

TWENTY—FIVE YEARS OF MODELLING THE IRISH ECONOMY — RETROSPECT AND PROSPECT[†]

Connell Fanning* and John Bradley**

I INTRODUCTION

Macroeconometric models provide a simultaneous and endogenous empirical framework for the evaluation of policy alternatives and the generation of forecasts. As such they can play a significant role in policy research and the broader policy—making process. To date, however, there has been little or no utilisation of this instrument in the wider policy process in Ireland.¹ This is despite the fact that at least twenty—one such models have been constructed during the period under review. The purpose of this paper is to survey the past record of model building in Ireland and consider some aspects for future development.

A survey, however brief, serves three functions. First, it is simply a statement of the historical record of work done and by whom. This is particularly important in this area because in many cases the research findings were never, or were only incompletely, published. Second, a survey is an attempt at stocktaking: where have we been; where we are now; where should we go from here? Such a need arises also because, for example, the lack of availability of models has hindered the development and use of models in Ireland and resulted in duplication of effort. Third, the survey should therefore assist in developing a “view” of the Irish economy based on past interactions between economic theory, actual experience, and economic data.

In the following section a short chronological account and comparative perspective on the models is presented. In the third section these will be reviewed against the stages involved in economic model building. The fourth section contains some considerations about future prospects for model development and use as part of the national policy—making process.

As will be seen the coverage of models exceeds the macroeconometric to include, as the paper title suggests, macromodels of the Irish economy. This allows us to include two models which were specified formally in mathematical terms but the parameters of which were not estimated nor the models operationalised. Also included are two further models that were not specified explicitly but rather were implicit in works not immediately concerned with the formal specification and testing of economy wide models. Therefore, because of the importance of the works, we have derived “core” models, which are obviously our own subjective constructions but, it is hoped, fairly represent the position.

Finally, two caveats are in order. First, the story is based on models which were published or at least recorded (and available to us) in some documented form. This, of course, may be only part of the story and so may result in biases but, as the story itself indicates, a major requirement for macroeconometric models to be used in policy analysis

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* Statutory Lecturer in Economics, University College, Cork, and Visiting Scholar, Economic and Social Research Institute, Dublin.

** Senior Research Officer, Economic and Social Research Institute, Dublin.

is documentation. Second, the models considered are those only for the economy of the Republic of Ireland and does not include models of Northern Ireland, United Kingdom, or the EEC countries that were sometimes constructed in relation to modelling the Irish economy.

II RETROSPECT: MODELS 1958–1982

The principal characteristics of Irish macromodels to date are summarised in Table 1. The arrangement is chronological and shows information about data, estimation, size, validation and purpose/use for each model. Further information about the main features and occasional comments are given in the following chronology in which the models are reviewed in three groups.²

Initiation of Macromodelling (1958–1967)

Economic Development, published in 1958, was the seminal document in economic programming and the analysis and policy prescriptions contained in it provided the basis for the (First) Programme for Economic Expansion. Although a macromodel is not specified explicitly in the manner of a mathematical or macroeconomic model, clearly there is an underlying view about the operation of the entire economy and, therefore, the overall approach has an affinity to these types of models. Macroeconomic models, being based on historical data and explicit behavioural relations, permit analysis of what resources are likely to be forthcoming given past experience. This concern with mobilisation of resources was a major aspect of Economic Development. (The other, of course, was the planning aspect concerned with the preferred use of resources.)

The underlying model identified, and illustrated in Figure 1, is, therefore, one for developing the economy. Its main property is that it is basically an export-led growth model with a key facilitating and promotional role assigned to government policy and foreign direct investment in manufacturing providing the main impetus in expanding capacity. The openness of the economy is reflected in the relationship between Irish and United Kingdom variables in the labour, goods and financial sectors. Subsequent econometric modelling operationalised, with varying degrees of detail, the basic framework sketched in Figure 1.

E.D. – 1958 is a model quite unlike others in the survey in that, while it may be based on theoretical and empirical analysis of the economy, it was not specified, estimated, or most importantly, tested in the manner that is possible with macroeconomic models. Rather the “testing” of this model was undertaken by direct application to the economy. There was no a priori evaluation of the relationships or quantitative effects of changes in policy variables. This has been a notable feature of the national economic policy process in Ireland until the present.³

The first macroeconomic model of the economy appears, hardly surprisingly, to be one by R.C. Geary.⁴ GEARY – 1964 is a small growth model of the Harrod–Domar type. Besides the accounting features and relationships associated with the standard Keynesian income determination model, the key relationship is between increases in the capital stock and increases in output via the constant (average and marginal) technologically fixed net capital to output ratio. In such models the rates of growth of income and capital stock are equal to the savings rate divided by the net capital to output ratio. Geary used this model, with parameters derived (generally by averaging) from recent economic data, to explore the effect of alternative output growth rates on the foreign balances constraint and of alternative savings and capital–output ratios on the growth rate of output.

The first large scale, and until quite recently the largest, macroeconomic model of the Irish economy was constructed by Walsh. WALSH – 1966 is more similar to the con-

Table 1 *Summary Comparison of Irish Macromodels, 1958–1981*^a

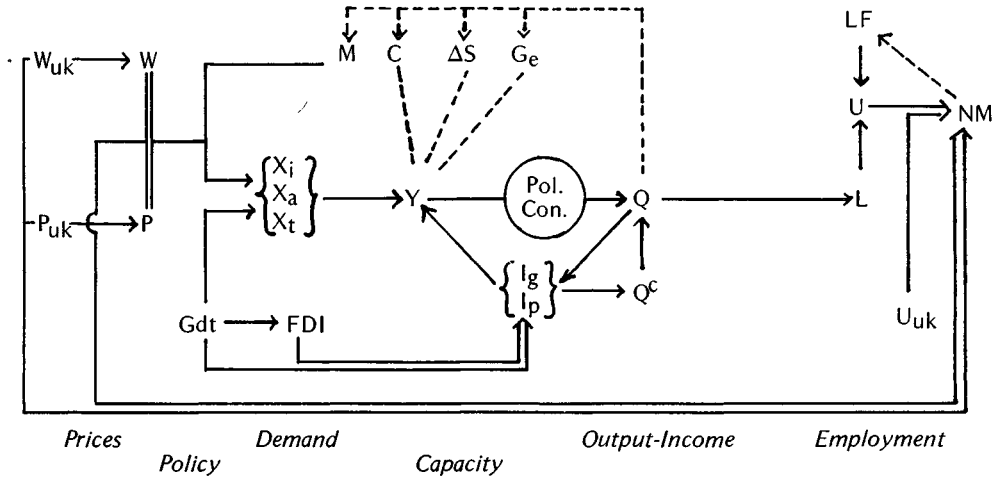
Model Designation and Year	Data		Estimation	Size				Validation ^b	Purpose/Use
	Periodicity	Sample Period		Equations		Variables			
				Behavioural	Identities etc	Endogenous	Exogenous		
1 ECON DEVEL — 1958	— ^c	—	—	—	—	—	—	—	
2 GEARY — 1964	Annual	1947–1961	OLS, Averages	6	3	9	1	—	Policy Analysis
3 LESER — 1964	Annual	1948–1962	OLS	6	0	6	3	1	Forecasting
4 WALSH — 1965	Annual	1944–1966	OLS, TSLS	20	1	21	17	1, (4)	Forecasting and Policy Analysis
5 LESER — 1967	Annual	1953–1965	OLS	4	1	5	7	1	Forecasting
6 STRONGE — 1971	Quarterly	1961 I–1968 IV	OLS	11	6	17	17	1, 2, 5	Policy Analysis
7 CLARKE — 1971	Annual	1958–1968	OLS	23	4	27	18	1, 2	Policy Analysis
8 CLARKE — 1972									
A Fiscal	Annual	1954–1969	OLS	n a	n a	n a	n a	n a	Accounting Framework
B Income/Expenditure	Annual	1958–1969	OLS	2	5	26	n a	n a	Accounting Framework
9 TEEHAN — 1972	Annual	1955–1970	OLS, TSLS	15	14	29	17	2, 5	Policy Analysis
10 LENNAN — 1972	Annual	1953–1968/69	OLS	16	11	27	29	1, 4	Policy Analysis
11 ISS — 1972	Annual	1950–1968	OLS	33	15	48	19	4, 5	Forecasting
12 NORTON — 1973	Annual	1958–1970	OLS, I V	9 ^d	3	11	28	1, 2	Policy Analysis
13 SMYTH — 1974	Annual	Not Estimated	—	—	—	—	—	—	Policy Analysis
14 DESMOS — 1974	Annual	Not Stated	OLS	23	15	38	24	1, 5	Policy Analysis
15 SPENCER/HARRISON — 1975	—	Not Estimated	—	9 ^e	8	17	7	—	Policy Analysis
16 KENNEDY/DOWLING — 1975									
A Income/Expenditure	—	—	—	—	—	—	—	—	Policy Analysis
B Growth	—	—	—	—	—	—	—	—	Policy Analysis
17 WEFA — 1975	Annual	1958–1973	OLS	79	13	92	13	n a	Forecasting
18 GEARY/McCARTHY — 1976	Annual	1951–1971	NLTSLS	4	3 ^f	7	6	1 ^g	Policy Analysis
19 COMET — 1976	Annual	1953–1972	OLS	31	37	68	9	1, 3, 5	Policy Analysis
20 CENTRAL BANK — 1977									
A MAXI	Annual	1953–1974	OLS	50	43	93	76	1	Policy Analysis and Forecasting
B MAXI (Rev)	Annual	1953–1975	OLS	53	54	107	89	1, 2, 3	Policy Analysis and Forecasting
C MINI	Annual	1953–1974	OLS	9	17	26	43	1–5	Policy Analysis and Forecasting
21 FANNING — 1979	Annual	1954–1974	OLS	79	114	193	85	1, 2, 3, 5	Policy Analysis
22 CB/DEPT of FINANCE — 1981	Annual	1960–1978	OLS, TSLS	77	191	268	117	1–5	Forecasting and Policy Analysis

Notes

- (a) Based on published information
 (b) The following was used to indicate roughly the type of validation carried out on a model
 1 Single equation statistics,
 2 Within-sample static simulations,
 3 Within-sample dynamic simulations,
 4 Out-of-sample dynamic simulations,
 5 Multiplier and elasticities analysis

- (c) Indicates not applicable
 (d) 4 stochastic
 (e) All non-stochastic
 (f) Two of these convert rates of growth to levels of variables
 (g) Analysis of comparative static properties

Figure 1: Scheme of 'Core' Model, ED – 1958



Notation:

- | | | | |
|-----|--|----------------|---|
| C | – Personal Consumption | NM | – Net Migration |
| FDI | – Foreign Direct Investment | P | – Price |
| Ge | – Endogenous Government Expenditures and “Non-Productive” Investment | Pol.Con. | – Policy Constraints, (Balance of Payments, Government Borrowing) |
| Gdt | – Government “Development” Transfers (Capital Grants etc., Training, Trade Promotion etc.) | Q | – Output (Value-Added) |
| Ig | – Government “Productive” Investment | Q ^c | – Capacity Output |
| Ip | – Private Investment | X _a | – Agricultural Exports |
| L | – Employment | X _i | – Industrial Exports |
| LF | – Labour Force | X _t | – Tourism Exports |
| M | – Imports | S | – Stocks (Δ : change) |
| | | U | – Unemployment |
| | | W | – Wage Rate |
| | | Y | – G.N.P. |
- (Subscript UK denotes British variables)

temporary approach to modelling the details of the economy, as summarised in the national income and product accounts, than the highly stylised approach of Geary. As with Geary's model the purpose was an examination of the structural development and growth of the economy. In this case two sectors (Industry and Agriculture) are separately endogenised reflecting the stage of development of the economy at the time, as well as severe data limitations. Within each of these sectors, employment, production, and exports are explicitly modelled. The interaction, growth, and change of the two sectors are thereby made explicit. The model also includes details of the demand, prices, incomes, and monetary sectors. With hindsight it can be regarded as filling in some of the behavioural relationships that underlie the "great ratios" of Geary (1964).

If both these models reflect one concern of Economic Development, that of growth and development in the medium-term, the other modelling work of that period reflects a second concern which was with immediate future prospects. LESER – 1964 and LESER – 1967 are small aggregate demand forecasting models. Their purpose was to produce short-term forecasts of the major components of GNP by expenditure. The equations are simply specified with little or no structural economic content.

The Second Modelling Phase (1971–1976)

The next group contains twelve models developed and published during the period 1971–1975. Three of these models are qualitative. Interestingly, of the nine macro-econometric models four were constructed by foreign modelling groups. The first, STRONGE – 1971, is the only quarterly model in the complete list of models. The data were derived from annual national accounts data by interpolation methods and using a range of expenditure indicators. The expressed purpose was to examine the dependence of the Irish economy on that of the UK. However, the only transmission mechanism included are the relationships between Irish exports of consumption goods and producers' non-durables and the corresponding UK imports. TEEHAN – 1972 is a small short-term aggregate demand model which was intended for policy simulation rather than forecasting.

Three models, CLARKE – 1971, LENNAN – 1972 and NORTON – 1973, are medium-small models constructed to analyse particular aspects of the fiscal system. CLARKE – 1971 focuses on the effect of public capital expenditure, and current government expenditure on incomes and expenditure in the "medium-term". There is no output sector, and non-agricultural employment is exogenous. Following on this Clarke, with collaborators, constructed two further related models designated as Fiscal and Income-Expenditure models. The role of the Fiscal model was to indicate the effect of imposed levels of taxation on the Income-Expenditure framework and to estimate the level of taxation necessary to finance government expenditures. Overall the purpose of these models was to systematize and computerize tasks which had to be done clerically. They were intended to provide national accounting frameworks usable over a medium-term horizon, rather than to be behavioural or explanatory. These models, just as in the case of GEARY – 1964 and WALSH – 1966, suffered from technical estimation and model solution difficulties and point to what is to date the single biggest difference in modelling activity in Ireland, namely, the substantial improvement in computer hardware and software facilities.

LENNAN – 1972 was for analysing the flexibility of tax revenue by calculating elasticities with respect to GNP. The main part of this model is the tax revenue sector. A limited set of expenditure, employment, price and income variables are endogenised to feed into the tax sector; but GNP was exogenous. NORTON – 1973 was designed to analyse the short-run effects of fiscal policy. This model also endogenised a very limited set of variables – personal consumption, gross private fixed investment, total imports and

undistributed company profits — together with isolating seven policy instruments to provide a highly aggregative tool for analysing the discretionary and non-discretionary impact of the government budget. This study was the first attempt to use an explicit endogenous and simultaneous framework for analysing the impact of government policy over some historical period, 1960–1970.

Two more comprehensive structural models were part of the DESMOS and COMET projects of nine interrelated models of EEC member countries. These were constructed by, respectively, Waelbroeck and Dramais of the Free University, Brussels and Barten et al., Louvain. The purpose was to study the interaction of policies and economic development in the EEC. In DESMOS each country's sub-model consists of four blocks of equations: a factor demand block, an income expenditure block, a wage-price block, and a trade linkage block. Similar equations were used for all sub-models so that the linked-model system would be easily understood. In other words, policy shocks would feed through each country sub-model in a similar manner so that divergent results would be due only to individual country coefficients and not behavioural differences. DESMOS — 1974 was also constructed to have reliable short and medium-term properties. Multipliers were calculated for each country and also for synchronised economic policies within the EEC.

The same desire and broad approach to capture inter-country effects motivated the construction of COMET — 1976.⁵ Once again identical models were specified for each country in order to control the sources of variation in results. COMET has a strong medium-term perspective with an explicit treatment of capacity utilisation and productive capacity developed by means of an aggregate vintage production function. This allows the interaction between supply and demand factors to be endogenised. The capacity utilisation variable has a major influence on the entire structure of the model, both as an explanatory variable in expenditure and demand for factors of production and to explain part of prices variation.

Because both DESMOS and COMET are sets of linked country models the treatment of inter-country trade, within the EEC, is endogenous to the overall model. The comparative response for each country to impulses due to national economic policies and shocks from outside the EEC can be traced. This is relevant both for individual country behaviour and the exploration of EEC policy harmonisation.

Two forecasting models were also constructed by foreign modelling groups. ISS — 1972 was constructed at the Institute of Social Studies, The Hague. This was done as a country case study by international participants in a seminar on socio-economic planning. It is a fairly large aggregate demand model for short-term forecasting. The interesting feature of the model is that variables in the major relationships are in nominal values rather than real or deflated terms. WEFA — 1975 is also a short-run forecasting model by Wharton Econometrics and Forecasting Associates, Philadelphia. The purpose of such a model is to simply track the main components of the national accounts and, to the extent that structural detail is included, it is a standard demand forecasting model in the "Wharton" mould.

The remaining models of this group are the three qualitative models. SMYTH — 1974 and SPENCER/HARRISON — 1975 are basically modifications to the conventional short-run comparative static macromodel to allow for key characteristics of the Irish economy, particularly the openness vis-a-vis the UK economy. Although specified formally in mathematical terms these models were not estimated (surprisingly perhaps in the case of the second one which includes substantial sectoral detail and which was intended as the overall framework for individual sector empirical studies). They were used for comparative static analysis of the impact of changes in policy and exogenous variables.

The final model KENNEDY/DOWLING — 1975, is interesting in that it results from an explicitly analytical and comprehensive examination of economic growth in Ireland

and considers both longer-term development aspects as well as shorter-term demand management issues. The authors' emphasis was on the behaviour of components of aggregate demand, changes in the structure of the economy and the major economic forces underlying these changes and the short-run management of the economy. To the extent that stylised formal models can be identified, in a manner suitable for comparison with those examined already, there would seem to be two such models underlying the Kennedy and Dowling analysis.⁶

The underlying medium-term model is regarded primarily as an export-led growth model, for example of the type analysed by Cornwall (1977: Chapter 9). The extensive discussion of demand management is not conducted in the context of this medium-term growth framework. Rather, a very short-term model seems to underlie the discussion of the role of fiscal policy. These are designated Model I and Model II, respectively, and are outlined in Table 2.

Model I shows (equations 1–3), that aggregate output growth is driven primarily by export growth; the competitiveness of the export sector determines export performance. Labour productivity growth is related to output growth in the manner of Verdoorn's Law. The remainder are aspects not explicitly examined by Kennedy and Dowling but fill in the elements necessary to determine employment and unemployment (equations 4–7) and wages–prices (equations 8 and 9). The main property of the model is its explicit identification of a driving force, exports (but modification can allow for investment), for growth in the economy and its longer-term orientation.

The main features and properties of Model II are those of similar small short-term demand management models, such as NORTON – 1973, and we need not consider it further here. The equations are also listed in Table 2 as an illustration of models of this type.

Phase Three (1979–1981)

The story so far has been one of quite a number of foreign and domestic modelling projects but, apparently, with little direct connection between the individual efforts. It is somewhat ironic that macroeconomic modelling, while it offers a very useful framework for bringing together in a coherent manner a diverse range of specialised and sectoral studies, did not in this instance, result in any great interaction and culmination of experience and understanding of model-building and model use in Ireland.⁷ The final two models, FANNING – 1979 and the various versions of the Central Bank model, culminating in the Central Bank/Department of Finance MODEL 80, while not guiltless in terms of trying to “re-invent the wheel,” were attempts to bring together and build on earlier work. Both are large sized structural models of the economy that have paid particular attention to the production and factor demand aspects of the economy.

The macroeconomic modelling project undertaken by a team at the Central Bank in 1975 is the largest modelling project to date in Ireland. For the first time the personnel (which varied) and other resources committed to the project were substantial and, of great importance, the support system of a model grew and was sustained. This resulted in a series of models [MAXI, MAXI (Revised), and MINI] which, with the major collaboration of the Department of Finance later on, resulted in the construction and extensive use of CENTRAL BANK/DEPARTMENT OF FINANCE (MODEL-80, 1981). These models were constructed primarily for short-run demand management and incomes forecasting and policy analysis. Their structure reflects those goals in the extensive government sector and attention given to the effects of government variables on other sectors. The testing and documentation of the construction and analysis of these models is the most comprehensive to date.

FANNING – 1979 is a general purpose model that was used to assess the relative effectiveness of various aspects of aggregate employment policy, as contained in the

Table 2: 'Core' Models, Kennedy/Dowling — 1975

<i>Model I: Export-led growth model</i> (· denotes rates of growth)	<i>Model II: Short-term demand management</i> (— denotes exogenous variable)	
1. $\dot{Q} = a_0 + a_1 \dot{X} + a_2 \dot{OD}$	1. $Q = C + I_p + \Delta S + \bar{I}_g + \bar{G} + \bar{X} - M$	
2. $\dot{X} = \beta_0 + \beta_1 [1 - (\dot{P}/\dot{P}_f)]$	2. $C = \phi_0 + \phi_1 Q$	
3. $\dot{q} = \gamma_0 + \gamma_1 \dot{Q}$	3. $I_p = \theta_0 + \theta \Delta Q$	
4. $\dot{L} = \dot{Q} - \dot{q}$	4. $\Delta S = \epsilon_0 + \epsilon_1 Q + \epsilon_2 S_{-1}$	
5. $U = LF - L$	5. $M = \mu_0 + \mu_1 Q$	
6. $\dot{LF} = \delta_0 + \delta_1 \dot{POP} + \delta_2 \dot{NMA}$	6. $BP = \bar{P}X - P_f M - NFI$	
7. $\dot{NMA} = \eta_0 + \eta_1 (\dot{U} - \dot{U}_{uk}) + \eta_2 (\dot{W} - \dot{W}_{uk})$	7. $L = \lambda_0 (Q)^{\lambda_1}$	
8. $\dot{W} = \omega_0 + \omega_1 \dot{q}$		
9. $\dot{P} = \dot{W} - \dot{q}$		
<i>Notation:</i>		
BP = Balance of Payments*	NFI = Net Capital Inflows*	S = Stocks
C = Personal Consumption	NMA = Net Migration Abroad	U = Unemployment
G = Government Current Expenditure	OD = Other Domestic Demand (C+I+G)	U_{uk} = Unemployment in UK
I_g = Public Investment	P = Domestic Price	W = Wage Rate
I_p = Private Fixed Investment	P_f = Foreign Price	W_{uk} = Wage Rate in UK
L = Employment	POP = Population	X = Exports
LF = Labour Force	q = Output-per-worker	
M = Imports	Q = GDP (Output/Expenditures)	

* denotes variables in nominal values; Greek letters denote coefficients.

Programmes for Economic Expansion (1958–1968), by estimating dynamic elasticities with respect to selected variables. The intention of analysing employment in a medium–term framework are reflected in: (i) consistency aspects of the production sector output–joint factor demand systems for Industry and Service sectors (only output was endogenized in Agriculture); and (ii) consistency among categories of the use of personal income, which includes personal saving, in the household sector.

Current Developments (1982)

CENTRAL BANK/DEPARTMENT OF FINANCE – 1981 (Model–80) is now shared between the Central Bank, Department of Finance, and the Economic and Social Research Institute. Of all the projects covered it is the only one which is now undergoing continued development and use, and is to be revised. Two other models are also under development at the ESRI. The first, ECM – 1982, is part of a Commission of the European Communities macrosectoral model and is a successor to the COMET project. As in that project it is constructed to a tight specification which is similar for all ten member countries and is intended to provide an “operational instrument for the preparation of economic and energy decision making” (d’Alcantara and Italianer, 1982:6). The second model, BRADLEY/FANNING – 1983, is a development of the medium–term line of analysis and part of a project intended to provide a multi–purpose medium–term model framework and to explore the uses of such models in policy research and decision–making. A draft report on the first stage of this project is available (Bradley and Fanning, January 1983).

III OVERVIEW OF MODEL FEATURES

Twenty–eight macromodels of the Irish economy were available for inclusion in the survey. Three were “implicit” models and two, although specified mathematically, were not estimated. In this section we summarise some general aspects of the remaining twenty–one macroeconomic models: (two models cited under current developments are excluded). The econometric approach to empirical analysis can be decomposed, conceptually at least, into five stages: (i) purpose or problem definition, (ii) specification of model, (iii) estimation of relationships, (iv) evaluation and, (v) application. The construction of macroeconomic models of the economy, is a sequence of applying the above stages to: (a) the equation(s) of individual components of the model; and (b) the complete macromodel. Here we are only concerned with each model as a whole and, in this light, will briefly review the modelling record under these five headings. Furthermore, no attempt is made to evaluate the quality either of individual models or macroeconomic model building and use itself. The quality, i.e., the plausibility and stability of relationships and model results, is determined by the adequacy of the underlying theory – indicating variables, functional form lags – and statistical aspects, estimation techniques and measurement issues, (including data availability and quality, sample size, periodicity etc.). As the recent FitzGerald and Keegan (1982) paper, and the ensuing debate, showed these are areas of important and continuing controversy.⁸ However, our concern here is more taxonomic, seeking to identify the types of models and their general characteristics.

Purpose

The two purposes for building econometric models are forecasting future values of variables and explanation, i.e., hypothesis testing and quantification of relationships for policy analysis and control. In practice it is very difficult to combine the two goals of a regular forecasting tool and of an analytical instrument in one macroeconomic model. Usually the purpose given priority tends to shape the project and be reflected in the model features. The expressed purposes for almost all the models were to provide explanations of some macroeconomic feature of the economy. Only the models by Leser and ISS had the expressed purpose of being solely for forecasting.

The amount of detail to be included in a model is determined by these purposes and the manner in which it is going to be used. Most of the models surveyed would be classified as small (up to 20 equations) or medium (up to 50 equations) sized in terms of the range of current models. Forecasting models tend to be small, such as Leser's model, reflecting the problem that the more disaggregated the model, usually, the more exogenous variables that also have to be forecasted by other means which introduces further channels for errors. The large models are usually the general purpose structural models although behaviourally Norton's model, for example, has only four endogenised variables.

Specification

An account of the detailed specification of each model cannot be included in a short review. Instead we set out a prototype model that encompasses the main features of models built to date. All are of the "Keynesian" aggregate demand/income determination type of model. The framework for these is the national income and product accounts. The prototype model is organised around three blocks and is given in Table 3. This model broadly reflects (ignoring lags and stochastic specification) the types of models constructed for Ireland. A monetary sector is not included here. Under fixed exchange rates — as was the case for the models constructed to date — money supply is endogenous in a small open economy. The monetary authority can only operate a reserves policy by varying the domestic credit expansion component of money supply.

Using this prototype macromodel we can segregate the models constructed according to their coverage. Models which emphasise the aggregate demand block are usually designated short-run or stabilisation models because of the omission altogether, or the narrowness, of the supply block features. The majority of the models were, therefore, short-term models. Exceptions, to varying degrees, were WALSH — 1966, DESMOS — 1974, COMET — 1974, FANNING — 1979, and CENTRAL BANK/DEPARTMENT OF FINANCE — 1981. GEARY — 1964 being a Harrod type growth model is also a model with supply side features but, in this case, the model is at such an abstract level that there is little behavioural detail.

Estimation

Following the specification of relationships, coefficients are then estimated by statistical techniques, almost entirely regression analysis. (An exception, for example, is GEARY — 1964 in which parameter values are sample period averages.) The most common estimator is ordinary least squares. As is well known, problems of simultaneity of relationships, errors in measurement and omission of variables may give rise to deficiencies in the OLS estimator for macroeconomic time series modelling. However, it continues to be the standard estimator especially for large sized models. Some use was made of other estimators in WALSH — 1966, NORTON — 1973, DESMOS — 1974, and CENTRAL BANK/DEPARTMENT OF FINANCE — 1981.

Evaluation

The evaluation of a model relates to the purposes for which a model is constructed. If forecasting is the sole purpose then the criterion that matters is how well the model performs that task. Particular equation specifications and design of the model system are not of major concern in that case. They are, however, fundamental if the purpose is explanation. The evaluation procedure usually employed to assess macroeconomic models is that of prediction. This involves two aspects: (i) retrospective predictions (historical validation); and (ii) prospective predictions (forecasting out of sample). It is basically a "goodness of fit" approach although there is less agreement on standardised set of error statistics for an entire model than in the case of individual equations.

To varying degrees all the models here, whether for forecasting or explanation, were evaluated according to the prediction criterion. Other than the ability to replicate actual

Table 3: *Prototype for Macroeconometric Models of the Irish Economy, 1958–1981*

Block Structure:

Block 1 – Aggregate Demand

$$\begin{aligned} C &= C(YDV/P, i, Z) \\ I &= I(Y, K, i, Z) \\ G &= \bar{G} \\ M &= M(Y, P/\bar{P}_f, Z) \\ X &= X(P/\bar{P}_f, \Pi/K, Z) \\ Y &= C + I + G + (X - M) \end{aligned}$$

Block 2 – Aggregate Supply

$$\begin{aligned} \hat{Y} &= aK_{-1} \\ K &= (1 - \delta)K_{-1} + 1 \\ CU &= Y/\hat{Y} \\ L &= L(Y, K_{-1}, W/R, Z) \\ LF &= LF(\bar{N}, NM, W/P, UR) \\ NM &= NM(W/\bar{W}_f, UR/\bar{UR}_f) \\ UR &= (LF - L)/LF \end{aligned}$$

Block 3 – Prices and Incomes

$$\begin{aligned} W &= W(P, UR, \bar{W}_f) \\ P &= P(W, Y/L, CU, \bar{P}_f) \\ YDV &= P.Y - \bar{T} \\ \Pi &= P.Y - \bar{T} - W.L \end{aligned}$$

Notation:

- (– above variable indicates exogenous)
- C = real consumption expenditure
 - Cu = capacity utilisation
 - δ = depreciation rate (exogenous)
 - G = government current expenditures (policy variable)
 - i = rate of interest
 - I = real investment expenditures
 - K = capital stock (deflated values)
 - L = employment (numbers)
 - LF = labour force (numbers)
 - M = real imports
 - N = population (numbers)
 - NM = net migration (numbers)
 - P = price level (subscript f indicates foreign)
 - Π = profit
 - R = rental rate for capital
 - T = net income taxes (policy variable)
 - UR = unemployment rate (subscript f indicates foreign)
 - W = money wage rate (subscript f indicates foreign)
 - X = real imports
 - Y = real gross national product
 - \hat{Y} = capacity real output
 - YDV = nominal disposable national income
 - Z = other exogenous variables

quantitative data no other corroborating evidence (other than the little implicit in the specification stories and calculation of multipliers which are evaluated subjectively by authors) was brought to bear on the model systems.⁹

Evaluation by the prediction criterion ranges from the application to individual equations, and the usual individual equation statistics, to quite comprehensive model-wide application. The most comprehensive prediction evaluation is that conducted over the years on versions of the Central Bank/Department of Finance model and the latest, that by FitzGerald and Keegan (1982), sets a standard of evaluation which future structural models will have to meet.

Application

The range of model applications as we saw in the chronological account of the surveyed models is quite extensive. They include (out-of-sample) forecasting, calculation of multipliers and elasticities and structural and policy dynamic simulations. The latter included examining impact of government policy (both structural and budgetary) over historical and future periods, interaction between UK and Irish economies and as part of feasibility studies for EEC policy coordination and harmonisation.

Implications

There has been extensive macromodelling of the Irish economy over the past twenty-five years. However, this has not resulted in what has been called a modelling "culture" in either empirical analysis of the Irish economic system or in policy making. A priori quantitative evaluation of alternatives is not a feature of the general policy process in Ireland despite the range of models constructed. The very range of models may have itself contributed to this situation. The story is one of diverse, disjointed, and once-off attempts with very little if any building on the work of previous modelers. Not until the work leading to Central Bank/Department of Finance – 1981 was a domestic model constructed in the context of an integrated support system that is essential for the use of models in policy making.

The first reason for the lack of sustained progress in empirical model based analysis in Ireland is that almost all the domestic attempts have been the work of individuals working singularly without the modelling support of any institution. There are four aspects to model based policy research: theoretical specification of a model; data collection; econometric estimation and evaluation; and, finally, model use. Whether the same individuals must cover all stages for any model does not seem as important as that the work is undertaken in a context that ensures the accumulation of information, experience and knowledge. The minimum requirements for the wide and continuing research use and maintenance of models is an integrated system consisting of data base (consistent and documented), econometric modelling software, a flexible and accessible simulation system (including remote interactive terminals) and a report generating system. There is no doubt that both computer hardware/software and data system difficulties have been major obstacles to the development and use of macroeconomic modelling research in Ireland to date.¹⁰ Given these, and institutional support for the model based approach to policy analysis, a pattern of model development and use might be brought about and sustained. But, given the manner in which modelling has been undertaken in the past, it is not surprising that systems and scenario analysis as operationalised in macroeconomic models is not yet a feature of the Irish policy process.

A second reason is the diversity of models that have been constructed. From the point of view of ongoing policy research macroeconomic models are, probably, the best general models to maintain for forecasting and policy analysis. Such models may be used for many different types of analysis and purposes. However, it is expensive to build models for every purpose, especially if once-off issues are to be explored. In order for macroeconomic models to be used as an integral part of policy making it is probably

necessary that multi-purpose general models of the economy be built and maintained in running order. The choice set for the construction of such models is: (i) forecasting and explanation; and (ii) short-term/stabilisation and medium/long-term features. For instance, the contemporary crises in energy and raw materials supply, growth and structure of the labour force and the role of the State suggest the need for long-term horizon models that emphasise such features as a tool for deriving macroeconomic scenarios as a basis for policy and planning. It is, of course, unlikely that any multi-role model will be as efficient as purpose built variants. The task is to minimise the differences so that all variants have the "maximum commonality". Then for specific projects such a model, (with tested and understood properties) can be adapted or extended in itself or by the addition of satellite models. Once again an implication would seem to be that the development and maintenance of general and plausible models of the economy in an operational state will require an institutional context that lowers the cost of model analysis and ensures cumulation of knowledge and expertise.

The barriers to the development of a modelling culture are well reflected in the following statement by one of the pioneers in macroeconometric model building and use:

A drawback of the econometric method is that it is time consuming, tedious, and complex. It is not a line of research for an armchair thinker. One must "roll up sleeves" and do a good bit of distasteful work if strong results are to be obtained. Modern machines are of the greatest help, but they cannot do all the library work, the building of series, the searching for causes of unsatisfactory results, and many other chores requiring patient hours of human labor. To build a realistic model of the American economy requires a year in data collection and preparation, another year in estimation with much experimentation following both false and fruitful leads, and finally years more of testing the model, applying it to practical problems. Every two or three years the model must be revised to keep it up to date. The magnitude of the effort involved is a definite drawback of the approach. (Klein, 1962:269)

While there have been major developments in computational facilities since that time there have been counteracting demands in terms of data and model specification, as well as assessment and use, that probably leaves the situation much as described above. Clearly if macroeconometric model analysis is to play a role in the broad policy-making process in Ireland, and not just within particular organisations and institutions, the barriers involved must be reduced. In the final section we turn to consider more generally how this might be brought about and, in particular, the institutional framework that may be necessary for the best use of this technique.

IV PROSPECT

Macroeconometric model-building is now an internationally established tool for economic research and can be expected to play an increasing role in Irish policy research. In this section some general issues involved in its future development and, especially, in the organisation of modelling activity are considered. It is emphasised that the concern here, as throughout the paper when judgemental aspects are involved, is with the role of macroeconometric models in the wider policy process.¹¹ That is, we are interested in their use as a framework for policy research and discussion by, for instance, the so-called "social partners". We believe that in such a context the nature of models as explicit, interpretative, and quantitative frameworks can make an important contribution to the political process of making economic policy in Ireland. The continual development and examination of models of the economy facilitates the common appreciation of how the economy works and of the constraints and potentialities facing decision makers.¹² The

following observations and suggestions about modelling are offered within this context and are not concerned about whatever uses individual organisations involved in forecasting and analysis may make of their own models within those organisations.

Two points about model-building in Ireland emerged from the survey. First, quite a large number of models were built, perhaps used once, sometimes published, and then, apparently, discarded. Second, although the models had a great deal of similarity, certainly in the broader structural features, there also seemed to be a lack of evolution, of "learning-by-doing" in a collective sense, in the activity, only one or sometimes two, persons constructing a model for a once-off purpose.

Because of the nature of forecasting and research activity generally it can be expected that the past process of individuals or groups singularly constructing their own models will continue. Researchers address new or different problems or have differing views about how a particular problem should be tackled. This, of course, is as it should be. But the construction of models, especially large-sized ones, the accompanying requirements for data collection and organisation, computer software and hardware systems, and the costs of updating and maintenance of data banks and models is such as to put sustained modelling activity beyond the scope of individual researchers (at least as such research is currently organised and financed in Ireland). It is most likely that future, especially large-scale, modelling activity will, not only, take place in but also require to be directly facilitated by research institutions, universities and other government agencies.¹³

These aspects, i.e., the proliferation and short-life span of models and the resource costs involved in such activity, raise questions about the approaches best suited to promoting model-based research and model-use in Ireland. First, we shall consider some aspects related to the multiplicity of models, data banks and computer software, and then turn to some issues concerning organisation of model-based research activity for use in national policy research and debate.

Whether model-building is undertaken by individuals alone or in a team context within organisations, model proliferation and discarding, and all that goes with it, seems to be a common phenomenon. Much the same reasons are valid whichever way the activity is organised. However, the remainder of the discussion is concerned with modelling in the context of major institutions for the reason stated about resource costs and, implicitly, because the interest is in sustained modelling activity and concern with research into the major current economic problems.

Among many reasons the following are particularly relevant to future development:

- (i) models are constructed to tackle particular problems and for a particular purpose. New problems, therefore, give rise to new models;
- (ii) even when a problem is much the same there is a personal element involved in that a researcher seems to need his or her own model;
- (iii) besides the individual preference aspect, model repetition is often necessary because of inadequate documentation of models, data, and econometric systems, which result in a lack of understanding and confidence as well as the lack of accessibility of the operational process;
- (iv) there may, therefore, be difficulties updating and adapting models to immediate needs;
- (v) such difficulties are further compounded by the very nature of model-building. A large amount of subjectivity goes into a model which, when added to the practical requirements of getting equations that "work" (and, therefore, which "fall apart" when data bases are revised), means that each model looks highly idiosyncratic to the next person;
- (vi) thus when personnel change, as is unavoidable in any research organisation, it may be, or appears to be, easier for a new person to begin again rather than spend the

- time trying to get a grip on the data, software, and “biases” etc., of a previous model; and
- (vii) besides these, factors such as major revisions to data bases and changes in computer technology and software systems add further to the same ground all too often being traversed in modelling macroeconomic activity.

Attention has been drawn in the preceding discussion to general factors causing unnecessary “social” and “private” costs in model—building. If macro—modelling is regarded as an important tool for policy research and economic forecasting these barriers, as well as the lack, indeed scepticism, of an empirical modelling approach to policy research will have to be overcome. Some arrangement is necessary to facilitate individual researchers in model—building and at the same time avoid wastage of the type outlined above.¹⁴

The implication of the above is that some “centre” is necessary to provide the base — the continuity of modelling data bases, models, and so on — for sustained model research and policy applications. It would seem necessary, because of limited resources reasons, that one such centre be founded initially as a deliberate promotion of such an approach to policy research.¹⁵ This, together with issues concerned with the nature and appropriate use of macroeconomic models, suggests that such “centres” should probably be in a non—government setting, but must be independent of interest groups. Four related issues are particularly relevant:

- (i) A fundamental reason is that once a model is used in policy research it becomes part of the “case”. Scientific procedure requires that it, like any laboratory technique, be open to inspection and replication by other researchers. While explicit, in the sense that equations are listed and so on, a large—scale macroeconomic model is a quite complicated amalgam of equation systems, data, econometric techniques, theories, and ad—hocery for non—modellers to grapple with. Since current or foreseeable models are not going to be based on any generally accepted theory of the economy and subsectors, or even data, (economic reality is probably too complex for that to be ever the case) it is necessary that the underlying theory, data, and statistical basis be part of the scientific process and be open to monitoring to prevent them being used as debating weapons. There is a real danger that models might be used as “black boxes” by, for example, selecting (not necessarily intentionally) appropriate sample periods for estimating coefficients or ex ante values for exogenous variables that support particular positions but which alternative assumptions would invalidate. Thus while models are suitable for identifying problems and generating information for evaluating alternative options, it is not an appropriate use of models, (as with any research activity) to have them in the role of “proving” that decisions already made were the correct ones.¹⁶

A model is a tool for interpreting the economy. The contribution this technique makes to this process is due to the explicitness it brings to the understanding and explanation of the functioning of the economy. It is only one input among many into decision making. Allowance has to be made for the fact that the design of models is not independent from the perspective of the modeller(s) or the purpose for which a model is constructed. Abstracting key elements from reality to construct a partial view of the economy reflects both the viewpoint of the modeller and the problem of interest. Furthermore, current practice in the usage of models where, for example, “add factors” are used to adjust models when they drift too far from reality, point to the unavoidable blending of model and modeller in model—based research. Such practice is acceptable in forecasting usage because ultimately a forecast is made by the individual forecaster, irrespective of what techniques have been used for assistance. None of these tools, of which a formal macroeconomic model might only be one, would be used without the fore-

caster's own judgement based on insight and experience guiding the forecast. However adjusting models to make them "work better" is not so obviously admissible as scientific procedure when conducting policy research. It raises issues that cannot be examined here but point to the need to bear in mind that model analysis inherently involves subjective and heuristic aspects.

It is important, therefore, that models – including assumptions, data, etc., – used in policy research be open to the public. A necessary part of this is that before quantitative techniques and results are used in policy evaluation they have been exposed to professional assessment in the acceptable manner. A corollary of this is that these models should not be seen in terms of a final product. Rather what is most important is the process of developing a model and continuing involvement in its operation rather than simply the generated output. There is thus a requirement that interest groups who are potential users of its results be willing to be involved, and to maintain that involvement, in the ongoing process of model development and analysis. To a large extent the process is the final product of this technique.

- (ii) Scientific methodology is one aspect. Since economics is a social study, there is also the pragmatic aspect. Policy making and implementation in the context of an electoral democratic system requires that policies have broad based support. While models attempt to highlight key features of the real economy no monocausal explanation is likely to provide in itself an adequate explanation of complex social process. In a situation where there are alternative perspectives and approaches to deriving policy implications the necessary political support is unlikely to be forthcoming for a policy derived by methods shrouded in mystery or narrowly reflecting one ideology or school. A modelling centre should encourage models to be constructed on the basis of competing frameworks. This is a crucial aspect of macroeconomic models as a research tool and it is, therefore, necessary that model centres be either independent of ideologies and schools or that different perspectives be promoted by different centres. Thus different models can reflect alternative perspectives of the economic system and can be put at the disposal of trade unions, employer federations, farmer organisations, etc., as well as state fiscal and monetary authorities. Policy implications derived on the basis of model-based research can then be validated from different points of view. In this context macroeconomic models could be properly developed and make a useful contribution to a reasoned policy process. For this purpose there should not be a monopoly of information or methodology, i.e., no advantages due to using unpublished data; unknown adjustments to published data, uncertainty as to methods of calculation and "barriers to entry" to the process. All should be readily available and documented so that debate can focus on the underlying theory and assumptions and other judgemental aspects which ultimately determine the validity of models.¹⁷
- (iii) In such a research approach openness to criticism results in an improvement in knowledge of the working of the economy (and models) and how it might be controlled to achieve desired ends, as well as in the identification of the ends themselves. Just as a macroeconomic model is one framework for bringing together diverse pieces of analysis and information so model "centres" can play a pivotal role in facilitating the direct and indirect collaboration of specialists, and not just academics, resulting in improvements in the model system and problem identification. Otherwise limitations of resources, knowledge, approaches and theories may handicap model development and use. Modelling is a large-scale task, especially if sectoral and intersectoral detail (including input-output and flow-of-funds transactions) requiring access to a wide range of expertise are included. This is so not

just for broad accounting and policy issues but especially the case where specific sector (agriculture), industry (energy, construction), and firm (ESB, Cement–Roadstone) detail is required. Here there is a need for the blending of microeconomic and macroeconomic approaches, techniques, knowledge and ideas. The advantages of an “interactive” and, furthermore, interdisciplinary context seem obvious. Not all is the domain of economists. Adequate modelling of the economy is really a multidisciplinary activity. For example, in the area of strikes and government–political aspects modelling by sociologists and political scientists is obviously also relevant for providing insights into economic activity.

- (iv) It may be difficult for basic research, such as that being considered here, to be carried out in a government setting no matter how committed in principle. The building of a decent large sized model of the economy probably requires 1-2 years. Generally, it may be difficult for government staff members to be given such time and resources may be spread too thin under immediate pressures. The demand would be there for quicker jobs and, if a model were seen as essential, probably something workable would be required in 3–6 months. The pressures on government research and policy units should not be underestimated. Their function is to service the immediate decision–making needs of their Departments or agencies. While such pressures may encourage the more efficient execution of routine tasks (to which macroeconomic models can make an important contribution), it would not appear that they contribute to problems which involve more fundamental consideration and analysis.¹⁸ Furthermore, the very nature of macroeconomic models constrains the uses to which they can be put. This topic in itself would require a long paper to develop and must confine ourselves to stating that, at its methodological foundations, macroeconomic modelling of the economy is subject to the same limitations as economic theory, which “is concerned not with practical rules for economic activity but with the conditions under which men engage in provident activity directed to the satisfaction of their needs” (Menger, 1950). Possibly the most frequent use of models in a government setting is to provide basic information for background reports. Even the simplest of models for this, little more than accounting consistency systems, require about six months from beginning, depending on data availability.

Finally, allowance must also be made for the fact that “economic policy decisions are usually made under great uncertainty as to future possibilities and under more or less awkward pressure from political bodies and organisations” (Lundberg, 1968). Ultimately economic policy is about politics and this unavoidable uncertainty combined with the interest–group process inherent in a democratic society is a potential source for the misuse of macroeconomic models of the economy. Furthermore, Government itself, or more precisely the various organisations and agencies that comprise it, is one of the most powerful of these interest groups. Thus it is necessary to recognise that “the relationship of the authorities to the public has an essential game–of–strategy aspect” (Fellner, 1976). It is likely, for example, that Government is more interested in examining the impact of its actions on other agents in the economy than in explaining (modelling) its own behaviour. Yet in developing models of the economy to assist policy making in its wider sense it is essential that government and its sub–organisations are subjected to the same scholarly analysis as private agents and sectors.

V CONCLUSION

The record surveyed here shows that there has been an extensive amount of macro-modelling of the Irish economy. As yet, however, progress does not seem to be sufficient,

either in model design or model using “culture”, for models to play an active role in the policy making process.¹⁹ Although they provide an overall framework for bringing together wide-ranging and specialised studies and are useful instruments for interpreting the evaluation of an economy and exploring the effects of alternative policy adjustments, to date they have, in their own right, provided very little empirical or conceptual knowledge of the Irish economy. In these terms, and looking backwards, GEARY – 1964, WALSH – 1966, and GEARY/McCARTHY – 1976, among the formalised models, would appear to mark the most important contributions made by this technique to providing or recording useful perspectives in the economy. Again from a contemporary perspective major difficulties were encountered in the areas of computer hardware and software, as well as the limited range of appropriate data and its availability in forms not readily useful for computer manipulation. Although bottlenecks in the former area are now being overcome²⁰ there is still a need for improvement in the latter area. But these were not the only, and today are not the most important, constraints on the use of models in policy debate. Both the narrow range of perspectives (paradigms) brought to bear and the related methodological and epistemological questions concerning the proper context and use of macroeconomic models in policy research are also involved. These, of course, are not unique to Irish modelling and indeed would seem to be the heritage of the manner in which macroeconomic modelling developed. The dominant influence on “western” modelling has come from the United States where no matter what claims are made, the ultimate use of this technique has been a part of the macroeconomic and industry forecasting process. The development and proper use of this technique in the political policy making process requires that consideration be given to the manner of organising such activities and the context in which it is to take place. The four aspects considered in the previous section suggest that if limited resources are available and it is deemed appropriate to put them in this area, and open and multi-disciplinary “centre” offers the best context for the proper development and use of macroeconomic model building as an input into a democratic policy-making process in Ireland. In order to contribute usefully to such a process it is essential to avoid their misuse, a danger inherent in any specialised technique, and the cult of mystery and expertism that tends all too often, unnecessarily and inappropriately, to pervade policy debates. The surest safeguards would appear to be the scientific competition founded on different models and approaches and the political balance grounded on the involvement of different interests, participating in policy debate, in the promotion and use of economy level models for national policy research.

APPENDIX A

MACROMODELS OF THE IRISH ECONOMY (Order is Chronological)

ECONOMIC DEVELOPMENT – 1958:

Economic Development, Stationery Office, Dublin, 1958.

Programme for Economic Expansion, Stationery Office, Dublin, 1958.

GEARY – 1964.

R.C. Geary, “Towards an Input–Output Decision Model for Ireland”, *Journal of the Statistical and Social Inquiry Society of Ireland*, Vol. XXI, Part II, pp. 1–49, 1963/64.

LESER – 1964:

C.E.V. Leser, “The Irish Economy in 1964 and 1965”. Research Paper No. 27, Economic and Social Research Institute, Dublin, 1965.

T.J. Baker and J. Durkan, “The Updating of Certain Econometric Models”, *Quarterly*

- Economic Commentary, pp.19–34, Economic and Social Research Institute, Dublin, September 1970.
- WALSH – 1966:
B.M. Walsh, “An Econometric Model of Ireland 1944–1962”, Ph.D. Dissertation, Boston College, USA, 1966.
B.M. Walsh, “Econometric Macro–Model Building in the Irish Context”, Quarterly Economic Commentary, pp.16–26, Economic and Social Research Institute, Dublin, June 1970.
- LESER – 1967:
C.E.V. Leser, “The Irish Economy in 1967”, Research Paper No. 39, Economic and Social Research Institute, Dublin, 1967.
T.J. Baker, and J. Durkan, “The Updating of Certain Econometric Models”, Quarterly Economic Commentary, pp.19–34, Economic and Social Research Institute, Dublin, September 1970.
- STRONGE – 1971:
W.B. Stronge, “Macroeconometric Simulation of Irish Dependence on the United Kingdom”, Ph.D. Dissertation, Iowa State University, 1971.
W.B. Stronge, “Macroeconometric Simulation of Irish Dependence on the United Kingdom”, Proceedings of the American Statistical Association, Business and Economic Statistics Section, pp. 461–466, 1972.
- CLARKE – 1971:
E.A. Clarke, “Public Capital Expenditure and Fixed Capital Formation in the Last Two Decades”, Ph.D. Dissertation, University College, Dublin, 1971.
- CLARKE – 1972:
A. Fiscal Model.
B. Income–Expenditure Model.
- TEEHAN – 1972:
P. Teehan, “A Macroeconometric Model for Ireland”, 1972.
- LENNAN – 1972:
L.K. Lennan, “The Built–In Flexibility of Irish Taxes and their Contribution to Economic Stability”, M. Litt. Thesis, Trinity College, Dublin, 1971.
L.K. Lennan, “The Built–In Flexibility of Irish Taxes”, Economic and Social Review, Vol. 3, No. 4, pp. 581–603, 1972.
L.K. Lennan, “The Flexibility of Irish Taxes on Incomes”, in A. Tait and J. Bristow, editors, “Ireland: Some Problems of a Developing Economy”, pp.68–97, Gill and Macmillan, Dublin, 1972.
- ISS – 1972:
J. Kooyman and J.V. Alarcon, “A Macro–Economic Model for Short–Term Planning in Ireland”, Institute of Social Studies, The Hague, 1972.
- NORTON – 1973:
D. Norton, “The Macro Stage in Irish Planning, 1958–1972: A Study in the Quantitative Theory of Economic Policy”, Ph.D. Dissertation, University of California, Berkeley, 1973.
D. Norton, “Fiscal Policy and Growth in an Open Economy: The Case of Ireland”, Public Finance, Vol. XXIX, No. 2, pp. 168–183, 1974.
D. Norton, “Estimation of the Short–Run Effects of Fiscal Policy in Ireland, 1960–1970”, Economic and Social Review, Vol. 6, No. 3, pp. 367–386, 1975.

SMYTH – 1974:

D.J. Smyth, "A Simple Short-Run Macroeconomic Model of a Small Open Economy: Ireland", Central Bank of Ireland, Dublin, 1974.

DESMOS – 1974:

J. Waelbroeck and A. Dramais, "DESMOS: A Model for the Co-ordination of Economic Policies in the EEC Countries", in A. Ando, et al., "International Aspects of Stabilisation Policies", Conference Series No. 12, Federal Reserve Bank of Boston, Boston 1974.

SPENCER/HARRISON – 1975:

J. Spencer and M. Harrison, "The Structure and Behaviour of the Irish Economies with an Illustrative Model", in N. Gibson and J. Spencer, editors, "Economic Activity in Ireland: A Study of Two Open Economies", pp.1–39, Gill and Macmillan, Dublin, 1977.

KENNEDY/DOWLING – 1975:

K.A. Kennedy and B.R. Dowling, "Economic Growth in Ireland: The Experience since 1947", Gill and Macmillan, Dublin 1975.

WEFA – 1975:

Wharton Econometrics and Forecasting Associates, "An Econometric Model of Ireland", Philadelphia, 1975.

GEARY/McCARTHY – 1976:

P.T. Geary and C. McCarthy, "Wage and Price Determination in a Labour-Exporting Economy: The Case of Ireland", *European Economic Review*, Vol. 8, pp.219–233, 1976.

COMET – 1976:

A. Barten, G. d'Alcantara, G. Carrin, "COMET: A Medium-Term Macroeconomic Model of the European Community", *European Economic Review*, Vol. 7, pp. 63–115, 1976.

A. Barten, et al., "The COMET III Model", *European Economic Community Document II*, 295/80/C. EEC, Brussels, 1980.

CENTRAL BANK – 1977:

A. MAXI:

B. MAXI (Revised):

"The Central Bank's Macroeconometric Model: A Progress Report", Technical Paper 2/RT/77. Central Bank of Ireland, Dublin, March 1977.

J. Bradley, R. Kelleher and C. McCarthy, "The Central Bank's Macroeconometric Model: Revised Estimates and Results of a Validation Exercise", Technical Paper No. 13/RT/77, Central Bank of Ireland, Dublin, December 1977.

C. McCarthy, "The Central Bank's Macroeconometric Model", *Central Bank of Ireland, Quarterly Bulletin*, pp. 76–87, Winter 1977.

J. Bradley, C. McCarthy and T. O'Connell, "The Central Bank's Macroeconometric Model: Structure, Estimation and Application", *Central Bank of Ireland, Quarterly Bulletin*, pp. 73–98, Winter 1978.

Central Bank of Ireland, "Modelling the Irish Economy: A Progress Report on the Central Bank's Macroeconometric Model", *Journal of the Statistical and Social Inquiry Society of Ireland*, Vo. XXIV, Part 1, pp. 1–39, 1978.

C. MINI:

J. Bradley and R. Kelleher, "MINI—A Truncated Version of the Central Bank's Macroeconometric Model", Technical Paper No. 10/RT/77, Central Bank of Ireland, Dublin, August 1977.

J. Bradley and R. Kelleher, "Studies in Optimal Control I – Modification to the MINI Model and a Preliminary Specification of a Welfare Function", Technical Paper 7/RT/78, Central Bank of Ireland, Dublin, June 1978.

J. Bradley and J. Sexton, "Stochastic Simulation with the Central Bank's MINI Econometric Model", Technical Paper No. 10/RT/78, Central Bank of Ireland, Dublin, September 1978.

J. Bradley and J.D. FitzGerald, "A Simulation and Multiplier Analysis of a Revised Version of the Central Bank's MINI Econometric Model: 1960–1976", Technical Paper No. 12/RT/78, Central Bank of Ireland, Dublin, December, 1978.

J. Bradley and C. O Raifeartaigh, "Optimal Control and Policy Analysis with a Model of a Small Open Economy: The Case of Ireland", Paper presented to the Third IFAC/IFORS Conference on Dynamic Modelling and Control of National Economies, Warsaw, 1980.

FANNING – 1979:

C.M. Fanning, "The Irish Economy: An Econometric Description of Structures and Processes, 1954–1974: OLS Regression Estimates, Variables List and Data Sources for a Medium–Term Macroeconometric Model", Working Paper 7902, University College, Cork, 1979.

C.M. Fanning, "The Irish Economy: An Econometric Description of Structures and Processes, 1954–1974: Specification of the Main Structural Relations", Working Paper 7903, University College, Cork, 1979.

C.M. Fanning, "The Irish Economy: An Econometric Description of Structures and Processes, 1954–1974: Model Evaluation", Working Paper 7904, University College, Cork, 1979.

C.M. Fanning, "The Irish Economy: An Econometric Description of Structures and Processes, 1954–1974: Policy Simulation", Working Paper 8001, University College, Cork, 1980.

CENTRAL BANK/DEPARTMENT OF FINANCE – 1981:

J. Bradley, C. Digby, J.D. FitzGerald, O. Keegan, K. Kirwan, "Description, Simulation and Multiplier Analysis of the MODEL–80 Econometric Model of Ireland", Research Paper 2/81, Department of Finance, Dublin, 1981.

J.D. FitzGerald and O. Keegan, "The Behavioural Characteristics of the MODEL–80 of the Irish Economy", *Journal of the Statistical and Social Inquiry Society of Ireland*, Vol. XXIV, Part IV, 1982.

ECM – 1982:

G. d'Alcantara and A. Italianer, "European Project for a Multinational Multisectoral Project", Mimeo XII/750/82, Commission of the European Communities, Brussels, March 1982.

BRADLEY/FANNING – 1983:

J. Bradley and C.M. Fanning, "Aggregate Supply, Aggregate Demand, and Income Distribution in Ireland: A Neoclassical Keynesian Macroeconometric Model of the Period 1960–1979", General Research Series No. 115, Economic and Social Research Institute, Dublin, 1984.

APPENDIX B

Excerpt from United Kingdom Industry Act of 1975, Chapter 68

SCHEDULE 5

Disclosure of Information by Government

1. For the purposes of this Schedule the Treasury shall keep a macro-economic model suitable for demonstrating the likely effects on economic events in the United Kingdom of different assumptions about the following matters, namely:—
 - (a) government economic policies;
 - (b) economic events outside the United Kingdom; and
 - (c) such (if any) other matters as appear to the Treasury from time to time likely to have a substantial effect on economic events in the United Kingdom.
2. The model shall enable forecasts to be made:—
 - (a) of any of the following, namely:—
 - (i) the level of gross domestic product;
 - (ii) unemployment;
 - (iii) the balance of payments on current account;
 - (iv) the general index of retail prices; and
 - (v) average earnings; and
 - (b) of such (if any) other economic variables as are appropriate in the opinion of the Treasury from time to time.
3. The references to forecasts in paragraph 2 above are references to forecasts relating to successive periods of three months and not to shorter periods.
4. The model shall be maintained on a computer.
5. The model shall be available to members of the public to make forecasts based on their own assumptions, using the computer during office hours upon payment of such reasonable fee as the Treasury may determine.
6. Not less than twice in each year commencing with a date not later than one year from the coming into force of this Act, the Treasury shall publish forecasts produced with the aid of the model as to such matters and based on such alternative assumptions as appear to them to be appropriate.
7. Any forecasts under this Schedule shall indicate, where possible, the margin of error attaching to it.
8. The Treasury shall from time to time publish an analysis of errors in such forecasts that would have remained even if the assumptions set out in the forecasts and on which they were based had been correct.
9. It shall be the duty of a Minister of the Crown who proposes to enter into, or has entered into a planning agreement with a body corporate to participate with that body in demonstrating so far as possible, upon the application of that body, the relationship between the undertaking to which the agreement relates and the national economy.

FOOTNOTES

1. The results of one or two models may have been noted and cited in support of various positions but such has been exceptional and perhaps not always appropriate use.
2. The intention of this survey is not to provide a detailed or critical review of each model but

simply to identify the main trends in model—building to date. A detailed survey of all the models mentioned is available in Fanning and Bradley (1983). With the accompanying paper on supply modelling, these papers constitute the preliminary stage of a project on the construction of an operational medium—term macroeconomic model of the Irish economy.

3. Limited ex post evaluation of the main elements of Economic Development and the First Programme was conducted in Fanning (1980).
4. Although only read before a meeting of this society in 1964, the model was available in mimeo form in June 1962.
5. COMET — 1976 is the second generation of models in that project and the first to include Ireland. It was succeeded by a formally unpublished set of models but COMET — 1976 is representative of this project's approach.
6. These are discussed in some detail in Bradley and Fanning (1983).
7. A partial exception to this might be the earlier work conducted in various sections of the Department of Finance. However, this had generally stayed within the confines of the Department and did not become part of the broader policy process which, as will be argued in the final section, is necessary for the appropriate use of macroeconomic models.
8. For example, the widely noted instability of estimated coefficients is due to: (i) inadequacy of theoretical specification; (ii) structural change in economic patterns and institutions; and (iii) statistical aspects including all too often data revisions (Ruane, 1975). Only the latter is a problem with the econometric method itself. The others arise from economic theory, e.g., in case (ii) the general lack of a theory of economic parameters and parameter change.
9. It is an open question to what extent prediction tests are adequate tests of the explanatory power of models. This is particularly so given the practice, almost inherent in building macroeconomic models of an economy, of getting equations that "work" etc., and which results in this validation rather than refutation approaches (as scientific methodology suggests) being applied. In the end, despite expressed purposes the only criterion applied seems to imply forecasting as the main goal.
10. The NBER—MIT TROLL package is one example which goes a long way towards meeting the general software needs with a standardised easily available package.
11. It should also be noted that the views expressed in this section are impressions derived from modelling experience generally, primarily US and UK experience, rather than from any particular Irish modelling projects.
12. This, of course, does not mean that one particular model of the economy will be accepted as the general theory of the economy. Any model is ultimately too simple and partial; no matter how technical and sophisticated it looks, the real world is far more subtle and complex. However different insights are obtained from using different models and despite (and even because of) their variety and conflicts they can be used to encourage the dialogue that promotes a common appreciation and understanding of complex social phenomena.
13. As, for example, occurred with the Central Bank and the Department of Finance during 1975—1981.
14. And also the policy—making loss due to not using appropriate and best techniques.
15. Although the label centre is used, it does not imply any particular physical setting, rather that a co—ordination is necessary. The "centre" could, for example, be situated in one of the universities or be an inter—university collaboration; it could involve existing research institutions, such as the Economic and Social Research Institute and Agricultural Institute, and policy analysis organisations, e.g., National Economic and Social Council, as well as government departments, e.g., Department of Finance. (The development of Central Bank/Department of Finance — 1981, mentioned in Section III on current developments, is an example of such an arrangement at present wherein the co—ordinating role in further development is undertaken by the ESRI, the data bank is maintained by the Department of Finance and the computing and software is provided by the Computer Department of the Public Service. The model specification itself and validation is the joint work of the Central Bank, Department of Finance, and ESRI.) The need to promote one "centre" would be greatly reduced if Irish economic and social statistics were available consistently on computer tape in "machine readable" format. A very large proportion of the "barrier costs" are due to having to bring together, adjust, and computerize the necessary data banks. Ireland seriously lags behind in the resources assigned to the national data collection processes, and especially at the user end, which is necessary for modern analysis and policy—making.
16. For instance, Montagu Norman, when governor of the Bank of England, believed that the role of a research department was to prove that decisions he had taken were correct, and would not have seen models as an interpretative tool.

- 17 In the United Kingdom, a period when macroeconomic models were used to win debating points would seem to be coming to an end as labour organisations and parliamentary parties in opposition avail of economy level models to prepare policy positions. As in any scholarly activity the "competition", i.e., the opportunity to replicate and criticize by other researchers, is a major element ensuring that scientific standards are maintained and correct usage made of scientific research. The following paragraphs from the Trade Union Congress (UK) Economic Review provides (i) an interesting example of the use of macroeconomic models in the context of what we have termed the wider policy process:

The TUC has used the government's own forecasting system — the Treasury model — to analyse in detail the effects of these proposals on the economy ... It cannot be emphasised enough that the results of any economic forecasts are subject to a margin of error. However, the Treasury model does have a relatively good forecasting record. Although too much precision should not be attached to the results, the model does show the direction of change and the relative merits of different policies.

as well as (ii) an indication, if only by implication, of the potential abuse by inappropriate use:

For many years governments have used the model to justify their own actions and criticise alternative policies. Now that the model is open for all to use and that the government is required to publish its own forecasts, it cannot apply double standards by arguing that the model is irrelevant. The government cannot dismiss the TUC results set out here by changing the assumptions in the model. (TUC, 1982:14–15).

A more recent example is the use made of the same Treasury model by the Labour Party (UK), for example, to produce its Programme for Recovery which has a timescale for a "parliament and beyond" (Shore, 1982:3). This exercise included an evaluation, by means of model—simulations, of the continuation of the Conservative Government's economic policy, Labour's preferred expansionary strategies. (Shore, 1982: Part III and Appendix.)

It is worth noting that this open access to the "Government" model is due to an amendment, proposed by Jeremy Bray (Labour) M.P., to the Industry Act of 1975, which was concerned with establishing the National Enterprise Board (UK, 1975:2039). The relevant section is as follows:

The [Treasury] model shall be available to members of the public to make forecasts based on their own assumptions, using the computer during office hours upon payment of such reasonable fee as the Treasury may determine.

The text of the full schedule is reproduced in Appendix B because it implicitly reflects an attempt to ensure the appropriate use of "official" models and to avoid to some extent at least, some of the pit—falls discussed in this section.

18. It is important to distinguish here the possibility that pressures arising from some crisis may encourage and facilitate political decision—making and problem solving.
19. Some use of CENTRAL BANK/DEPARTMENT OF FINANCE — 1981 has been made within the Central Bank and Department of Finance for forecasting and budget analysis. A limited use for policy analysis has been made outside these organisations by the Economic and Social Research Institute (P. Bacon, et al., 1981 and 1982) and, very tentatively, by a Government Committee of Inquiry (Ireland, 1981). Other than these latter uses little effort has been made to introduce macroeconomic modelling into the policy making process.
20. Particularly with the availability of Modelling orientated software packages such as the NBER/MIT TROLL programme which is now available at CDPS in Dublin and UCC in Cork.

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