL
UPRV	:	BFL
SIV	:	The Value Indicator for Social Insurance Contributions (ISIV)

Results

Table 1 below summarises the regression results using the indicators. Except for notable exceptions, where indicators were used the regression results were very good, showing high t values and high R^2 statistics. One notable exception was Government Expenditure where the indicators performed very badly, having consistently low t values. A lot more work would have to be done before satisfactory indicators are derived for this variable.

The Volume of Exports and Imports of Services still require more indicators, Imports of Services having to be completely interpolated and Exports of Services only having an R^2 of .2. However, the relative size of these variables (i.e., XS and IMS) is small and more urgent data priorities are evident in other areas.

TABLE 1: Results of Regressing Annual National Accounts on Annual Indicators

National Accounts Variable	Indicators	t values*	R^2	DW
CNDV + CDV	RETV	239.5	1.00	1.42
CDV	RETCDV	38.9	.99	.83
CND + CD	RET	23.8	.97	1.25
CD	RETCD	8.7	.82	.23
KDV	HV	60.2	1.00	2.50
KOBV	CEMV	30.3	.99	2.39
KOMV	QV, DELSTV, XMACHV, MMACHV	-2.5, 1.7, 12.4, 13.9	1.00	2.00
KO	CEM, H	6.2, -2.1	.89	1.36
KOM	Q, DELST, XMACH, MMACH	-1.9, .1, 5.5, 8.6	1.00	1.41
GOVV	GSALV, GOCPV, GLATV	2.8, -1.2, .9	.99	1.37
GOV	GSAL, GOCP, GLAT	.8, 1.1, 1.9	.96	1.30
XSV	XV, HGV	.7, 1.9	.84	2.29
XS	X, HG	-.1, 2.3	.23	1.60
IMSV	IMV	14.1	.93	1.32
STKV	DELCOV, IFPSV, TCTSV	-0.4, 6.0, -4.7	.79	1.16
STK	DELCO, IFPS, TCTS	2.1, 6.1, -4.5	.70	2.01
TXEXV	ITXEX	129.7	1.00	1.35
CGEECSV	IECGSUV	41.7	.99	.53
CGTIV	ICGTIV	47.0	.99	2.49
TIMSV	ITIMSV	46.2	.99	1.93
SIV	ISIV	35.8	.99	1.06

* The t values are listed across the page in the same order as the indicators. Thus the t value for QV is -2.5, DELSTKV is 1.7 etc.

One such case is the performance of the indicators for changes in stocks, the R^2 statistics being .8 and .7 for current and constant prices, respectively. This is worrying from the point of view of modelling stocks on a quarterly basis since this is one variable whose variation is most important to measure as it plays a much more important part in a quarterly model than it does in an annual one. More work on its measurement would be well worthwhile. Also, the breakdown between industrial, agricultural and intervention stocks would be very useful.

Of course, in assessing priorities for future work, it is not enough to look at the R^2 statistic for national accounts variables for which indicators are available but also one has to examine the other variables for which no indicators are available. A full evaluation is given in the following section.

Appendix 3 lists quarterly data for a selection of national accounts variables listed in Section 3. A full set of the national accounts variables estimated is provided in the Annex. The data is available from 1963 to 1977. A table is presented for each variable. At the head of each table the mnemonic of the variable is first given, then a title of the variable is given followed by the equation used to estimate the variable on a quarterly basis. Finally, some regression statistics are put at the head of the table - the R^2 statistic, t values on the coefficients of the indicator and finally the Durbin-Watson statistic. As has already been stated in Section 3, when the DW values indicate first-order autocorrelation the residuals of the regression are distributed using the BFL method, when it does not, the residuals are spread evenly over the year.

Graphs of the main aggregates of GNP in current and constant prices and a graph of disposable income in current and constant prices is shown below. The most notable feature of the graphs is the high degree of seasonality in all the components which is carried through to total GNP. There is also a high degree of seasonality in disposable income. Another feature worth mentioning is the high degree of variability of the stocks series which again adds to worries about its reliability although it must be said that stocks are highly variable, by their very nature, and portray this feature, not only on a quarterly basis, but also on an annual one.

5. EVALUATION, DIRECTION OF FUTURE WORK AND IMMEDIATE USES

Taking into account the regression results and gaps in information, the variables which are most unsatisfactory are Government Expenditure, Exports and Imports of Services and Stocks where the regression results could be improved by the introduction of better quality indicators. Government Expenditure is one of the areas in which the quality of historical information on a quarterly basis should be much better. A little more research should release more information. A good deal of priority should be given to estimate the changes in stocks, which is very important for quarterly model building.

A good number of the components of disposable income are interpolated. More research in this area should improve estimates by introducing more indicators. Undistributed profits is one particular variable on which quarterly information would be useful.

A question arises at this stage as to whether there is enough information available to produce quarterly accounts. It is the author's opinion that the information base in this country is as good as it was in other countries when they started producing. It is also the author's opinion that unless we start producing quarterly accounts, no improvements will be made to the information base. It is only by producing accounts that gaps in information are discovered. This represents a start where methodology is now set out and therefore can be improved upon.

Figure 1A Components of Gross National Product and Disposable Income (£m)

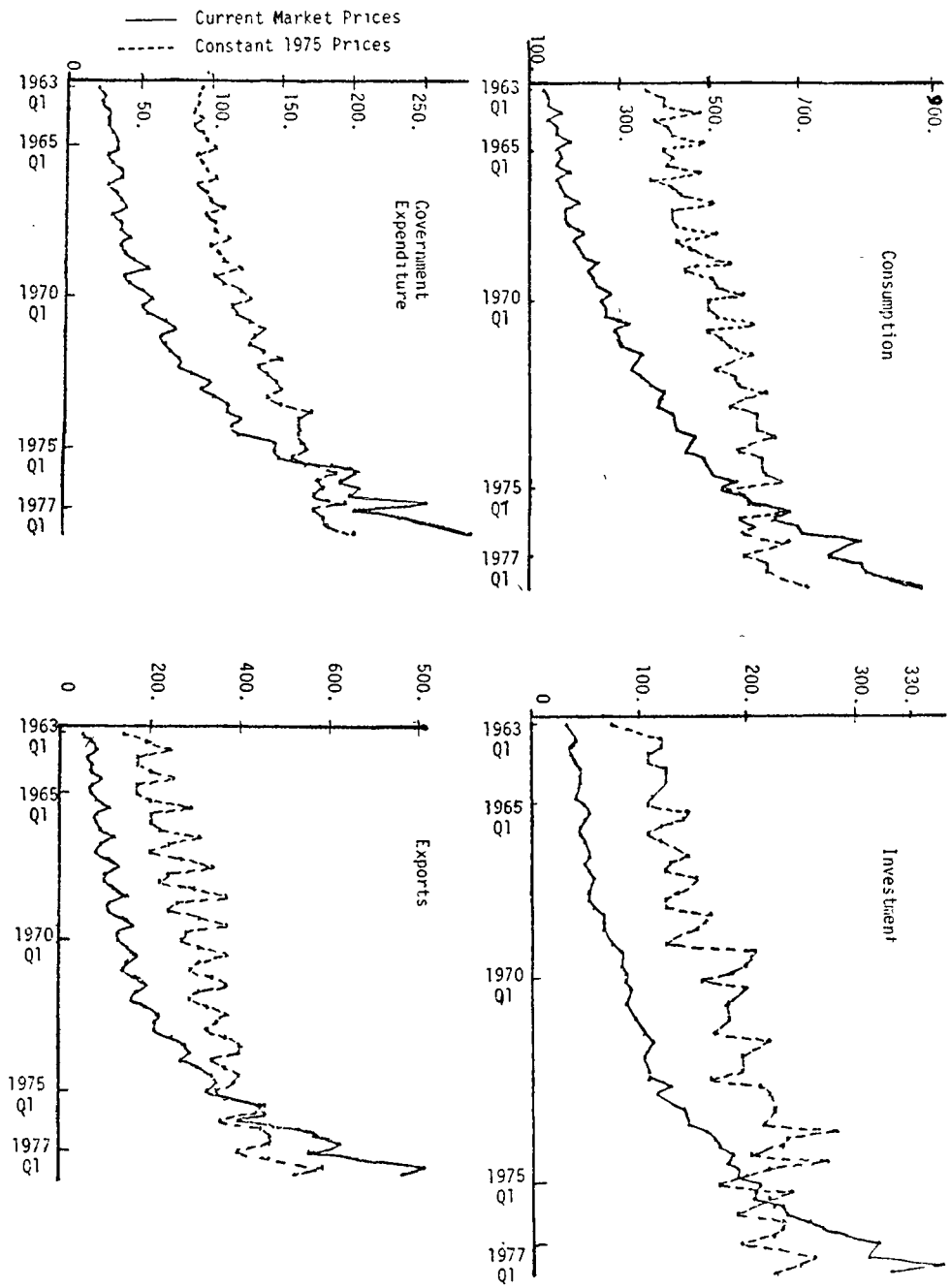
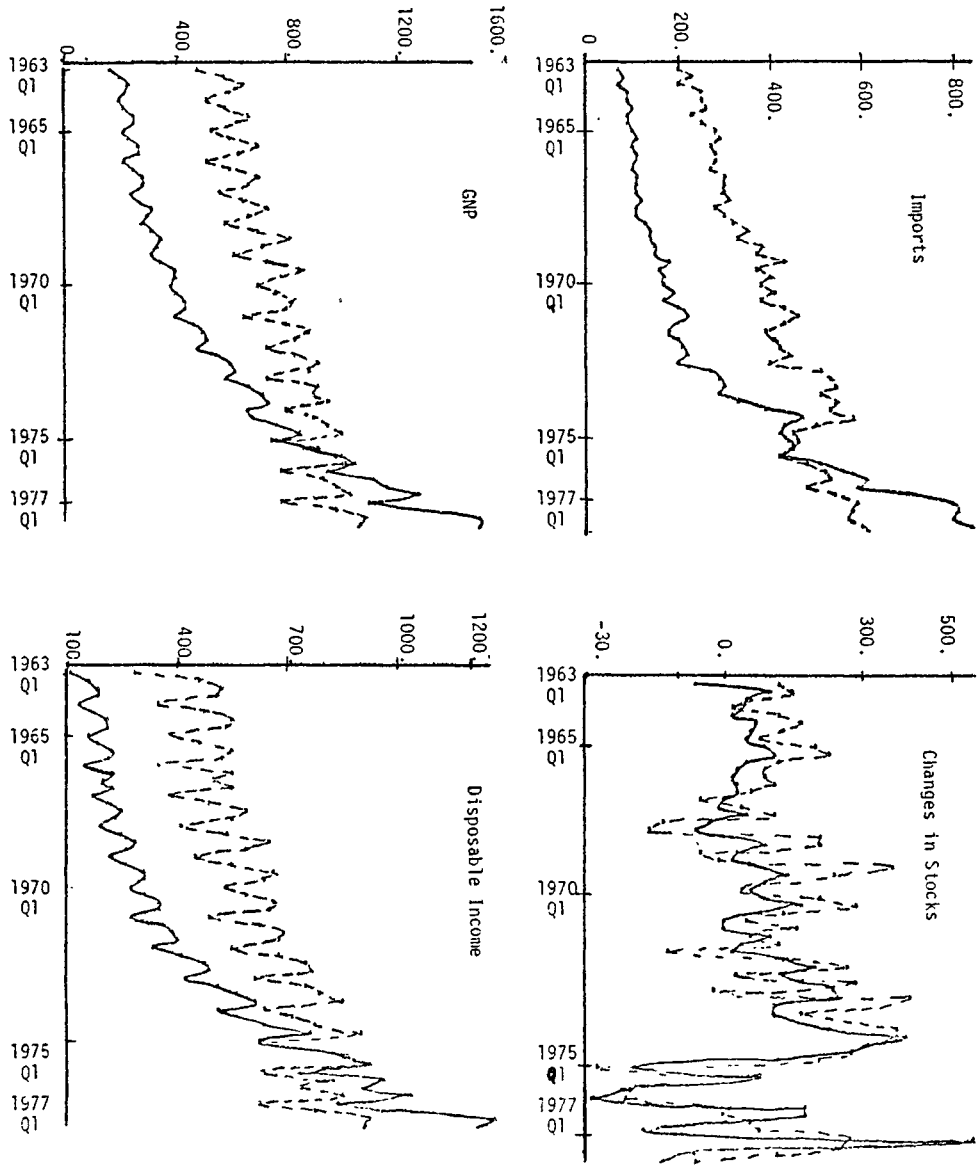


Figure 1b Components of Gross National Product and Disposable Income (£m)



At this stage, a few words of warning should be given to users. The quarterly national accounts produced here can be no more accurate than the annual ones, as they are tied to them. They can only be used as an indicator of variations within a year. At the same time, however, new information is being added within a year in that the indicators which have always been available are now organised in a systematic manner and are "corrected" to agree with the annual national accounts. Care must be exercised by model estimators that none of the indicators used in estimating the accounts are ever put on the left-hand side of an equation containing the national accounts estimate. This could lead to spuriously good fits being obtained.

An argument could be made that the econometric problem of errors in variables occurs extensively in the quarterly estimates leading to estimation problems. It is the author's contention that although the degree of the problem might be greater in the case of quarterly accounts, the problem already exists in annual accounts and had, to a large extent, been ignored. It should be sufficient that a caveat be expressed and then to leave it up to the econometrician estimating models.

The direction of work can be divided naturally into four main areas. First, it is necessary to improve the information base from which the quarterly accounts presented in Appendix 3 are estimated. This means improving the present indicators and developing others so that the amount of interpolation is reduced.

The second main area that has to be discussed is the updating of the accounts. It may be argued that this logically lies within the first area. However, several separate issues have to be discussed in relation to the updating of accounts. Given the gaps in information in the historical data, it is necessary to see if new information has become available for later quarters which would allow the use of new indicators. Also, the indicators that are available have to be updated. The updating of indicators to 1980 will be undertaken by the Research Department of the Central Bank. It is an open question as to where the data will be updated subsequently and who should take over the task of filling gaps in information.

The third main area is that of increasing the number of estimated national accounts variables. In particular, there is a need to derive quarterly accounts on the income side.

Finally, the methodology needs to be improved. At the moment the regression/BFL method is used to estimate the accounts. However, as has been stated, the author is working on a computer program to implement the full Chow and Lin method.

The first use to which the accounts will be put will be in research regarding behavioural relationships such as those listed in Appendix 1. This task in itself should test out the usefulness of the data. The accounts may also be incorporated fairly quickly into the short-term forecasting exercises which are undertaken in the different institutions. Of course, when the indicators are used in forecasting exercises, by definition no annual national accounts variables to which to tie the indicators will be available. However, the Chow and Lin method also provides the best linear unbiassed method of extrapolating quarterly national accounts using indicators.

APPENDIX 1

IDENTITIES[1]

C	=	CND + CD + CO	I 1[2]
CNDV[3]	=	$\overline{PCND}$*CND	I 2
CDV	=	$\overline{PCD}$*CD	I 3
COV	=	$\overline{PCO}$*CO	I 4
CV	=	CNDV + CDV + COV	I 5
PC	=	CV/C	I 6
K	=	KOM + $\overline{KO}$	I 7
KOMV	=	$\overline{PKOM}$*KOM	I 8
KOV	=	$\overline{PKO}$*$\overline{KO}$	I 9
KV	=	KOMV + KOV	I 10
GOVV	=	$\overline{PGOV}$*$\overline{GOV}$	I 11
TOTX	=	XM + $\overline{XO}$ + $\overline{XS}$	I 12
XMV	=	$\overline{PXM}$*XM	I 13
XOV	=	$\overline{PXO}$*$\overline{XO}$	I 14
XSV	=	$\overline{PXS}$*$\overline{XS}$	I 15
XV	=	XMV + XOV	I 16
TOTXV	=	XV + XSV	I 17
TOTIM	=	IMM + $\overline{IMO}$ + $\overline{IMS}$	I 18
IMMV	=	$\overline{PIMM}$*IMM	I 19
IMOV	=	$\overline{PIMO}$*$\overline{IMO}$	I 20
PIM	=	IMV/IM	I 21
IM	=	IMM + $\overline{IMO}$	I 22
IMSV	=	$\overline{PIMS}$*$\overline{IMS}$	I 23
IMV	=	IMMV + IMOV	I 24
TOTIMV	=	IMV + IMSV	I 25
NFIV	=	$\overline{PNFI}$*$\overline{NFI}$	I 26
STKV	=	$\overline{PSTK}$*$\overline{STK}$	I 27
Y	=	C + K + $\overline{GOV}$ + TOTX - TOTIM + STK + $\overline{NFI}$	I 28
YV	=	CV + KV + GOVV + TOTXV - TOTIMV + STKV + NFIV	I 29
SUV	=	$\overline{CGEECSV}$ + $\overline{OSUBSV}$	I 30
TIV	=	$\overline{CGTIV}$ + $\overline{OTIIV}$	I 31
TPYV	=	$\overline{TIMSV}$ + $\overline{SIV}$	I 32
YDV	=	YV - $\overline{TXEXV}$ + SUV - $\overline{DEPV}$ - $\overline{STKAPV}$ - $\overline{GTIV}$ + $\overline{NDIV}$ + TIV - $\overline{UPRV}$ - TPYV	I 33
YO	=	Y - YM	I 34
YNS	=	Y - STK	I 35

BEHAVIOURAL EQUATIONS

CND	=	f(YDV, $\overline{M3}$, PC)	B 1
CD	=	f(YDV, $\overline{M3}$, $\overline{R}$, PC)	B 2
CO	=	f(YDV, $\overline{M3}$, PC)	B 3
KOM	=	f(YM, M3, R)	B 4
XM	=	f($\overline{YW}$, $\overline{IDA}$, $\overline{DCR}$, $\overline{E}$, PC/PIM)	B 5
YM	=	f((C + K + $\overline{GOV}$), XM, IMM)	B 6
IMM	=	f($\bar{\gamma}_j$, C, K, $\overline{GOV}$, $\overline{E}$, PC/PIM)	B 7
STK	=	f(YNS)	B 8

FOOTNOTES

1. '-' over the mnemonic indicates that the variable is exogenous.
2. 'I' relates to the fact that these are identities while 'B' indicates behavioural relationships.
3. Throughout this set of identities, implicit price deflators are defined. It should be fairly obvious where they occur so they will not be defined further in the list of definitions. For instance, PCND is the implicit price deflator for CNDV.

APPENDIX 2

SUMMARY OF SOURCES AND METHODS OF DERIVING INDICATORS

Indicators for Consumption

RETV — The Index of Value of Retail Sales - All Businesses Combined. (Source: Irish Statistical Bulletin)

RET — The Index of Volume of Retail Sales - All Businesses Combined. (Source: Irish Statistical Bulletin from 1968 only. Pre-1968 values were obtained by deflating RETV by the Consumer Price Index (CPI).)

RETCDV — The Index of Value of Retail Sales of Consumer Durable Goods. This index was obtained by combining indices of retail sales which related to consumer durable goods. The indices were combined using Census of Distribution weights. (Source: Weights and indices from the Irish Statistical Bulletin.)

RETCD — The Index of Volume of Retail Sales of Consumer Durable Goods. Post-1968 data for this variable was calculated in the same manner as RETCDV. (Source: Whereas components of RETCDV are available in the Irish Statistical Bulletin, the components of the volume counterparts were kindly provided by the Central Statistics Office. Pre-1968 estimates for RETCD were obtained by deflating RETCDV by the Consumer Price Index for durable goods.)

H — The Number of Dwellings Completed. Various adjustments had to be made to the series to make it historically consistent. These adjustments are described in O'Reilly (1980b).
(Source: Quarterly Bulletin of Housing Statistics.)

PH — The Price of Dwellings Completed.
(Source: Quarterly Bulletin of Housing Statistics post-1968. The interpolated annual implicit price deflator for KDV is used pre-1968.)

HV — The Value of Dwellings Completed.
(Source: H*PH.)

CEMV — The Value of Cement Sales.
(Source: CEM*PMAT.)

CEM — The Volume of Cement Sales.
(Source: Cement Limited.)

PMAT — Wholesale Price Index of Materials for Use in the Building Industry.
(Source: Irish Statistical Bulletin.)

SKOMV — Seasonal Factors for KOMV Estimated using X11 Method of Seasonal Adjustment. These seasonal factors were applied to the interpolated values for KTAV to obtain a series for KTAV which included seasonality. The assumption is that the seasonality in KTAV is the same as that in KOMV.

Q — The Volume of Production of Machinery and Equipment. This series was obtained by combining Quarterly Industrial Inquiry (QII) Output indices relating to Output of Mechanical Equipment (Item 41 of QII) and Output of Electrical Equipment (Item 42 of QII) using net output weights.
(Source: Irish Statistical Bulletin.)

P — Wholesale Price Index for Capital Goods.
(Source: Irish Statistical Bulletin.)

QV — The Value of Production of Machinery and Equipment.
(Source: P*Q.)

DELSTV — The Value of Changes in Stocks of Machinery and Equipment. The joint CII/ESRI survey has asked questions on the adequacy of stock levels since 1962. The qualitative survey results were transformed to quantitative information using the methodology described in Carlson and Parkin (1975). An index of stock adequacy (SAI) was thus produced. Using this stock adequacy index and information gleaned from the Census of Industrial Production on annual sales of machinery and electrical equipment (SVA) and annual levels of stocks in these categories (STVA), it was possible to produce an indicator of changes in stocks (DELSTV). Full details of how DELSTV was derived is described in O'Reilly (1980b). The method is based on the following model: stock adequacy can be defined as actual stocks (STV) divided by desired stocks (STDV). Desired stocks can be assumed to be a function of sales (SV). The variable SV was obtained using the BFL interpolation method on SVA. Thus $STDV = \alpha SV$ and

$$STV/STDV = 1 + \delta SAI$$

$$\rightarrow \quad STV = \alpha SV + \delta\alpha(SAI*SV).$$

Estimates of a and δ were obtained using regression on the annual data and thus STV was obtained and changes in stocks were obtained by first differences on STV (DELSTV = STV - STV(-1)).
(Source: CII/ESRI Industrial Surveys and Irish Statistical Bulletin.)

XMACHV — The Value of Exports of Machinery and Equipment.
(Source: Sum of items relating to machinery and equipment from Trade Statistics of Ireland.)

MMACHV — The Value of Imports of Machinery and Equipment.
(Source: Trade Statistics of Ireland.)

DELST — The Volume of Changes in Stocks of Machinery and Equipment.
(Source: DELSTV/P.)

XMACH — The Volume of Exports of Machinery and Equipment.
(Source: XMACHV/P.)

MMACH — The Volume of Imports of Machinery and Equipment.
(Source: MMACHV/P.)

Indicators for Government Expenditure

GSALV — Indicator for the Value of Central Government Wages, Salaries and Pensions. The annual national accounts values of Central Government variables are derived from the Appropriation Accounts (1980) - an annual publication. The Appropriation Accounts show a detailed breakdown of expenditure by vote. To calculate the national accounts values each item of expenditure detailed under each vote heading has to be reclassified under the following national accounts headings:

*subsidies; domestic national debt interest; foreign national debt interest; land bond interest;
*current transfer payments; capital grants to enterprises; capital transfer payments; redemption of securities; loan and share capital; gross physical capital formation; capital payments abroad;
*transfers to Local Authorities; capital transfers to the rest of the world;
*wages, salaries and pensions;
*other current payments.

(This list is shown in Table A15 of NIE.)
*These categories are the ones for which information is needed quarterly.

The reclassified data are than aggregated over all the votes. For example, subsidies in votes 1, 2, 3, ..., etc., are summed for all the votes to obtain a figure for total subsidies. If the information in the Appropriation Accounts were available quarterly, then it would be a simple, though laborious, task to obtain quarterly values for the above items. Unfortunately, this information is not available. However, it was possible to obtain total expenditure by vote on a quarterly basis, from the second quarter of 1963, from the Department of Finance. A detailed breakdown of each vote was not available. It was assumed that the expenditure breakdown by national accounts category under each vote was the same proportion of total expenditure for each quarter of the year as it was for the year as a whole. A breakdown of expenditure

for each vote and for each national accounts category was obtained from the Central Statistics Office from 1963 to 1977. A computer program was devised to apply the annual pattern of expenditure for each vote to the quarterly totals for each vote in order to obtain the quarterly national accounts estimates. Thus, for example, the quarterly value for the vote for education was allocated to the national accounts categories subsidies, national debt interest, etc., using the annual proportions. These national accounts variables were then aggregated over the votes to provide a set of total quarterly data for each national accounts variable. It was in this manner that the indicator GSALV, was estimated. Other indicators mentioned later and marked with an asterisk on the list on the previous page were also obtained in this manner.
(Source: Department of Finance and Central Statistics Office.)

GOCPV — Indicator for the Value of Other Current Payments by Central Government. Obtained in the same manner as GSALV.
(Source: Department of Finance and Central Statistics Office.)

GLATV — Indicator for the Value of Central Government Transfers to Local Authorities. Obtained in the same manner as GSALV.
(Source: Department of Finance and Central Statistics Office.)

GSAL — Indicator for the Volume of Central Government Wages, Salaries and Pensions.
(Source: GSALV/CPI.)

GOCP — Indicator for the Volume of Other Current Payments by Central Government.
(Source: GOCPV/CPI.)

GLAT — Indicator for the Volume of Central Government Transfers to Local Authorities.
(Source: GLATV/CPI.)

CPI — Consumer Price Index
(Source: Irish Statistical Bulletin.)

Indicators for Imports and Exports of Goods and Services

XV — The Value of Merchandise Exports.
(Source: Trade Statistics of Ireland.)

HGV — The Value of Receipts of Hotels and Guest Houses from non-Residents.
(Source: Irish Statistical Bulletin.)

PX — Unit Value Index for Total Merchandise Exports.
(Source: Irish Statistical Bulletin.)

X — The Volume of Merchandise Exports.
(Source: XV/PX.)

HG — The Volume of Receipts of Hotels and Guest Houses from non-Residents.
(Source: HGV/CPI.)

IMV — The Value of Merchandise Imports.
(Source: Trade Statistics of Ireland.)

PIM — Unit Value Index for Total Merchandise Imports.
(Source: Irish Statistical Bulletin.)

IM — The Volume of Merchandise Imports.
(Source: IMV/PIM.)

Indicators for Changes in Stocks

DELCOV — The Value of Changes in Cow Numbers.
(Source: COWNOW - COWNOW (-1).)

COWNOW — The Value of Cow Stocks.
(Source: COWNO*CATP.)

CATP — Price per CWT of Live Cattle.
(Source: Irish Statistical Bulletin.)

COWNO — The Stock of Cows.
(Source: MIPR/MICNOS.)

MIPR — The Volume of Milk Delivered to Creameries. This variable is available quarterly from 1967 to 1977. The 1963 to 1966 data was obtained by interpolating annual data (which was available) using the BFL method. The seasonality in MIPR (SMIPR) which was estimated from subsequent years, was imposed on the 1963 to 1966 interpolated data. Thus an estimate of data over the period 1963 to 1977 was obtained.
(Source: Bord Bainne kindly provided annual information from 1963 to 1966 and quarterly information from 1967 to 1977.)

SMIPR — Seasonal Factors for Milk Delivered to Creameries.
(Source: Factors estimated using the American Bureau of the Census XII programme and MIPR.)

MICNOS — The Volume of Milk Delivered to Creameries per Cow. This variable was calculated using interpolated annual data on milk deliveries per cow (MICNO) and seasonal factors SMIPR. The assumption is that the seasonality in milk deliveries is due to seasonality in deliveries per cow alone.
(Source: MICNO*SMIPR.)

MICNO — The Interpolated Values of Milk per Cow Delivered to Creameries.
(Source: Annual values obtained from Conway, Kearney and O'Connor (1978). Interpolated quarterly values derived using BFL method of interpolation.)

IFPSV — The Value of Imports of Materials for Further Production.
(Source: Trade Statistics of Ireland.)

TCTSV — The Value of Cattle Slaughtered at Meat Export Premises.
(Source: TCTS*CATP.)

DELCO — The Volume of Changes in Cow Numbers.
(Source: COWNO - COWNO (-1).)

IFPS — The Volume of Imports of Materials for Further Production.
(Source: IFPSV/WPOM.)

WPOM — Wholesale Price Index for the Materials for Use in All Industry.
(Source: Irish Statistical Bulletin.)

TCTS — The Volume of Cattle Slaughtered at Meat Export Premises.
(Source: Irish Statistical Bulletin.)

Indicators for the Remainder of the Components of Disposable Income

ITXEXV — The Value Indicator for Taxes on Expenditure. Data are available from the Iris Oifigiuil from 1963 to 1977 for the following series:

(i) customs duties;
(ii) excise duties;
(iii) stamps;
(iv) turnover tax;

(v) wholesale tax;
(vi) value added tax;
(vii) agricultural levies;
(viii) motor vehicle duties.

The sum of (i) to (vii) plus that part of motor vehicle duties relating to indirect taxes are used as an indicator (ITXEXV). The Iris-Oifigiuil data on motor vehicle duties do not distinguish between that part of duties which relate to indirect taxes and that part which relates to direct tax. Thus, the portion relating to indirect taxes had to be estimated on a quarterly basis. To do this, the annual proportion of duties relating to indirect taxes - available from NIE - was applied to the quarterly figure.
(Source: Iris Oifigiuil.)

IECGSUV The Value Indicator for Central Government plus EEC Subsidies. An indicator for Central Government subsidies was computed by the method described for GSALV. EEC subsidies were only available for three quarters of the year in earlier years. The fourth quarter was obtained by linear interpolation. The sum of the two series (IECGSUM) was used as an indicator for the national accounts item. Central Government plus EEC subsidies.
(Sources: Department of Finance, Central Statistics Office and "Developments in the EEC Community", published by the Department of Foreign Affairs.)

ICGTIV The Value Indicator for Central Government Transfer Payments. Computed in the same manner as GSALV.
(Source: Department of Finance and Central Statistics Office.)

ITIMSV The Value Indicator for Taxes on Personal Income and Wealth *less* Social Insurance Contributions. The following information is available on a quarterly basis from the Iris Oifigiuil:

(i) capital taxes;
(ii) income tax;
(iii) corporation profits tax;
(iv) corporation tax; and
(v) motor vehicle duties.

The addition of (i) to (iv) above plus that part of motor vehicle duties relating to taxes on income and wealth was used as an indicator.
(Source: Iris Oifigiuil.)

ISIV The Value Indicator for Social Insurance Contributions. Social insurance rates are available from year to year in the budget statements. These annual rates were multiplied by quarterly employment in transportable goods industries to produce an indicator for the value of social insurance contributions.
(Source: Quarterly Industrial Inquiry and Budget Statements.)

APPENDIX 3

(The number of decimal places to which the national accounts are reported bears no relationship to their accuracy.)

CV - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1961 1 TO 1977 4

THE VALUE OF TOTAL CONSUMPTION(NIE-ITEM 55)

1961	1	118.301	124.862	121.868	144.909
1962	1	127.071	134.575	130.26	157.393
1963	1	133.709	142.821	140.228	169.44
1964	1	144.937	157.283	161.807	189.672
1965	1	162.674	169.353	164.063	191.711
1966	1	161.649	174.911	181.086	207.716
1967	1	182.852	184.352	185.93	220.368
1968	1	200.348	210.141	223.082	249.929
1969	1	225.361	244.769	250.505	282.667
1970	1	257.096	266.047	274.3	318.458
1971	1	287.74	304.534	313.575	354.848
1972	1	327.728	347.224	365.764	403.885
1973	1	386.053	419.292	434.769	472.884
1974	1	454.772	491.558	514.71	559.061
1975	1	528.612	576.312	596.309	681.565
1976	1	653.004	701.896	712.094	827.907
1977	1	771.12	840.532	853.194	972.151

C - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1961 1 TO 1977 4

THE VOLUME OF EXPORTS OF GOODS AND SERVICES(NIE ITEM 68)

1961	1	340.322	367.589	361.406	438.882
1962	1	358.384	378.575	367.535	457.604
1963	1	356.045	398.984	395.981	475.188
1964	1	375.959	408.245	422.667	489.428
1965	1	398.49	417.673	406.75	480.786
1966	1	367.216	415.703	440.401	508.28
1967	1	417.941	423.919	432.004	517.334
1968	1	427.704	460.419	503.457	552.348
1969	1	451.608	507.671	518.545	577.574
1970	1	497.199	503.77	517.864	596.064
1971	1	499.311	533.992	550.932	600.664
1972	1	523.479	561.053	569.271	627.995
1973	1	554.075	611.213	606.284	654.126
1974	1	572.128	616.008	625.615	657.146
1975	1	544.194	578.233	590.725	669.646
1976	1	570.08	602.357	576.603	679.259
1977	1	576.391	633.77	630.4	720.44

KV - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VALUE OF TOTAL INVESTMENT(NIE ITEM 57)

1963	11	31.9804	39.8603	38.0689	39.5228
1964	11	41.8724	46.552	44.3092	42.5992
1965	11	48.7103	54.3622	49.7312	47.4187
1966	11	46.4381	49.8169	52.5973	51.3999
1967	11	53.6897	57.6871	55.0233	54.3984
1968	11	58.1213	65.3662	67.1489	67.5258
1969	11	74.1915	84.8764	84.4652	89.0733
1970	11	85.5234	91.8143	89.2103	95.0499
1971	11	105.9	112.317	103.897	107.732
1972	11	110.257	127.101	118.554	140.895
1973	11	147.885	161.258	170.354	176.41
1974	11	187.57	183.391	190.731	191.451
1975	11	212.692	206.655	209.197	232.4
1976	11	238.997	259.963	271.087	291.887
1977	11	319.756	314.138	377.732	331.487

K - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VOLUME OF TOTAL INVESTMENT(NIE,ITEM 66)

1963	11	76.0459	120.553	119.	108.42
1964	11	109.55	126.76	123 119	113.696
1965	11	108.911	146.655	143.595	121.174
1966	11	108.687	119.737	146.639	129.665
1967	11	123.	152.881	137.29	124.663
1968	11	124.525	166.824	161.39	155.593
1969	11	125.703	206.802	201.509	185.825
1970	11	156.77	200.854	181.575	183.039
1971	11	172.267	222.322	194.867	194.687
1972	11	165.147	213.141	222.406	224.469
1973	11	217.186	285.19	237.028	234.868
1974	11	204.831	274.286	220.198	201.566
1975	11	173.189	240.274	222.234	225.687
1976	11	190.287	233.199	233.996	225.489
1977	11	193.989	261.018	250.217	228.849

GOVV - DATE REVISED: 10/09/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VALUE OF CURRENT GOVERNMENT EXPENDITURE (NIE, ITEM 56)
GOVV=(-17.446)/4.+0.324*GSALV/100.-0.229*GOCPV/100.0.3929*GLATV/1000.+RGOVV
RSQ=.993 DW=1.37 T(-17.446)=-.5 T(GSALV)=2.8 T(GOCPV)=-1.2
TGLATV=.9

1963	11	21.9733	24.4573	26.2773	26.7229
1964	11	27.4901	27.5943	29.955	35.2294
1965	11	33.3062	28.7561	32.079	36.4443
1966	11	36.3309	29.4709	33.9187	37.6769
1967	11	41.3501	30.8927	36.7172	38.6488
1968	11	42.28	36.9934	41.283	45.9798
1969	11	56.5773	41.3162	43.4418	53.5374
1970	11	60.198	52.2935	57.6029	67.6257
1971	11	75.5084	64.7312	69.5042	73.3364
1972	11	76.7289	77.2363	87.8457	100.642
1973	11	94.7128	102.183	113.176	112.494
1974	11	123.072	115.813	121.32	146.484
1975	11	146.764	150.419	187.283	204.633
1976	11	192.642	205.188	198.74	253.996
1977	11	201.773	232.836	257.881	284.668

GOV - DATE REVISED: 10/09/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VOLUME OF CURRENT GOVERNMENT EXPENDITURE (NIE, ITEM 65)
GOV=91.3183/4+.009808*GSAL+.00163*GOCP+.000519*GLAT+RGOV
RSQ=.960 DW=1.3 T(91.3183)=2.32 T(GSAL)=.8 T(GOCP)=1.13
T(GLAT)=1.9

1963	1	92.3282	89.7931	90.5633	88.1741
1964	1	94.3721	89.0166	92.8039	95.4444
1965	1	102.507	91.797	94.4827	96.1507
1966	1	103.459	90.9006	95.4067	99.5276
1967	1	108.371	95.3976	103.579	102.519
1968	1	112.42	101.557	105.505	110.524
1969	1	123.408	104.507	109.647	121.326
1970	1	129.671	116.453	118.585	128.683
1971	1	138.776	129.844	128.7	138.872
1972	1	150.526	135.475	140.239	148.185
1973	1	148.635	141.605	151.337	172.098
1974	1	161.102	163.421	162.711	165.495
1975	1	168.386	158.808	166.788	191.571
1976	1	178.631	181.347	174.695	197.605
1977	1	174.245	180.873	183.897	204.544

TOTXV - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VALUE OF EXPORTS OF GOODS AND SERVICES(NIE,ITEM 59)

1963	1	51.7167	66.6422	84.0941	63.0411
1964	1	65.8883	74.52	93.2617	67.023
1965	1	65.4714	77.7793	111.012	79.5294
1966	1	79.0178	86.5841	118.14	92.5504
1967	1	82.829	106.646	132.346	95.8697
1968	1	95.1164	123.716	150.852	113.905
1969	1	105.556	138.806	163.215	129.314
1970	1	126.738	149.184	174.757	148.211
1971	1	142.719	171.802	189.541	165.029
1972	1	159.687	185.125	215.3	213.079
1973	1	213.117	247.833	277.556	287.882
1974	1	270.202	310.596	340.947	349.94
1975	1	333.649	373.929	451.688	459.715
1976	1	398.979	540.279	579.339	634.18
1977	1	555.484	666.404	820.979	766.101

TOTX - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

TOTX = X+XS

1963	1	139.016	185.848	241.298	168.909
1964	1	172.771	196.515	251.85	172.346
1965	1	165.325	201.648	294.394	203.718
1966	1	198.544	218.57	305.422	235.089
1967	1	204.165	270.521	343.436	237.274
1968	1	222.418	295.266	365.899	264.141
1969	1	238.12	314.22	367.596	280.762
1970	1	267.302	311.964	368.419	306.193
1971	1	287.282	338.101	369.637	310.363
1972	1	293.908	330.67	374.831	352.677
1973	1	330.081	370.926	400.037	398.843
1974	1	343.166	373.994	401.924	390.645
1975	1	353.278	371.751	458.431	435.558
1976	1	355.982	449.309	468.863	474.462
1977	1	403.07	468.892	585.023	531.979

TOTIMV - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VALUE OF IMPORTS OF GOODS AND SERVICES(NIE, ITEM 60)

1963	1	73.3214	84.2266	73.3206	91.8324
1964	1	92.08	96.0607	86.395	94.6656
1965	1	103.468	111.009	100.751	105.273
1966	1	107.012	101.912	113.165	114.213
1967	1	113.444	118.139	105.253	114.566
1968	1	130.928	143.001	135.895	153.478
1969	1	153.963	179.975	158.778	173.387
1970	1	170.694	185.849	172.304	199.656
1971	1	219.174	204.687	183.686	196.356
1972	1	205.559	218.046	203.127	266.371
1973	1	286.343	301.066	292.217	331.377
1974	1	393.133	469.427	430.489	415.355
1975	1	439.406	447.654	421.448	505.497
1976	1	560.695	613.281	591.004	702.227
1977	1	804.358	813.347	797.654	836.65

TOTIM - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VOLUME OF IMPORTS OF GOODS AND SERVICES(NIE ITEM 69)

1963	1	201.583	230.736	202.525	249.956
1964	1	250.255	259.708	234.817	254.32
1965	1	275.151	290.719	266.187	277.843
1966	1	282.291	268.236	299.029	299.444
1967	1	299.161	310.442	279.674	302.222
1968	1	324.183	349.154	329.371	376.192
1969	1	368.765	426.035	371.478	398.121
1970	1	381.333	406.537	379.143	434.086
1971	1	463.461	429.731	386.237	405.67
1972	1	419.469	439.853	398.069	512.908
1973	1	526.64	539.543	505.531	535.586
1974	1	534.465	578.805	496.091	450.24
1975	1	460.928	454.49	418.585	479.997
1976	1	515.617	534.877	483.348	540.457
1977	1	591.601	583.245	569.899	597.254

STKV - DATE REVISED: 10/09/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VALUE OF PHYSICAL CHANGES IN STOCKS (NIE, ITEM 58)
STKV=(-.54923*DELCOV+2.92532*IFPSV/10000.-1.28058*TCTSV/1000.+RESTKV
RSQ=.793 DW=1.16 T(DELCOV)=-.35 T(IFPSV)=6.0 T(TCTSV)=-4.7

1963	1	-6.4	9.76729	5.41844	3.84231
1964	1	1.81087	7.13068	5.89598	5.16229
1965	1	8.56213	11.0206	5.05412	2.66299
1966	1	2.20413	2.81879	2.66615	0.119729
1967	1	-0.709171	4.59793	-2.51357	-5.875
1968	1	2.49443	9.35719	2.69756	1.55067
1969	1	7.65663	14.478	8.61637	6.37885
1970	1	9.15712	17.108	8.39942	0.234824
1971	1	-0.16807	9.64631	3.52112	1.80049
1972	1	13.7662	19.6394	13.1282	17.466
1973	1	24.0581	25.2741	10.9035	10.864
1974	1	23.1871	40.2614	27.6227	12.4285
1975	1	-18.7403	7.7261	-21.3127	-28.3734
1976	1	17.8776	17.8737	1.2863	-17.2384
1977	1	55.2861	31.7199	-5.51	-13.4971

STK - DATE REVISED: 10/09/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VOLUME OF PHYSICAL CHANGES IN STOCKS (NIE, ITEM 67)
STK=(-150.381)*DELCO+1.99831*IFPS/10000-1.68564*TCTS/10000+RESTK/4
RSQ=.695 DW=2.01 T(DELCO)=2.1 T(IFPS)=6.12 T(TCTS)=-4.5

1963	1	12.4	14.8717	5.98209	1.64061
1964	1	12.0356	17.1239	12.8213	8.41925
1965	1	19.7703	23.4888	12.399	9.142
1966	1	8.96219	10.8798	6.05993	-5.0019
1967	1	3.76629	11.0335	-12.5898	-15.6101
1968	1	21.0454	20.9963	-4.54786	-1.09384
1969	1	37.3213	23.9068	9.23766	3.91614
1970	1	20.872	28.5475	12.5325	4.94785
1971	1	15.6803	6.41562	12.0455	-12.0414
1972	1	12.6718	26.6211	2.9874	29.2198
1973	1	-2.46156	41.1653	11.1489	17.1475
1974	1	37.9928	38.3804	28.103	20.924
1975	1	-27.3034	7.78401	-20.4614	-20.7195
1976	1	1.52024	0.345669	6.1369	7.69717
1977	1	28.1573	25.5249	11.6549	-6.3368

YV - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VALUE OF EXPENDITURE ON GROSS NATIONAL PRODUCT
(NIE ITEM 63)

1963	1	165.434	203.859	225.036	214.904
1964	1	194.058	221.341	253.564	250.328
1965	1	221.187	236.665	267.805	259.042
1966	1	224.59	247.594	280.84	280.676
1967	1	252.055	271.828	308.574	295.839
1968	1	275.679	310.63	357.294	333.281
1969	1	322.802	351.288	398.348	394.527
1970	1	375.15	397.819	439.081	436.753
1971	1	399.029	464.742	502.963	513.473
1972	1	490.207	546.059	604.937	616.343
1973	1	585.385	660.231	720.2	735.637
1974	1	673.302	680.736	773.705	852.469
1975	1	770.986	873.413	1006.24	1047.47
1976	1	942.405	1112.13	1170.37	1285.96
1977	1	1095.14	1266.98	1499.93	1496.18

Y - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VOLUME OF EXPENDITURE ON GROSS NATIONAL PRODUCT
(NIE ITEM 72)

1963	1	487.438	591.838	662.215	603.848
1964	1	525.789	589.74	681.244	639.266
1965	1	535.668	607.523	702.901	650.362
1966	1	521.24	603.127	709.778	682.699
1967	1	572.892	658.839	740.713	681.958
1968	1	603.141	715.78	822.125	724.342
1969	1	625.245	747.872	851.22	787.268
1970	1	706.563	771.077	835.448	799.714
1971	1	663.904	814.554	883.598	841.262
1972	1	741.409	842.484	926.444	883.234
1973	1	732.498	920.749	909.804	951.081
1974	1	794.898	897.809	952.786	994.943
1975	1	758.688	908.452	1005.45	1024.46
1976	1	782.212	931.794	975.972	1042.08
1977	1	781.341	983.018	1086.59	1076.64

YDV - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VALUE OF DISPOSABLE INCOME

1963	1	109.326	165.265	185.234	182.596
1964	1	135.973	180.78	210.591	207.924
1965	1	157.059	185.327	220.993	210.297
1966	1	153.09	230.736	203.106	224.187
1967	1	170.243	212.961	250.184	235.259
1968	1	195.375	244.808	285.565	263.418
1969	1	226.428	267.446	317.946	312.868
1970	1	275.02	307.834	350.409	342.135
1971	1	277.803	359.401	392.273	401.936
1972	1	341.985	415.292	479.102	493.253
1973	1	430.225	514.577	566.789	610.329
1974	1	506.274	568.303	638.021	763.939
1975	1	620.292	759.214	864.97	924.424
1976	1	735.678	962.92	918.2	1040.81
1977	1	835.974	1033.27	1257.09	1228.88

YD - DATE REVISED: 10/30/81
QUARTERLY DATA FROM 1963 1 TO 1977 4

THE VOLUME OF DISPOSABLE INCOME(YDV/PC)

1963	1	291.118	461.681	523.073	512.083
1964	1	352.708	469.235	550.097	536.525
1965	1	384.734	457.067	547.892	527.398
1966	1	347.772	548.381	493.954	548.584
1967	1	389.12	489.708	581.298	552.293
1968	1	417.088	536.374	644.471	582.158
1969	1	453.746	554.705	658.147	639.285
1970	1	531.864	582.896	661.554	651.611
1971	1	482.066	630.199	689.075	680.371
1972	1	546.253	671.041	745.668	766.952
1973	1	617.471	750.111	790.385	844.249
1974	1	636.92	712.184	775.496	897.969
1975	1	638.576	761.745	856.371	908.258
1976	1	642.256	826.365	743.493	853.933
1977	1	624.868	779.099	928.826	910.699

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FOOTNOTES

1. A description of the ESA basis of national accounts is given in "National Income and Expenditure 1976".
2. At the time of writing, the official version of National Income and Expenditure had not been published.
3. The superscript 'a' indicates the corresponding annual vector. Of course Z^a is known.
4. A computer program was devised in the Central Bank to effect this interpolation method - Bradley (1975).
5. How this indicator was devised is described in Appendix 2.
6. Figures in parentheses denote t values.
7. The following conventions are followed for the national accounts variables. The 'V' after the variable indicates the value counterparts of a volume variable. An 'A' after the variable indicates the annual counterpart of a quarterly variable. Thus STKV is the value counterpart of STK and STKVA is the annual version of the STKV variable (i.e., the addition of the four quarterly values for STKV for a particular year).
8. The reference in brackets locates the national accounts variables in NIE. Where item numbers are written specifically in NIE, no table number is given.

DISCUSSION

J. B. Broderick: I would like to congratulate Mr O'Reilly on the paper which we have just heard. It is the first paper presented to the Society on the subject of quarterly national accounting, which is an interesting and important subject. I think Mr O'Reilly has carried out a very useful piece of work and has done us an invaluable service in this. Any criticisms I have to make relate to the subject of quarterly accounts in general and not to the author's treatment of the subject in his paper.

I think we would all agree that quarterly national accounts are a valuable tool for the policy maker - if they can be produced quickly and if the figures are reasonably accurate. The problem is, of course, can this be done? One must remember that even the annual national accounts have been criticised by policy makers because amendments to figures

are made many years after they first appear. If these criticisms are valid, then we must expect even greater criticisms in the case of quarterly accounts where the standard of accuracy would not be as good as for annual accounts. One must ask whether changes in certain aggregates in the quarterly accounts could more readily be misinterpretated by policy makers than changes in certain well-known indicators - such as retail sales, houses built, earnings in industry - for the items consumption, capital formations, incomes, etc.

Mr O'Reilly has introduced and discussed some mathematical relationships in his paper and, as I am not familiar with this field of work, I will leave it to others to comment on them. I must just raise one query - will the more sophisticated mathematical approach, such as Chow and Lin method, produce more reliable figures than the simpler methods of interpolation and regression? I remember some years ago, a past president of this Society saying to me that he thought that intuition and the "feel" of the situation were more valuable in producing reliable up-to-date estimates than complicated model building. Perhaps the users of the figures can furnish an opinion on this matter. It appears to me that improvement of basic data is a first priority for improved reliability rather than the use of more sophisticated models.

While the assumption the author has made in his paper in order to derive quarterly data are perhaps the best that can be made in view of the lack of information in many fields, there are two places in the accounts where the probability of deriving incorrect estimates is large and, unfortunately, the items themselves are large. Indeed, Mr O'Reilly has himself drawn our attention to them. The first relates to items in the Government accounts. This may seem surprising to you since it is known that Government accounts are very accurate and very detailed. However, a detailed classification of Government expenditure by economic category is available only annually, although summaries of departmental expenditures are available quarterly. If, however, one then assumes that the annual pattern of expenditure can be applied to quarterly total figures for the different departmental votes (as the author has done), erroneous results may be obtained. For instance, while wages and salaries may be spread fairly uniformly over the year, certain large subsidies and certain capital expenditure, appearing in the appropriation accounts, are not spread uniformly over the year but will occur at certain specific times. And, indeed, expenditure on sickness benefit and unemployment benefit would tend to be proportionately higher in the Winter than in the Summer. There is, therefore, no alternative to obtaining more detailed quarterly information for Government expenditure. Even if a full analysis of quarterly date by category cannot yet be carried out, some analysis restricted to categories which we suspect are not uniformly distributed over the calendar year would be beneficial and perhaps this could be done for one or two recent years without imposing too great a burden on departments.

The other weakness I see, and which the author recognises, is where Mr O'Reilly has tackled the rather intractable problem of estimating changes in stocks. While what Mr O'Reilly has done may seem reasonable, I think there is no alternative to obtaining data from a direct inquiry if we want reliable figures, particularly for industrial and commercial stocks. It is hardly surprising that the author is telling us that the performance of the indicators for changes in stocks is worrying.

To turn to some of the conceptual and practical problems in compiling quarterly accounts in a more direct manner.

It is always difficult to measure satisfactorily income and output in industries which have a long period of production compared with the accounting period. There are practical difficulties in measuring the output of construction for the national accounts in this regard and these, of course, are more difficult still in the case of quarterly accounts. This problem arises, both on a practical and conceptual level for agriculture. What should one do about crops which are harvested in the third quarter of the year? Should changes in

the stocks of growing crops be introduced into the accounts? Depending on the concepts adopted, I believe estimates for farm income can either fluctuate markedly from quarter to quarter or have a certain smoothness given to them. I have a recollection of looking at some quarterly accounts figures for different countries years ago and finding these differences in the treatment of agricultural income. Of course, the method of treating agricultural income is not of major concern in countries where it is a relatively small part of GDP but for Ireland it is a major problem. Another problem is the estimation of the profits of unincorporated businesses. In this field there are no up-to-date data available and, even in the case of annual accounts, these estimates, which are mainly based on Revenue data, are often revised for recent years. Since agriculture and small unincorporated businesses are important in Ireland, the estimation of quarterly accounts is made that much more difficult.

Even the direct compilation of expenditures on a quarterly basis is difficult. I have already referred to the problems with building and construction. In theory, there should be no problems with regard to expenditure on machinery and equipment and consumption expenditure of general government but there are practical problems in getting reliable data for these expenditures. The other main difficulty is to obtain quarterly information on stock changes. Clearly, these changes can be extremely volatile and the solution is to institute a quarterly stocks inquiry. While such an inquiry might give good data for larger concerns, it would be very difficult to get reliable data for small concerns.

If I appear to be disparaging any attempt to extend the use of surveys to obtain quarterly data, that is not my intention. It appears to me, however, that only the CSO and other Government departments are in a position to delve into individual monthly production forms (in order to obtain better estimates for capital formation) and to compile quarterly estimates of Government expenditure in various categories. These are essential constituents of an expenditure breakdown of GDP and if they were supplemented by reliable figures for changes in stocks, obtained from a special inquiry, we would be in a good position to compile reliable quarterly accounts on an expenditure basis. With the current emphasis on retrenchment in Government spending, it is not likely that the necessary work can be undertaken in the immediate future. I would, however, hope that some advance on these lines could be made during the present decade. In view of the fact that agriculture is such an important constituent in Ireland, perhaps research could be carried out with a view to determining the best method of obtaining quarterly estimates of agricultural income and expenditure. The question of priorities must enter into any decision to use scarce resources to develop quarterly accounts. There are still several countries in Europe which do not publish quarterly national accounts, so Ireland is not unique in this. So far, the EEC has not insisted on the production of these accounts.

While Mr O'Reilly's research into quarterly accounts is extremely interesting and important, it is difficult to assess the value of the methods he proposes for compiling quarterly accounts because, of course, there are no final figures available to measure the reliability of the estimates made. No doubt, those interested in up-to-date economic trends can make use of Mr O'Reilly's work, as well as using economic indicators at present available, and they will come to some conclusions on the matter. The real value of quarterly accounts depends on whether policy makers can make use of the results in guiding the economy and whether the decision-making processes will thereby be improved. For an answer to these questions, we must turn to the users of the accounts.

Once again I would like to pay tribute to Mr O'Reilly for an extremely interesting and useful paper, and I have much pleasure in proposing this vote of thanks.

E. Clarke: It gives me great pleasure to second the vote of thanks. We are privileged,

indeed, to have presented to us so clearly and so competently a summary of the work so far completed in the Research Department of the Central Bank of Ireland on the estimation of quarterly national accounts. This paper adds to the well established reputation of the Research Department of the Central Bank, and Mr O'Reilly is to be commended on a scholarly piece of work.

The Committee on Statistical Requirements and Priorities which reported in 1974 gave a high priority to the preparation of quarterly accounts produced on an expenditure basis. The fact that this recommendation has not been acted upon, reflects not only the resource difficulty of estimating national quarterly accounts which Mr Broderick has referred to, but also the extent of the statistical improvements since implemented, which had to take precedence over the preparation of quarterly national accounts.

However, for the purpose of annual model building, the preparation of quarterly accounts is a pressing need. It is the experience of the Department of Finance that further significant progress in annual model building will have to await the availability of quarterly data.

Pending the availability of official statistics, any attempt to make quarterly national accounts available is to be welcomed. However, it is difficult to assess the reliability of the data produced. This is not so much a criticism of the author but a reference to the more general question of the extent to which statistical manipulation of annual data will ever yield estimates of quarterly data which will be an adequate substitute for a real quarterly data and in which economic researchers can have reasonable confidence. The important aspect of this difficulty relates to the fact that the only tests on the estimates concern the extent to which the indicators perform in predicting each series on an annual basis. The assumption that the behaviour of the relationship between the indicator and the national accounts variable is no different on a quarterly basis than it is on an annual basis is so fundamental to the entire exercise that it should be subjected to some testing in order to reassure users of the data.

In the absence of quarterly national accounts, it is obviously impossible to test the derived series against actual data. Two approaches can be suggested, however, that might overcome this problem and allow the derived data and the fundamental assumptions to be tested. First, is it possible that in compiling annual data, the CSO may have sufficient data on certain series to allow a limited quarterly series to be made available to the author for the purpose of testing the derived series against "actual" series. Second, in those areas where quarterly series are actually available, perhaps the author would derive quarterly series using appropriate indicators and compare his derived series with the actual series. This would at least test the general applicability of the assumption that is fundamental to the methodology adopted. With these tests, practitioners will be in a better position to accept or reject the methodology and the derived quarterly series.

In evaluating the results and the direction of future work, the author includes Government expenditure among the most unsatisfactory variables. He points out that Government expenditure is one of the areas in which the quality of historical information should be much better and adds that a little more research should release more information. I would agree that the prospects for improvements are good because much of the central Government accounts are now computerised on an annual basis and it is intended to extend computerisation to the monthly monitoring. Problems of local authorities might be reduced when account is taken of the extent of central Government financing.

In conclusion, I would again wish to congratulate the author on a very worthwhile contribution.

R. C. Geary: I would like to add some notes to the historical opening of the paper in which the lecturer kindly notes me as part of the history, if now but an ancient monu-

ment. It all started during the war when J. J. McElligott, then Secretary of the Department of Finance, said at a conference to Stanley Lyon, Director of Statistics, and me, "national income is in the fashion; we should have a try". C. H. Murray, then an officer of the Revenue Commissioners, was seconded to us; we infer that his contact with national accounts did not impair his subsequent distinguished career. Years later, Richard Stone, then the prime authority on national accounting, praised Ireland for being one of the first five countries with official national accounts.

Mention of my lifelong friend, M. D. McCarthy, prompts the reflection that two years after Ireland's entry into UN we were awarded the chairmanship of the US Statistical Commission, in the person of Donal. I recall the occasion when he and I were on the UN rostrum, I, as a UN official presenting a staff memorandum on national accounts at constant prices. In those days, the late 1950s, it had a very cool reception; nowadays, with the blight of inflation so much increased, the constant price series are much more important than the current price series.

But as regards quarterly national accounts, I recall that at an international meeting (of IARIW, I think) in the 1950s, I rather sensationally announced that, as a result of an investigation I had made, the current quarterly USA national accounts estimates were unacceptable. I based this opinion on the fact that latest *changes* recorded in the values of several variables compared with the previous quarter were of the same order of magnitude as the changes due to correction subsequently made in the figures. These corrections in the latest estimates are the bugbear of national accounts. Also, the problem of up-to-dateness, for which I don't blame CSO but their correspondent's delay in sending in returns. Tonight's paper deals, not at all with the problem of producing current quarterly national accounts, far more important than the interpolated series for past years. It is hoped the lecturer proposes to tackle this problem and that he will have regard to the problem of change. I am at present examining theoretically whether changes recorded in his quarterlies are greater than the sampling errors of estimates, as of course they should be. I would like to know, as a test of reliability, what the quarterly estimates for 1977 would be if extrapolated from equations based on annual data for 1963 to 1976, i.e., how the sums of these 1977 quarterlies agree with national income and expenditure annuals.

Remarks about delay in publication of all economic statistics of which the NAs are a systematic synthesis, point to the need for a revolution in the manner of collection of these statistics. Surely something better than mailed returns will be possible in the age of the miracles of the computer and telecommunications. That the market economies are manifestly out of control everywhere is due in large part to economic statistics being too few and too late.

In Section 3 the example is not well chosen. The reason for the $R^2 = .999$ is that the sum of the indicators is nearly the same as the national income and expenditure variable, so why not use the latter? I have a lingering hankering for direct estimates of quarterlies, i.e., on the lines of the annuals because of my sense of the problem of change, already expressed. It is odd that despite the $R^2 = .999$, the DW is in the doubtful region. In a still, small voice may I remark that tau has no doubtful region, and that for practical purposes it is as good as DW and much simpler. When I see an R^2 of .99 between time series, like Marshal Goering about kultur, I reach for my gun.

I am puzzled by the role of Appendix 1, a system of equations with endos as NIE variables and exos mostly prices. Another oddity is that this equation system has 52 endos but only 42 linear equations for their determination.

I don't think Appendix 2 need be published. And out with all those preposterous computer decimal places from the quarterly table. One decimal place may be retained conventionally but in the certainty that the estimates are not correct to this place.

J. Durkan: I have two sets of comments. The first relate to the paper by L. O'Reilly and the second to some aspects of B. Broderick's comments.

The paper is an excellent piece of work. Quarterly National Accounts in Ireland have been prepared many times in the past but as an adjunct to other work where the quarterly data were required to provide data for hypothesis testing (MacAleese (1970), Stronge (1972)). Quarterly estimates currently available differ from each other so that an attempt to provide estimates that can be used by everyone is to be welcomed. However, having said this, there are some areas where further work needs to be done.

In particular, the figures for stocks need to be looked at again. The regression equation includes as independent variables the change in cow numbers, slaughterings of cattle at meat export premises and imports of materials for further production. The first variable seems to be incorrectly signed. Slaughterings, of course, include cows slaughtered. My point is not about this, however, but about the way to go about making up the figures. Stocks consist of stocks of livestock, intervention stocks and other stocks. For livestock there are two figures available per year - from the June and December enumerations. Both should be used with March and September derived from information and disposals. It is well known that reconciliation between the June and December figures is difficult - but this is the research problem. It does not make sense not to use all the information available.

For intervention products there are essentially two agencies - the Department of Agriculture and Bord Bainne. I am sure both know how much is held at any time, but there may be some work in providing this data going back. They should be doing it as a matter of course. In principle, there should be no difficulty with getting actual data for intervention products.

With regard to other stocks, we have to ask what are they? They consist primarily of work in progress, stocks of finished products at industry and distribution level and stocks of materials in industry. Rather than dealing solely with imports of materials for industry, the problem could be approached by looking at end year imports, and year retail sales, end year exports and end year industrial products.

On some other estimation problems it may be possible to derive tourism receipts on a quarterly basis from Bord Failte data. Many years ago, data were published by Bord Failte on a monthly basis showing the numbers of visitors arriving in Ireland. Even though these data are no longer published, they are, I understand, still collected and could be used to get an idea of the general flow per quarter. Nor do I think that imports of services under tourism would be difficult to get quarterly, given the limited number of travel agents and carriers. The only problems with both receipts and expenditure derive from day trippers.

In essence, what I am saying is that where there are data, use them rather than relying on mechanical measures.

At a different level, the description of what forecasters do is not fully accurate. There is first the question of consistency. It is possible to make up a set of expenditure forecasts using indicators but by itself this would be useless. An essential check is that the expenditure table should equal the National Income table. A second consistency check is that the volume of GDP from the expenditure side and the output side should be consistent. Thus, cement sales are not just an indicator of investment - they tell something about output, profits, etc. The second question relates to the claim that the procedure, as described, is informal and represents what forecasters do. In fact, forecasters have already estimated many of the relationships given here on annual data. What is fair to say is that they have not been published.

Finally, I would like to turn to some of the comments made by B. Broderick. In particular I would like to focus on the question of a stocks survey. The feasibility of such a

survey has already been established by Dr Geary and the results published in the *Quarterly Economic Commentary.* No one doubts that a continuous survey of this sort would be difficult, but many things are difficult.

Mr Broderick further assumes that no money will be available next year, so that even if the CSO were in a position to carry out such a survey, the constraint would be lack of funds. One could guarantee that if State agencies as a whole behaved this way, nothing would ever get done. The correct procedure is to gear up resources to be fully utilised, submit claims for new projects and increased resources and let policymakers choose between expenditures. I say this in the full belief that total State expenditure is too high.

Reply by L. O'Reilly: I would like to thank all who commented on this paper for their kind remarks and also for the criticisms which can only improve quarterly national accounts estimates.

I agree with Mr Broderick, Dr Clarke and Mr Durkan when they say that the estimates for Government expenditure and stocks need a great deal of improvement. In the case of Government expenditure, it is hoped to obtain more detailed information for later years from the Department of Finance. This should greatly improve the estimates for these years. It is intended to experiment with different indicators for earlier years. In the case of the stocks figures, again I agree with Mr Broderick that direct surveys are the answer. However, until they are instituted, we have to make do with the information available. In this regard, Mr Durkan's suggestions are most useful and will be pursued.

As well as Government expenditure and stocks, I would mention disposable income as being a variable needing improvement. Too many elements of this variable are interpolated at the moment. Undistributed profits is a variable which needs particular attention. Also, an attempt to estimate GNP from the income side would be a project well worth taking on. This would also partially satisfy Mr Durkan's point on consistency checking.

I would like to take up Mr Broderick's point that my method is not a direct one. I would disagree with this contention. My method uses survey information which is directly available on a particular variable (e.g., Retail Sales Index for consumption). Where I would agree is that in some cases, the information is scarce and in these cases more intensive surveys are necessary - e.g., stocks. The regression method is then used simultaneously to gross and interpolate survey information to the aggregate level; again a recognised procedure. This brings me on to another point of Mr Broderick's which states that the Chow and Lin method is complicated. The only difference between Chow and Lin and the simpler methods of regression and interpolation is that Chow and Lin integrate their regression and interpolation procedure and allow for the possibility of autocorrelation, an endemic problem with economic time series. Also, Mr Broderick's point on the meaningfulness of quarterly agricultural income (and thus on total quarterly income) becomes less relevant as we become more industrialised.

Finally, and most especially, I would like to take up the comments made by Dr Geary, a person with a distinguished record in the national accounts field. I agree that up-to-dateness of statistics is very important and in picking my indicators I had particular regard to this. In fact, it is one of the reasons why I tackled the estimation of quarterly accounts from the expenditure side where data are much more up-to-date than on the output or incomes side. As I mentioned in this paper, I intend to automate the whole procedure to facilitate the production of up-to-date numbers. I agree that a better example could have been chosen in explaining my methodology. However, this is only from the statistical side, whereas the mechanical methodology was being explained in the text at that point. I do intend, on his suggestion, when automating the procedure, to integrate the Tau test into the methodology. His comment about 52 endos and only 42 linear equa-

tions is correct, and I will be making an appropriate adjustment to the system.

The role of Appendix 1 was to emphasise that when collecting and estimating data one has to have in mind the purpose of their collection. On the content of the model, I could argue about the specific merits of the model specified. However, as stated in the paper, its purpose is to set up a framework to estimate the accounts. Once the accounts have been estimated and I have reached the model building stage, the functional form and the exogenous variables used could be changed somewhat.

On Dr Geary's suggestion, I have removed the decimal places from the tables for publication purposes and have only published a selection of the variables estimated.